



Analysis of some factors and COVID-19 mortality in the population of 0 to 24 years in 29 countries: open schools could be a protection

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Abstract

Background. It is limited literature on the possible factors related to mortality by COVID-19 in minors. Children and young people are generally considered vulnerable, especially in low-income countries, whereby consistent evidence must arise to protect them and avoid mortality. **Methods.** A multiple linear regression model was fit to evaluate the relationship between deaths per 100,000 inhabitants and pandemic containment policies, the duration of totally closed schools, and GDP in 29 countries under study. **Results.** Linear regression analysis shows that the association between deaths per 100k and the number of weeks of closed schools had a coef $B=0.355$, [CI 0.010; 0.699], and it is statistically significant (P -value = 0.044). Similarly, the association between deaths per 100K and GDP was -0.001, [CI -0.003; 0.001], and is not statistically associated (P -value 0.633). **Conclusions.** This study suggests that open schools could be a protective space for COVID-19 mortality in the child and youth population and that each country should implement studies on the subject at the local level.

Key word: COVID-19, mortality, school closure, associated factors, minors.

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Introduction

After more than two years of the pandemic, the coronavirus is spreading worldwide, mainly due to the appearance of the Omicron variant, impacting all age groups and with repercussions in many areas⁽¹⁾. According to United Nations Children's Fund (UNICEF, 2021), the direct impact of COVID-19 on the mortality of children and young people is limited. Still, there is concern that the indirect effects of the pandemic on the mortality in these age groups stemming from health disruptions and poverty may be even more significant.

Countries scarcely report COVID-19 data on the number of deaths among children and youth. By January 2022, of the total deaths worldwide, 0.4% correspond to children and young people under 20 years of age; of them, approximately 12,300 deaths, 58% of the population between 10 and 19 years, and 42% of children between 0 and 9 years⁽²⁾.

Since 11th March 2020, when the WHO declared the

coronavirus a pandemic^(3,4), almost all countries began implementing social distancing, among other measures. They began to investigate the efficiency, effectiveness, and plausibility of multiple ways to contain transmission of the virus and the consequences of the possible strategies to be implemented⁽⁵⁾. But added to the measures implemented, there were other determinants specific to each country, such as the level of development, poverty, and performance in health areas. These environmental and health issues began to be necessary to consider.

The countries, following the recommendations of international agencies, have implemented different measures; some countries like China, Korea, and Singapore, which implemented complex containment measures at the individual level, have had an efficient control of the pandemic; some others have opted for mitigation policies and have experienced a high increase in cases and deaths⁽⁶⁾.

Despite mortality due to the appearance of variants, the countries have reported more cases in children and young

people. Still, there is practically no literature on the possible factors related to mortality in this age group. In the sources of mortality data, few countries report and update the figures for deaths of children and young people. Children and young people are generally considered a vulnerable population(7), especially in low-income countries, for which constant evidence must arise to protect them and avoid mortality.

Understanding how the measures implemented and the characteristics of the countries can be related to mortality and what factors could be protective are vital to understanding how to protect this age group and assess which measures have been effective and which have not. For this reason, using an ecological framework, this study points to analyzing some country factors and the mortality of COVID-19 in 0 to 24 years.

Methods

This is an ecological study of 29 countries from different world regions and income levels to study the association between mortality in children and young people by COVID-19 and some country factors. As data sources, we used: A. Global Health 50/50; Covid-19-project is a partnership housed at University College London, the African Population and Health Research Center, and the International Center for Research on Women(8). B. Ourworldindata.org; dataset uses updated official numbers from governments and health institutions(9). C. School Closures Database by income and region downloaded from UNICEF; the definition of school closure used is in line with UNESCO's methodology(10). UNICEF and the World Bank(11).

Outcome

- Primary outcome: deaths by COVID-19 per inhabitant (100k), < 24 years; by sex and gender; the most recent report published (Nov 2021).

Predictors

- School closing weeks by country; are calculated by the number of students from pre-primary education to upper secondary education per region/globally based from March 2020 to November 2021(12).
- Gross domestic product (GDP) is the sum of gross value from all resident producers in the economy plus any products and subsidies not included in the value of the products(13).
- COVID-19 Containment and Health Response index, which is based on thirteen policy response metrics (Table 1): rescaled from 0 to 100 (100 = strictest)(9).

Statistical analysis

A multiple linear regression model was used to evaluate the relationship between deaths per 100,000 inhabitants and pandemic containment policies, the duration of totally closed schools, and the 'countries' GDP under study. The model's adjustment variables were selected considering correlations patterns and their possible relationship with mortality plausibility within a context where the previous

literature of studies with this outcome and age group to data is limited (some environmental and health systems variables were considered and tested previously, but due to their low correlation and theoretical plausibility were not included in the final model).

Model fitness was assessed using the Overall F- test and was adequate ($p < 0.05$). Variables' diversity was estimated using the Variance Inflation Factor (VIF), and the mean VIF was less than 2.

The analyses were performed with Stata (StataCorp. 2017. Stata Statistical Software: Release 15.1. College Station, TX, USA: StataCorp LLC).

Table 1

COVID-19 Containment and Health Index and the composite measures are based on thirteen policy response indicators

	Containment index
Indicators of government response(9)	Cancel public events
	Restrictions on gatherings
	Close public transport
	Public information campaigns
	Stay at home
	Restrictions on internal movement
	International travel controls
	School recommendations
	Testing policy
	Contact tracing
	Face coverings
	Vaccination policy
	Work place closures

Results

The sociodemographic characteristics of the countries are presented in Table 2. In total, there are 29 countries under study, of 4 economic levels and nine geographic regions (East Asia and Pacific 6.9%, Eastern Europe and Central Asia 3.4%, Eastern and Southern Africa 10.34%, Latin America and Caribbean 10.3, Middle East and North Africa 6.9%, North America 6.9%, South Asia 6.9%, West and Central Africa 3.4% and Western Europe 44.8%). Also, the Human Development Index is shown for each country.

Figure 1 shows the extension of the country's mortality per 100k, total and by sex. Peru, Mexico, the Philippines, South Africa, Slovakia, and Colombia, reported the highest number of deaths; mortality by sex varies between countries.

The countries with the fewest deaths were Uganda, Ireland, Nigeria, Ireland, Australia, and Belgium, which did not report any deaths.

Figure 2 shows the weeks with wholly closed schools and the total samples per country. The countries that

reported the highest weeks of school closures were Uganda and the Philippines (60 weeks), followed by Jordan (44 weeks), and then Nepal and Afghanistan (35 weeks). On the other hand, the countries with the lowest weeks of school

closures were Australia and the United States (0 weeks), Uganda (6 weeks), and France (7 weeks). The average duration of school closures was 21.3 weeks.

Table 2

Sociodemographic characteristics of the countries studied (n= 29)

Country	ISO	Region ^a	Income ^b	HDI ^c
Afghanistan	AFG	South Asia	Low	0.511
Nepal	NPL	South Asia	Low	0.602
Uganda	UGA	Eastern and Southern Africa	Low	0.544
Kenya	KEN	Eastern and Southern Africa	Lower middle	0.601
Nigeria	NGA	West and Central Africa	Lower middle	0.539
Philippines	PHL	East Asia and the Pacific	Lower middle	0.718
Bosnia and H	BIH	Eastern Europe and Central Asia	Upper middle	0.78
Colombia	COL	Latin America and Caribbean	Upper middle	0.767
Ecuador	ECU	Latin America and Caribbean	Upper middle	0.759
Jordan	JOR	Middle East and North Africa	Upper middle	0.729
Mexico	MEX	Latin America and Caribbean	Upper middle	0.779
Peru	PER	Latin America and Caribbean	Upper middle	0.777
South Africa	ZAF	Eastern and Southern Africa	Upper middle	0.709
Australia	AUS	East Asia and the Pacific	High	0.944
Austria	AUT	Western Europe	High	0.922
Belgium	BEL	Western Europe	High	0.931
Canada	CAN	North America	High	0.929
Denmark	DNK	Western Europe	High	0.94
France	FRA	Western Europe	High	0.901
Germany	DEU	Western Europe	High	0.947
Greece	GRC	Western Europe	High	0.888
Ireland	IRL	Western Europe	High	0.955
Israel	ISR	Middle East and North Africa	High	0.919
Italy	ITA	Western Europe	High	0.892
Portugal	PRT	Western Europe	High	0.864
Slovakia	SVK	Western Europe	High	0.86
Slovenia	SVN	Western Europe	High	0.917
Spain	ESP	Western Europe	High	0.904
Switzerland	CHE	Western Europe	High	0.955
United States	USA	North America	High	0.926

Notes: a. UNICEF regions; b. World Bank classification; c. Human development index 2019

Regarding mortality, Peru and Mexico reported the highest causality, 50 and 42.7 deaths per 100k, respectively. While, Belgium and Uganda have the lowest causality, with 0 and 0.5 deaths per 100k, respectively (Figure 2).

Linear regression analysis (Table 3) shows that a significant association (P-value = 0.044, coef B= 0.355, CI 0.010; 0.699] exists between the number of deaths per 100k and the duration (number of weeks) of school closures. However, no significant association (P-value 0.633, coef B= -0.001, CI -0.003; 0.001) exists between the number of deaths per 100K and GDP. Also, there was no significant association

between the number of fatalities per 100k and containment index (P-value 0.431, coef B= 0.147, CI 0.528; -0.232).

Discussion

COVID-19 mortality in children and young people has been little studied, hence, the limited published literature on the subject. Most of it consists of the guidelines and recommendations by international organizations such as UNICEF, UNESCO, WHO, and the World Bank, among others(14).

Figure 1

Extension of deaths per 100 thousand inhabitants by sex; from 0 to 24 years of age; 2020-2021

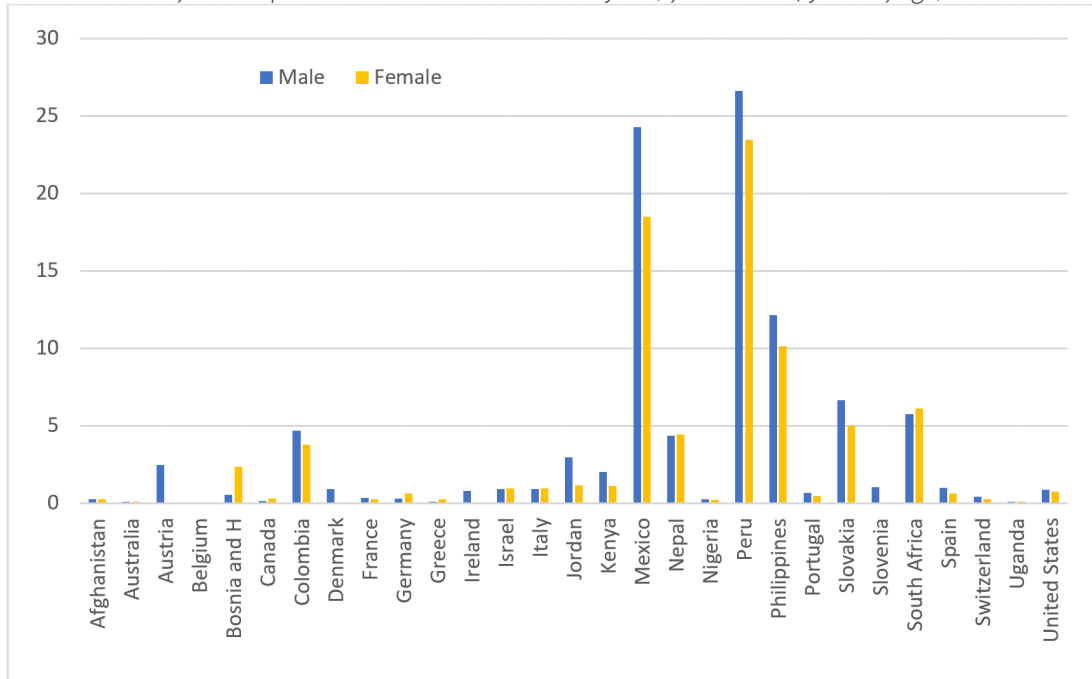


Figure 2

Duration of school closure (Weeks) by country and deaths per 100 thousand inhabitants (100K) of the population from 0 to 24 years of age; 2020-2021

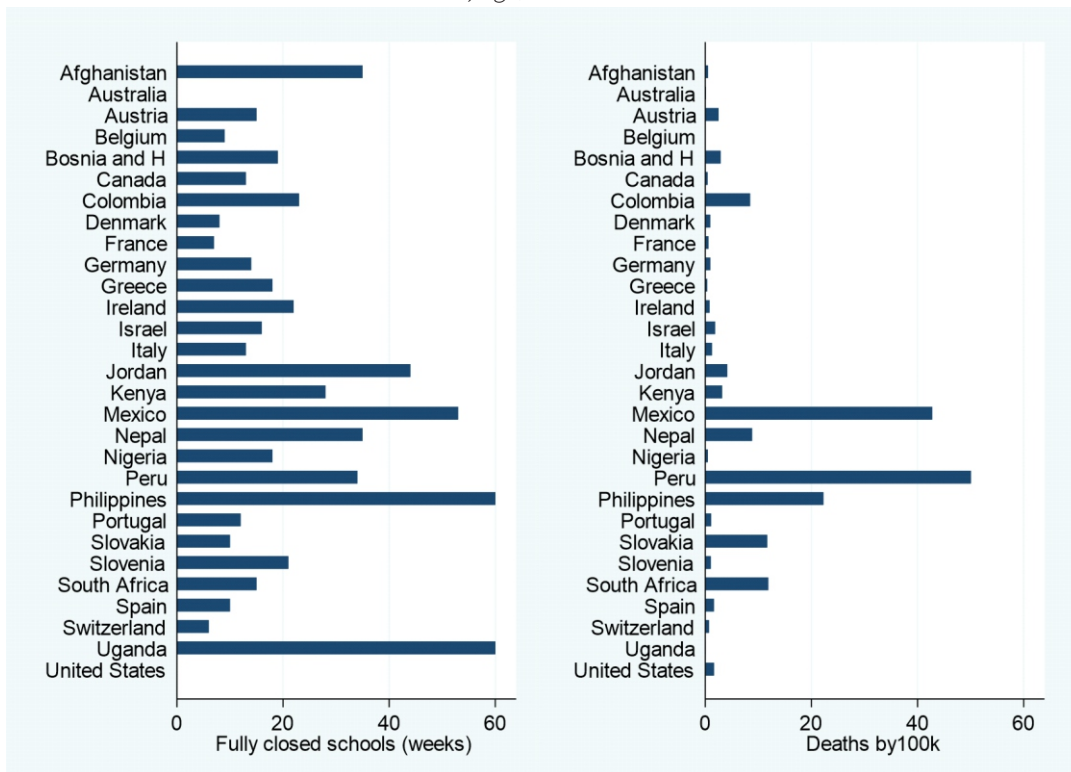


Table 3

Multiple linear regression (Coefficient [coef B] and 95% CI) to assess the association between country factors and deaths by 100k due to COVID-19 (n=29 countries), 2020-2021

Deaths by 100k	Coef B	P value	95% CI	
			Lower	Upper
Full closed school weeks	0.355	0.044*	0.01	0.699
GDP	-0.001	0.633	-0.003	0.001
Containment index	0.147	0.431	-0.232	0.528

Notes: P value < 0.05 *; Model overall F-test P = 0.049; Mean VIF test= 1.62

To date, this is one of the few studies that address mortality from COVID-19 in the population aged 0 to 24 years and its possible relationship with factors and measures to contain the pandemic implemented in a group of countries. It is essential to correctly locate our age group, where the pandemic has had a different behavior in many ways from the older population. It is possible to see a large variability between samples per 100k, GDP, containment index, and the number of weeks of fully closed schools between countries. The outcome of this study shows that a significant association exists between the duration of school closures (number of weeks) and deaths per 100k. In other words, when adjusting for the containment policies of the countries expressed in the containment index and by GDP, the more weeks schools are closed, the greater the number of deaths from COVID-19 in the population between 0 and 24 years of age.

Despite not being statistically significant, a higher containment score is positively associated with more deaths because there are more cases, more deaths, and society is more closed. But the coefficient of school closure fits this, so there appears to be an association with young death regardless of more or fewer containment measures.

The closure of schools in most countries covers elementary, secondary, and university education, which means that they have been affected from very young children to young adults. From the beginning of the pandemic, it was considered that schools could be places of multiple infections and that the students could later transmit the virus to their relatives at home, which generated a severe risk, especially for the elderly; but, review studies report that transmission from children to adults is lower than transmission from adults to children (15-27).

Not attending classes implies the loss of a safe space, socialization, or joy; for many students, it means losing the most balanced meal of the day, which increases the risk of affecting physical and mental health; It has also been reported that the increase in violence suffered by minors increased during the pandemic (28-30). Without considering the high educational cost for students, the measure generated the high school dropout (10). The closure of schools to date has generated much controversy and debate; there is evidence in the literature in favor (31) and a growing against even from 2020 (32-35) for the direct and indirect negative impact on the physical and mental health of children and young people (35).

Limitations and Strengths

This study has some limitations, typical of an ecological study. It does not ensure a causal association between the number of weeks of school closures and mortality from COVID-19. In the same way, it can be seen that some countries like Mexico, the Philippines, and Peru, having many cases, decided to close schools for a longer time and not the other way around. However, our study shows that in other countries such as Australia, France, Switzerland, and the United States closed schools little or no, and the mortality in children and young people is very low. One of the limitations

that can also be given is that young mortality is still a rare event, and therefore there may not be enough variability to detect these associations. In other words, there may be no association with the country's development index.

This study also has strengths, such as that its results are consistent with other studies (10,15,32,34), in that closing schools could do more harm than good and that depending on different social and family factors, it could directly or indirectly increase mortality from COVID-19 in this group. Closing schools could be a rational and effective measure for some countries and contexts, but it was not for most.

Another strength is the use of the containment index that, despite being considered an orientation to assess the effects of policy measures on the dissemination of COVID-19 cases and deaths by the countries (9); considers the thirteen most important actions that the countries have implemented, from internal and external mobility and restrictions, policies of vaccination and use of face masks among others, already detailed in Table 1.

Conclusion

The outcome of this study shows that a significant association exists between the duration of school closures (number of weeks) and the number of COVID-19 deaths per 100k. Several countries draw attention. Peru and Mexico have reported high mortality rates of children and young people following the closure of schools, contrasting with countries like Belgium and Australia. However, currently, with the Omicron variant in the entire expansion, and despite taking the number of cases to unexpectedly high numbers, children and young people have continued to be at lower risk of COVID-19 mortality. Meanwhile, debates are ongoing on whether the current approach to containing the pandemic should focus more on preventing deaths than on becoming infected.

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Availability of data and materials

Databases are anonymous, guaranteeing data confidentiality. Our analyzes were based on public available secondary data.

Consent for publication

Databases are anonymous, guaranteeing data confidentiality. Our analyzes were based on public available secondary data.

Ethical aspects

All surveys that will be used in the analyzes were approved by the ethics committee of each country where they were carried out. Databases are anonymous ensuring

data confidentiality. Our analyzes will be based on publicly available secondary data.

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Author Contributions

JDCG proposed the study, prepared the analysis datasets, carried out the analysis, and wrote the article's first draft. PMVA guided the framework and statistical approach and the elaboration of the final manuscript.

Competing of interests

We declare no competing interests.

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