Short communication

The early evolution of COVID-19 incidence and mortality among people aged under 80 years or 80 years and above after COVID-19 vaccine implementation in the state of Bahia, Brazil

Mariana C. Cruz [a],*, Cristiana M. Nascimento-Carvalho [b]

[a] Bahiana Foundation for Science Development, Bahiana School of Medicine and Public Health, Salvador, Brazil
[b] Federal University of Bahia, School of Medicine, Salvador, Brazil

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ABSTRACT

This study evaluates the early effects of COVID-19 vaccine implementation in the number of cases and deaths due to COVID-19 among those aged < 80 years or $\geq$ 80 years in the state of Bahia, Brazil. For that, we used data from the Bahia state Secretary of Health platform of cases and deaths due to COVID-19 in all age groups, between March 2020 and May 2021, when 82% of COVID-19 vaccines were CoronaVac. Overall, there were 1,012,200 cases and 21,241 deaths due to COVID-19, of which, respectively, 2.3% and 25.3% occurred in patients aged $\geq$ 80 years. The median proportion of deaths in those $\geq$ 80 years decreased from 29.8% (27.8%–30.4%) in the pre- to 18.8% (15.6%–18.8%) in the post-vaccine periods (p = 0.04). Significant reduction in the median proportion of deaths from COVID-19 among those aged $\geq$ 80 years after COVID-19 vaccine implementation was found, which suggests CoronaVac effectiveness against death from COVID-19 in the elderly.

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1. Introduction

Brazil has the 3rd highest number of cases and the 2nd highest number of deaths attributable to COVID-19 in the world [1], being Bahia the Brazilian state with the 5th highest number of cases in the country [2]. On January 18, 2021, the Brazilian Ministry of Health launched a nationwide vaccination program which included prioritizing the elderly as a high-risk group, starting with the oldest and descending by age [3]. By the beginning of March 2021, approximately 100% of people aged $\geq$ 80 years in the state of Bahia had received the 1st dose of a COVID-19 vaccine [4], while the vaccine coverage among all age groups was 2% [5]. Between January and March 2021, approximately 82% of COVID-19 vaccines distributed in Brazil were CoronaVac [6]. This vaccine is administered in two doses, 28 days apart, stimulating seroconversion in 98% of the vaccinees [7]. By the beginning of April 2021, almost all elderly $\geq$ 80 years vaccinated with CoronaVac had also received the 2nd dose [4]. The SARS-Cov-2 Variant of Concern was predominantly the B.1.1.28 and B.1.1.33, until October 2020 [8]. After this period, two national variants stood out: P.1 and P.2 [9]. We

assessed the early evolution of COVID-19 incidence and mortality among people aged < 80 years or $\geq$ 80 years after COVID-19 vaccine implementation in the state of Bahia, Brazil, when CoronaVac had been given to 82% of the vaccinees.

2. Methodology

In this ecological population-based study and interrupted time-series analysis of the population in the state of Bahia, data between March 2020 and May 2021 were retrieved from the Bahia state Secretary of Health platform (SESAB), where data on COVID-19 was identified from all age groups and those who died were marked.

Data were stored in Microsoft Office Excel 2019 and analysed in SPSS Statistics. Number of COVID-19 cases and deaths were presented as absolute and relative values. Monthly average numbers of COVID-19 reports were described for 2 age groups: <80 years and $\geq$ 80 years. Incidence and mortality rate of COVID-19 per 100,000 inhabitants were calculated based on the estimated population per year in the state of Bahia in those < 80 years and in $\geq$ 80 years. Median (inter-quartile range) proportion of COVID-19 cases and deaths within each age group for the pre (from March 2020 to February 2021) and post (from March to May 2021) vaccination periods were compared by Mann Whitney U test, as distribution was non-parametric (p < 0.05 was significant). As we

* Corresponding author at: Bahiana Foundation for Science Development, Bahiana School of Medicine and Public Health, Rua Tenente Fernando Tuy, No. 318, Salvador, Bahia, CEP 41830-498, Brazil.
E-mail addresses: mariana.cmc@hotmail.com (M.C. Cruz), nascimentocarvalho@hotmail.com (C.M. Nascimento-Carvalho).

used secondary anonymous public domain data, our study was exempt from being approved by the Research Ethics Committee.

3. Results

Between March 2020 and May 2021, 1,012,200 inhabitants in the state of Bahia had COVID-19 diagnosed by: RT-PCR (610,892; 60.4%), rapid test (388,499; 38.4%), clinical-epidemiological criteria (6,356; 0.6%), serology (3,075; 0.3%), clinical-image criteria (1,379; 0.1%), pending confirmation (1,999; 0.2%). There were 21,241 deaths due to COVID-19 in this period. Overall, 2.3% of the cases and 25.3% of the deaths occurred in patients aged $\geq$ 80 years

(Table 1). In this age group, the median proportion of the number of cases decreased from 2.35% (2.2%-2.7%) to 2.1% (1.6%-2.1%) (p = 0.145), whereas the median proportion of the number of deaths decreased from 29.8% (27.8%-30.4%) to 18.8% (15.6%-18.8%) (p = 0.04) (Table 1). The monthly evolution of the incidence and mortality in both age groups is depicted in the Fig. 1. It is possible to observe that incidence and mortality rates are decreasing among people aged $\geq$ 80 years as of March 2021. Monthly incidence rate of COVID-19 in those with 80 years or above reduced from 1,170 / 100,000 (in Mar-2021) to 718 / 100,000 (in May-2021) (Fig. 1A). As for the mortality rate, there was a reduction in the 80 years or more group from 351 / 100,000 (in Mar-21) to

Table 1
Absolute number and proportional distribution of recorded cases (A) and number of deaths (B) due to COVID-19. Bahia March 2020 to May 2021.

A. Recorded cases

Age group	Mar-20		Apr-20		May-20		Jun-20		Jul-20	
	N	%	N	%	N	%	N	%	N	%
<80y	211	97.2	2,545	96.0	15,181	97.8	53,216	96.9	90,606	97.6
≥80y	6	2.8	105	4.0	344	2.2	1,699	3.1	2,241	2.4
Blank	–	–	–	–	–	–	–	–	–	–
All ages	217	100.0	2,650	100.0	15,525	100.0	54,915	100.0	92,847	100.0

Age group	Aug-20		Sep-20		Oct-20		Nov-20		Dec-20		Jan-21	
	N	%	N	%	N	%	N	%	N	%	N	%
<80y	88,547	97.8	52,554	97.7	41,566	97.5	48,838	97.8	88,207	97.7	92,342	97.5
≥80y	2,026	2.2	1,245	2.3	1,065	2.5	1,076	2.2	2,122	2.3	2,364	2.5
Blank	–	–	–	–	–	–	–	–	–	–	–	–
All ages	90,573	100.0	53,799	100.0	42,631	100.0	49,914	100.0	90,329	100.0	94,706	100.0

Age group	Feb-21		Mar-21		Apr-21		May-21		All period	
	N	%	N	%	N	%	N	%	N	%
<80y	93,677	97.7	116,687	97.5	95,136	97.9	109,556	98.4	987,758*	97.6
≥80y	2,254	2.3	2,940	2.5	2,041	2.1	1,803	1.6	23,331	2.3
Blank	–	–	–	–	–	–	–	–	1,111	0.1
All ages	95,931	100.0	119,627	100.0	97,177	100.0	111,359	100.0	1,012,200	100.0

Median (inter-quartile range) proportion (%) of number of cases			P-value
Age group	Pre-vaccination Mar-20 to Feb-21	Post vaccination Mar-21 to May-21	
<80y	97.65 (97.3–97.8)	97.9 (97.5–97.9)	0.145
≥80y	2.35 (2.2–2.7)	2.1(1.6–2.1)	

B. Number of deaths

Age group	Mar-20		Apr-20		May-20		Jun-20		Jul-20	
	N	%	N	%	N	%	N	%	N	%
<80y	2	100.0	73	70.2	437	77.9	861	72.6	1,136	70.6
≥80y	0	0.0	31	29.8	124	22.1	325	27.4	474	29.4
All ages	2		104		561		1186		1610	

Age group	Aug-20		Sep-20		Oct-20		Nov-20		Dec-20		Jan-21	
	N	%	N	%	N	%	N	%	N	%	N	%
<80y	1,373	71.0	946	70.2	607	69.1	454	70.3	590	68.5	679	70.1
≥80y	561	29.0	401	29.8	271	30.9	192	29.7	271	31.5	289	29.9
All ages	1,934	100.0	1,347	100.0	878	100.0	646	100.0	861	100.0	968	100.0

Age group	Feb-21		Mar-21		Apr-21		May-21		All period	
	N	%	N	%	N	%	N	%	N	%
<80y	1,196	69.5	2,630	74.9	2,554	81.2	2,333	84.4	15,871	74.7
≥80y	526	30.5	881	25.1	593	18.8	431	15.6	5,370	25.3
All ages	1,722	100.0	3,511	100.0	3,147	100.0	2,764	100.0	21,241	100.0

| Median (inter-quartile range) proportion (%) of number of deaths			P-value
Age group	Pre-vaccination Mar-20 to Feb-21	Post vaccination Mar-21 to May-21	
<80y	70.2 (69.7–72.2)	81.2 (74.9–81.2)	0.04
≥80y	29.8 (27.8–30.4)	18.8 (15.6–18.8)	

Source: Bahia state Secretary of Health platform (SESAB).
*By summing up the monthly numbers of cases in < 80 years, the final result includes the number of blank cases as their ages are still waiting confirmation.

A. Incidence rate
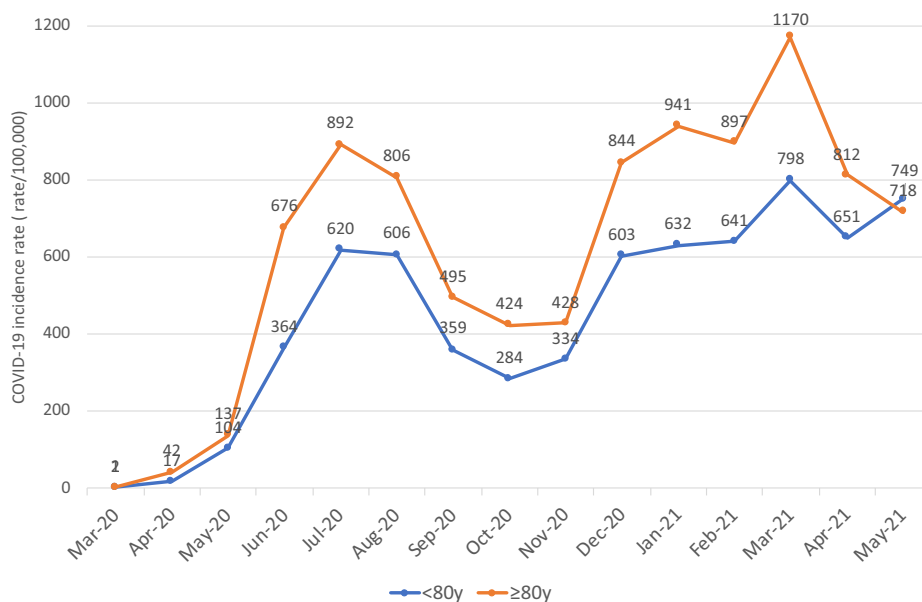
Source: Bahia state Secretary of Health platform (SESAB)
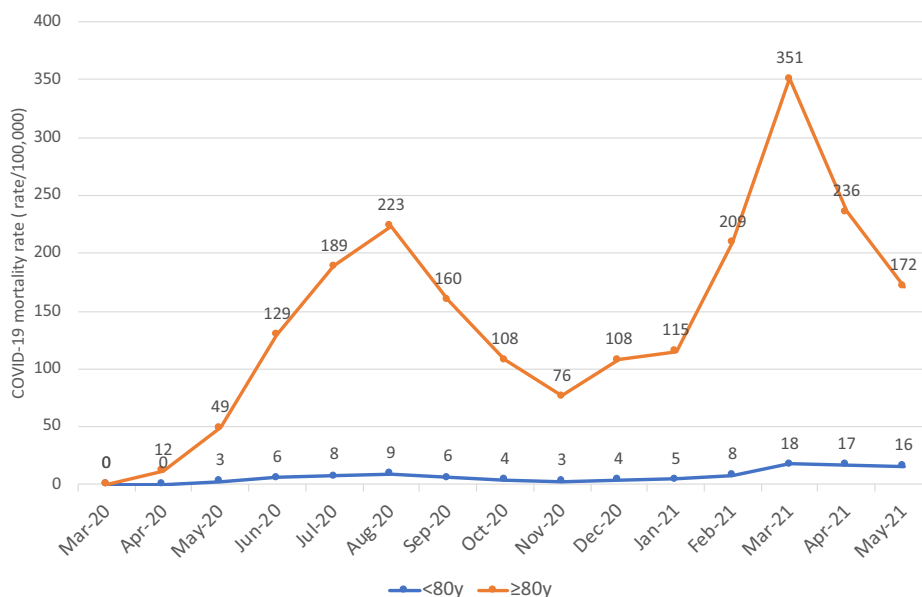
B. Mortality rate

Source: Bahia state Secretary of Health platform (SESAB)

Fig. 1. Incidence (N cases/100,000 population) (A) and mortality rate (N death/100,000 population) (B) due to COVID-19. Bahia March 2020 to May 2021. A. Incidence rate. Source: Bahia state Secretary of Health platform (SESAB). B. Mortality rate. Source: Bahia state Secretary of Health platform (SESAB).

172 / 100,000 (in May-21) (Fig. 1B). Conversely, both epidemiological indicators are keeping the same magnitude among people aged < 80 years.

4. Discussion and limitations

Based on our results, it is possible to infer that the high vaccine coverage among people aged ≥ 80 years is influencing the downward trend in the incidence and mortality rates in this age group. As it is estimated that four fifths of this age group had been vacci-

nated with CoronaVac [6], our results suggest that CoronaVac might be effective particularly in preventing deaths. Between 2020 and 2021, Brazil experienced two COVID-19 pandemic waves: the 1st had its peak in July/2020 and decreased until November/2020; the 2nd one had its peak in June/2021 and decreased until December/2021 [10]. This pattern differs from the one found in our results, as the mortality rate kept decreasing in those aged 80 years and above. Besides that, the evolution of the mortality rate differs when people aged 80 years and above or under 80 years were assessed (Fig. 1B).

After the second dose, SARS-CoV-2 antispike antibodies have been detected in 99.6% of 1,012 healthcare workers vaccinated with CoronaVac [11]. As for the elderly, Ranzani et al demonstrated in a case-control study that CoronaVac vaccine was associated with the reduction of symptoms, hospitalization, and death in patients aged $\geq$ 70 years infected with COVID-19 gamma variant, in São Paulo state, Brazil [12]. Preliminary results from a post-trial with 2.5 million people from Chile estimated that CoronaVac had an 80% effectiveness at preventing death from COVID-19; additionally, in the town of Serrana, Brazil, early results from a trial demonstrated a significantly reduction in the number of cases of COVID-19, hospitalizations and deaths after almost all adult population had been vaccinated with CoronaVac [13]. Moreover, Akpolat et al. demonstrated a reduction in the death ratio due to COVID-19 among healthcare workers in Turkey, after CoronaVac second dose implementation in this population [14]. To the best of our knowledge, this is the first time that probable effectiveness of CoronaVac against COVID-19 original variants among the elderly is demonstrated on a population-based level.

This study has limitations. All analysis were based on secondary data; therefore, completeness problems, underreporting, filling delays, and registration errors must be considered. Follow-up period was short (March/2021 to May/2021), since the acquisition of CoronaVac by the Brazilian government proportionally decreased, corresponding to approximately 10% of the vaccines delivered to the population during the 2nd semester of 2021, as the quantity of other vaccines increased substantially [6]. As such, the analysis of CoronaVac effectiveness in a longer follow-up would be biased in this ecological population-based study.

5. Conclusion

In conclusion, there was a significant reduction in the median proportion of the number of deaths from COVID-19 among those aged 80 years and above in the state of Bahia, Brazil, after COVID-19 vaccine implementation, which included CoronaVac as the vaccine in every-four among five vaccinated people. Such finding suggests CoronaVac effectiveness against death from COVID-19 in the elderly.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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