

## REVISTA ARGENTINA DE MEDICINA

ISSN 2618-4311

Buenos Aires

Zamora RJ, Beltramone A, Alem F, et al. Analysis of excess, all-cause mortality in a population with health insurance in Argentina, in the context of the covid-19 pandemic. *Rev Arg Med* 2021;9(3):283-9

ARK CAICYT: <http://id.caicyt.gov.ar/ark:/s26184311/ram.v9i4.645>

\*Para la versión en castellano del artículo visite el siguiente vínculo: <https://drive.google.com/file/d/1SwidOyZjR-fbGuVLmBL5t0n07FLBNiYy/view?usp=sharing>

Received: April 21, 2021.

Accepted: May 25, 2021.

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The authors state that they have no conflict of interest whatsoever.

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## ANALYSIS OF EXCESS, ALL-CAUSE MORTALITY IN A POPULATION WITH HEALTH INSURANCE IN ARGENTINA, IN THE CONTEXT OF THE COVID-19 PANDEMIC

### ANÁLISIS DEL EXCESO DE MORTALIDAD POR TODAS LAS CAUSAS EN UNA POBLACIÓN CON MEDICINA PREPAGA DE ARGENTINA EN EL CONTEXTO DE LA PANDEMIA POR COVID-19\*

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#### ABSTRACT

**Introduction.** The covid-19 pandemic has had a profound impact worldwide. Argentina faced one of the highest covid-19 surges and longest lockdowns in the world. **Objective.** Estimate the excess deaths from any cause between March and August 2020 in a population with private health insurance. **Methods.** We analyzed the death rate of the entire study period (March-August 2020) and the death rate per month. We compared the observed rates with the average expected rate and the limit of the 95% confidence interval (CI). Normal distribution was considered for this comparison. **Results.** 429 deaths were registered during the study period. Of those, 19.1% (82/429) were identified as covid-19-related. Despite these covid-19 related deaths, a significant increase of mortality in the overall population was not observed in that time frame. March, April, and June showed a significant decrease in mortality rates. However, August 2020 had a mortality rate of 6.9 per 10,000, with an excess of mortality of 67.2% compared to a historical average of 4.1 per 10,000 and 55.2% to the upper limit of the 95% CI for the August months in 2015-2019 ( $p < 0.001$ ). This pattern occurred primarily in the group aged 60 years and older (32.3 per 10,000 vs. 20.4 per 10,000;  $p < 0.001$ ). **Conclusions.** Even though March, April, and June showed a decrease in mortality rates, in August 2020 we observed a significant increase of the reported mortality in the population aged 60 and older.

**KEY WORDS.** Mortality, excess, covid-19, pandemic.

## RESUMEN

**Introducción.** La pandemia de covid-19 tuvo un profundo impacto en todo el mundo. Argentina enfrentó una de las mayores olas de covid-19 y uno de los confinamientos más prolongados.

**Objetivo.** Estimar el exceso de mortalidad en el período de marzo a agosto de 2020 en los afiliados de una empresa de medicina prepaga. **Materiales y métodos.** Analizamos la tasa de la mortalidad durante el período de estudio (marzo-agosto de 2020) y de forma mensual. Se compararon las tasas observadas con la tasa promedio esperada y el límite del intervalo de confianza (IC) del 95%. Se utilizó una distribución normal para esta comparación. **Resultados.** Se registraron 429 muertes en el período de estudio. El 19,1% (82/429) se identificó como relacionado con la covid-19. A pesar de esas muertes relacionadas con la pandemia por covid-19, no se observó un aumento significativo de la mortalidad en la población general durante ese lapso. Los meses de marzo, abril y junio registraron una disminución significativa en las tasas de mortalidad. Sin embargo, agosto de 2020 tuvo una tasa de mortalidad de 6,9 por cada 10.000 afiliados, con un exceso de mortalidad del 67,2% frente a un promedio histórico de 4,1 por cada 10.000 y del 55,2%, con el límite superior del IC del 95% para los meses de agosto de 2015-2019 ( $p < 0,001$ ). Este patrón ocurrió principalmente en el grupo de los mayores de 60 años (32,3 por 10.000 vs. 20,4 por 10.000;  $p < 0,001$ ). **Conclusiones.** Aunque se observó una disminución en las tasas de mortalidad en marzo, abril y junio, en agosto de 2020 observamos un aumento significativo de la mortalidad en la población mayor de 60 años.

**PALABRAS CLAVE.** Mortalidad, exceso, covid-19, pandemia.

## 1. Introduction

In December 2019, Wuhan city, the capital of Hubei province in China, became the center of an outbreak of pneumonia of unknown cause. By Jan 7, 2020, a novel coronavirus was identified as the source of this outbreak of severe acute respiratory syndrome (1,2). Following its emergence, this novel coronavirus (SARS-CoV-2) and the associated coronavirus disease 2019 (covid-19) rapidly developed into a global pandemic, causing millions of cases and millions of deaths in Europe and worldwide over the following months (3).

Notably, there has been a remarkable uncertainty of the real number of covid-19 cases, especially at the beginning. Initially, China estimated that only 10% to 15% of all infections were laboratory-confirmed (4). Due to this, estimating the number of deaths caused by covid-19 is a challenge. In fact, many questions have been raised about the reported tallies of deaths related to covid-19 all over the world.

Vital registration data on the cause of death are likely to underestimate the mortality burden associated with the pandemic for several reasons (5,6). Covid-19 could be assigned to other causes of death due to the lack of a testing policy, low rates of diagnoses at the time of death, or the absence of uniform mortality coding (7,8). Also, deaths from unusual covid-19 complications or complications not yet attributed to covid-19 could lead to confusion, with potential attributions of death to other causes (9). Remarkably, covid-19 death counts do not reflect indirect consequences of the lockdown on mortality levels (10). Factors including decreased access to

health care services, psychosocial consequences of isolation, stress, and depression (11,12,13), and economic, housing, and food insecurity may contribute to mortality, including suicide, especially among those living with chronic illness (14,15). On the other hand, reductions in travel, commerce and public gathering during the pandemic may have resulted in a reduction of motor vehicle mortality, violent deaths, and air pollution-related deaths (16,17). Estimates of excess deaths from all causes associated with the pandemic provide a useful measure of the total mortality burden associated with covid-19. Excess death refers to increases in mortality over what would normally have been expected based on historical data for the period of analysis, and the concept includes deaths which were either misclassified to causes of death other than covid-19 or were indirectly related to the covid-19 pandemic. Using all causes of death to measure the excess mortality impact of the covid-19 pandemic can help circumvent biases in vital statistics and reporting lags, capturing excess deaths indirectly related to the pandemic (6).

The aim of our study is to estimate the excess deaths due to any cause during the March-August 2020 period in a private health insurance program in Argentina. We also estimated the percentage of deaths related to covid-19 during the analyzed period.

### 1.1 Argentina

On March 12, 2020, a National Decree (260/2020) declared the existence of a health emergency. This measure decreed the suspension of all international flights from affected areas, as well as the compulsory isolation of trav-

elers from those “affected areas” (18). On March 19, a measure of “social, preventive and mandatory isolation” was established from March 20 to March 31, 2020 in order to protect public health. This mandate was extended several times over the following months (19). In June, 2020 President Fernandez announced 18 provinces could end the lockdown but continue with social distancing practices. The city of Buenos Aires and its metropolitan area remained in partial lockdown and began a slow reopening of some commercial activities (20).

## 1.2 Medicus

Medicus is a private health insurance company in Argentina. It has 200,000 affiliate members and has been part of the Argentinean private insurance market for over 45 years. Although it is a countrywide company, most of its members live in the Buenos Aires Metropolitan Area<sup>a</sup>. Becoming an affiliate is either voluntary or is provided through social security from job benefits. The distribution in each subgroup is around 50% and the benefits are the same.

Compared to the Argentinean population distribution, where inhabitants aged 30 to 49 years old represent almost 19% of the population structure, Medicus population has around 27% of affiliates in these age groups (21).

## 2. Materials and methods

We developed an exploratory analysis of “excess of mortality” in a private health insurance population. Because the first covid-19 case in Argentina was identified on March 3, we developed the analysis of excess mortality between March and August 2020.

When Medicus members die, they are immediately unsubscribed in order to stop monthly payment. We included all individuals unsubscribed due to mortality as our observed/occurred cases and as a proxy data for numbers of deaths in the analyzed period. For expected cases in our analysis, we used the average data for the same period, March-August in the five previous years (2015-2019). Data were analyzed as total instances with 0-59 and  $\geq 60$  years old as separate subgroups. The standard for documentation of death cases was the same throughout the analyzed period (2015-2020). For the design and statistical comparison, we followed the World Health Organization recommendations for rapid mortality surveillance and epidemic response (22).

In addition, we explored the percentage of deaths due to covid-19 and any existing excess of mortality when excluding covid-19 death from the equation.

## 2.1 Excess of mortality calculation

### 2.1.1 Expected deaths

For each year we looked for other external situations, such as civil wars, natural disasters, etc., that could produce an excess of death not representing long term trends.

Due to the economic crisis in Argentina, between March 2015 and August 2020 the number of Medicus members decreased by 6.6%, from 210,747 to 196,793 members. As this reduction occurred across the Argentinean private health care sector (23), our analysis used the death rate instead of absolute numbers. In addition to the member population reduction, we observed a mild relative increase of 60 years and older clients over the years (from 17% of all members in March 2015 to 19.6% in August 2020). We must point out that the aging in the Medicus population was similar to the aging in the Buenos Aires Metropolitan Area (21). Age-specific death rates were calculated for each age group (0-59 years and  $\geq 60$  years). Displaying the data in this fashion pinpoints at least one population sub-group (those over age 60), known to be especially vulnerable to covid-19. We defined death rate as the total deaths per 10,000 in the general population.

### 2.1.2 Occurred deaths

We used the number of dead Medicus members from March 2020 to August 2020 as the cases to obtain the rates.

We analyzed the death rate per the entire period and per month. We estimated the monthly mortality ratio using the number of deaths registered in the prior five years of data (2015-2019) and we compared the observed rates with the average expected rate and the upper limit of the 95% confidence interval (CI). Due to the high number of deaths, Poisson distribution, usually considered the probability distribution which better describes mortality rates, could be approximated by the normal distribution, which is simpler (24). In this case non-significant Shapiro's tests were obtained for all months and for all analyzed age categories; therefore, normal distribution was considered. We then obtained the p-value for hypothesis testing the null hypothesis: 2020 mortality ratio does not differ from the estimated ratio in 2015-2019, and the alternative hypothesis: 2020 mortality ratio is different from the estimated ratio in 2015-2019. Statistical significance for rejecting the null hypothesis was declared when p-value was  $> 0.05$ .

Due to the short period analyzed (monthly basis), and in order to obtain simpler parameters, we defined death rate

<sup>a</sup>Buenos Aires Metropolitan Area refers to the urban agglomeration comprising the Autonomous City of Buenos Aires and the adjacent 24 districts in the Province of Buenos Aires. Thus, it does not constitute a single administrative unit.

as the total deaths per 10,000 in the population (22). Due to the absolute numbers observed, gender sub-analysis was not feasible.

## **2.2 Percentage of deaths due to covid-19 calculation**

At the beginning of the epidemic, Medicus developed an active surveillance system that included daily follow up of symptoms, admissions to the hospital, case recovery and covid-19 mortality. All polymerase chain reaction (PCR) diagnostic tests were registered during the period.

We explored the percentage of deaths due to covid-19 in March-August 2020 using covid-19 confirmed deaths and total deaths. We also analyzed excess of mortality in each month of the chosen period, after removing all deaths due to covid-19. For the purpose of this analysis, only deaths that can be accurately attributed to covid-19 were considered (those deceased in hospitals).

## **3. Results**

### **3.1 Excess of mortality**

Table 1 shows the analyzed data for mortality rate per 10,000 affiliates for the entire March-August period. For total cases, the mortality rate in 2020 was 3.6 per 10,000 and the excess of mortality, when compared to average historical data, was 2.4%. Nevertheless, it shows no significance when compared to the 95% CI upper limit (-2.4%;  $p = 0.37$ ). For the 0-59 subgroup the death rate in 2020 was 0.3 per 10,000 and the excess of mortality, when compared to average historical data, was -36.7% (-46.3% vs 95% CI upper limit;  $p = 0.34$ ). Finally, the subgroup 60 and older had a mortality rate of 17.3 per 10,000 and the excess of mortality, when compared to average historical data, was -1%. That decrease was also not significant when compared to the historical 95% CI upper limit (-6.7%;  $p = 0.41$ ).

Using the same approach but analyzing data for the monthly periods (Table 1 and Figure 1), we observe a significant decrease in mortality rates during March, April, and June. However, in August 2020 we observe an increase in mortality rate of 2.8 per 10,000 affiliates, an excess of mortality of 67.2% when compared to average historical data. The comparison with the upper limit of the 95% CI shows that the excess of mortality in this month was statistically significant (55.2%;  $p < 0.001$ ). This same pattern was seen in August for the subgroup of 60 and older. We observed a 2020 mortality rate of 32.3 per 10,000 and an excess of mortality compared to average historical data of 58.3% and 43.6% to the upper limit of the 95% CI (20.4 and 22.5 per 10,000 affiliates, respectively;  $p < 0.001$ ).

It is remarkable that the highest death rate in the history of Medicus had been in August 2014, with 4.8 deaths per 10,000 affiliates. Instead, the death rate in August 2020 was 6.9 per 10,000, showing a 45% increase in this line item.

### **3.2 Percentage of deaths related to covid-19**

Between March and August 2020, Medicus registered 429 deceased clients. Of those, 19.1% (82/429) were covid-19 related (Table 2). When removing deaths due to covid-19, we still observe a significant excess of death for other reasons in August 2020 when comparing those 95 non-covid-19 deaths with the 85 expected deaths for the same period in 2015-2019 and with the upper limit of the 95% CI interval of 92.

The active surveillance and follow up shows that all registered covid-19 deaths were hospitalized patients. No deaths of a covid-19 positive patient was detected in an outpatient/home setting along the study.

## **4. Discussion and conclusions**

When analyzing the entire period, we do not see a significant mortality increase in either the total sample or the chosen age subgroups. Nevertheless, when using the same approach per month, we observe a decrease of the mortality rates in March, April, and June, probably due to the effect of lockdown. However, during August, we observe a significant increase in reported mortality in the total numbers. This could be linked to the loosening of the lockdown measures observed in almost all countries including Argentina. Mathematical models show that lockdown fatigue and relaxation could trigger an increase in hospitalization and death as early as two weeks after the population starts breaking the confinement (25).

The excess of mortality after several months could be accounted for by covid-19 cases directly or by the collateral damage of the pandemic in the private healthcare centers of Argentina. Bozovich et al. observed a decrease in emergency room visits (75%) and hospitalizations (48%) in the first months of the covid-19 pandemic, as well as a 62% decrease in admissions for angina pectoris and acute coronary syndromes, a 46% decrease in admissions for stroke and transient ischemic attack, and a 16% decrease in cancer treatments (26). Authors concluded that even though social distancing measures were the key strategy to flatten the infection curve, the observed decrease in medical visits and interventions could have impacted negatively on cardiovascular, cerebrovascular, and even cancer-related morbidity and mortality. These observations could account for the increase we observed in non-covid deaths in August 2020.

Our study shows no excess of mortality in the under 60-year-old population, but demonstrates a significant

TABLE 1. EXCESS OF MORTALITY HISTORICAL COMPARISON. TOTAL AND PER MONTH IN BOTH AGE GROUPS. MEDICUS, MARCH-AUGUST 2020

Age groups	Month	2015-2019 monthly average [95% CI]	2020 mortality x 10.000	% above baseline*	% above threshold†	p-value
0-59	March	0,5 (0,3-0,7)	0,2	-62,8%	-73,6%	0,09
	April	0,4 (0,3-0,6)	0,3	-29,6%	-49,4%	0,23
	May	0,5 (0,3-0,7)	0,2	-62,8%	-73,5%	0,09
	June	0,4 (0,3-0,5)	0,2	-52,9%	-61,9%	0,02
	July	0,5 (0,3-0,7)	0,3	-47,8%	-62,3%	0,22
	August	0,5 (0,4-0,7)	0,7	27,6%	-2,1%	0,22
<b>Total for 0-59</b>		<b>0,5 (0,4-0,6)</b>	<b>0,3</b>	<b>-36,7%</b>	<b>-46,3%</b>	<b>0,34</b>
60+	March	15,6 (15,0-16,3)	13	-17,1%	-20,6%	<0,001
	April	14,5 (12,6-16,5)	10,4	-28,6%	-37,1%	0,03
	May	16 (12,9-19,1)	18,7	16,6%	-2,2%	0,23
	June	18,9 (16,6-21,2)	11,9	-36,9%	-43,7%	0,001
	July	19,2 (15,9-22,5)	17,3	-9,7%	-23,0%	0,30
	August	20,4 (18,4-22,5)	32,3	58,3%	43,6%	<0,001
<b>Total for 60+</b>		<b>17,5 (16,4-18,5)</b>	<b>17,3</b>	<b>-1,0%</b>	<b>-6,7%</b>	<b>0,41</b>
Total	March	3,2 (3,0-4,5)	2,7	-17,2%	-22,3%	0,02
	April	2,9 (2,6-3,3)	2,3	-23,9%	-31,9%	0,03
	May	3,3 (2,8-3,8)	3,8	15,5%	-0,3%	0,21
	June	3,7 (3,3-4,1)	2,5	-33,4%	-39,8%	<0,001
	July	3,9 (3,3-4,4)	3,6	-6,9%	-18,1%	0,33
	August	4,1 (3,8-4,5)	6,9	67,2%	55,2%	<0,001
<b>Total</b>		<b>3,5 (3,4-3,7)</b>	<b>3,6</b>	<b>2,4%</b>	<b>-2,4%</b>	<b>0,37</b>

\*Above average (2015-2019).

†Above 95% upper limit CI.

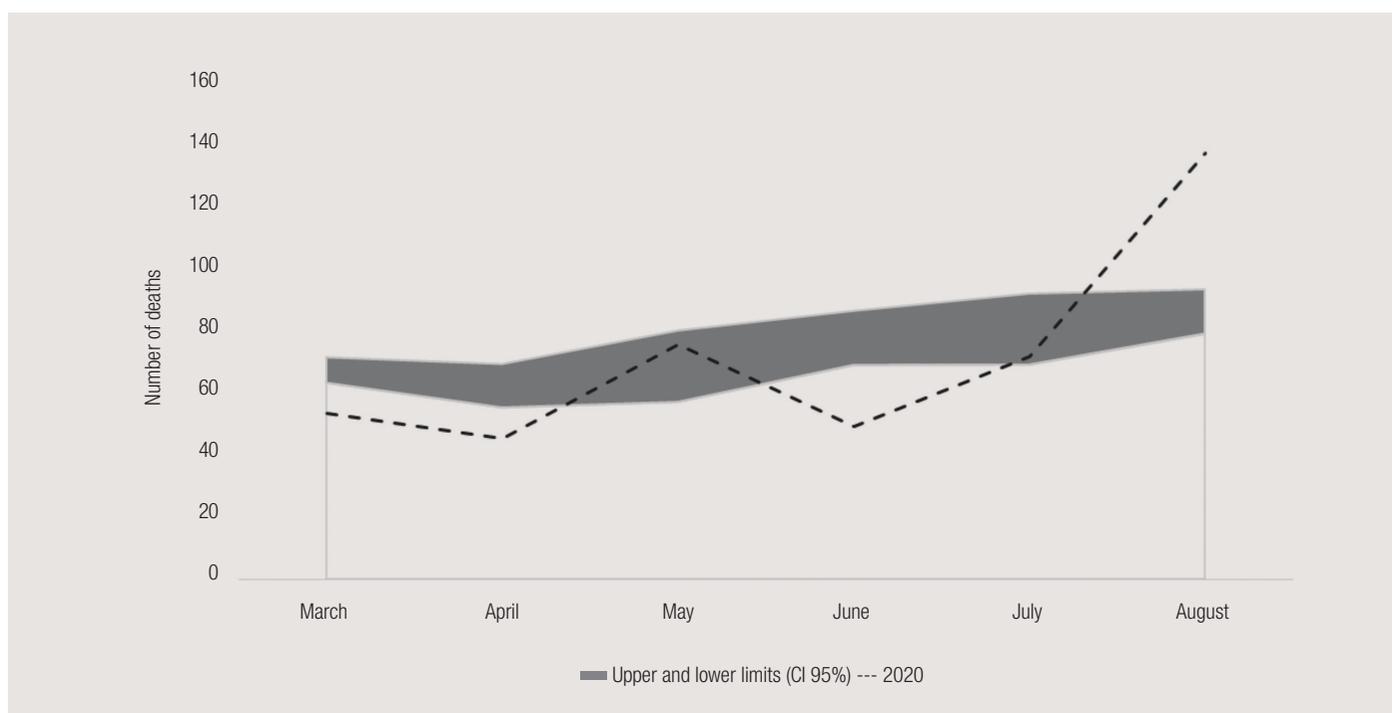


Figure 1. Medicus 2020 deaths by month compared to the upper and lower limits of historical deaths (95% CI).

TABLE 2. EXCESS OF MORTALITY. COVID-19 AND NON-COVID-19 CASES PER MONTH. MEDICUS, MARCH-AUGUST 2020

	Total deaths	Covid-19 deaths	Covid-19 deaths [%]	Non-covid-19 deaths	Average expected deaths	95% tail of expected deaths	Absolute excess mortality [per 10,000]*
<b>March</b>	53	0	0%	53	67	71	-0,7.
<b>April</b>	45	2	4%	43	62	69	-0,8
<b>May</b>	75	4	5%	71	68	79	0,4
<b>June</b>	49	5	10%	44	77	86	-1,4
<b>July</b>	71	30	42%	41	80	91	-0,4
<b>August</b>	136	41	30%	95	85	92	2,6
<b>Total</b>	429	82	19%†	347	439	488	-0,5

\*Absolute excess mortality = (observed-expected) \* population.

†Covid-19 deaths (%) average.

excess due to the increased mortality in age 60 and older affiliates. This is consistent with other studies conducted in the first months of the pandemic, where the excess of mortality was associated with older people (27,28).

Furthermore, our analysis shows an excess of non-covid-19 mortality in August 2020. Non-published data from Medicus shows a 75% and a 49.5% decrease in medical and laboratory visits, respectively, from March to August 2020, when compared to the same period of 2019. In line with the aforementioned, this could have impacted negatively on cardiovascular, cerebrovascular, and non-communicable events in terms of morbidity and mortality.

This study was conducted in a small and relatively homogeneous population. As Medicus is a private health insurance where a high percentage of clients pay their membership voluntarily, affiliates are usually middle/high class. As we do not have the exact day of death, we conducted a monthly analysis instead of a weekly one, which is the one globally done and published.

Due to the small numbers in each category, we did not analyze the excess of mortality per gender or per smaller age groups, as part of the literature shows. Remarkably, during the time period under analysis, two effects were observed in the demographic distribution: a decrease of mortality in the total population and an increase in the average age of the population. Given that the mortality rate in the over 60-year-old group was higher than the mortality rate of the under age 60 group, the shift of the population density towards age over 60 had a significant effect on the total mortality rate, even though a slight decrease of the mortality rate for each age group was observed. The decrease in the total population seen at the same time than an increase in the over age 60 portion of the population potentiates this dynamic.

Finally, we believe that the excess of mortality analysis should be used as a mortality surveillance strategy by

decision makers. It is a simple methodology that, if done on a regular basis, shows not only mortality directly related to covid-19, but a broader picture of mortality patterns in a pandemic context.

## 5. Acknowledgements

Enrique Vazquez, MD.

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