Brief Report

Covid-19 Incidence And Mortality By Age Strata And Comorbidities In Mexico City: A Focus In The Pediatric Population.

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Covid-19 incidence and mortality by age strata and comorbidities in Mexico City: a focus in the pediatric population.

Abstract

Introduction: SARS-COV2 appears less frequently and less severely in the pediatric population than in older age groups. In the face of the urgent need to reactivate activities suspended during the lockdown, mainly those essential for child development, this study aims to describe the risks of death of persons infected with SARS-COV2 by age group and according to the presence of comorbidities.

Methodology: We analyzed data of confirmed SARS-COV2 infection cases where symptoms began between February 22th, 2020, and March 31, 2021, as published by the General Epidemiology Direction (DGE) of the Mexican Ministry of Health. We calculated COVID-19 incidence and mortality by age group with population data from the Statistics and Population National Institute (INEGI), estimating the correlation between risk of death and the presence of comorbidities.

Results: Mortality in SARS-COV2 infected people varied considerably, between 7 to 155 deaths per million per year in the under-20 age groups compared to 441 to 15929 in the older age groups. Mortality in pediatric populations is strongly associated with comorbidities (OR: 4.6- 47.9) compared to the milder association for older age groups (OR: 3.16-1.23).

Conclusions: The risk of death from SARS-COV2 infection in children is low and strongly associated with comorbidities.
Introduction

After more than a year, the COVID-19 pandemic has generated millions of hospitalizations and deaths worldwide. Besides the direct impact caused by the SARS-COV2 infection itself, indirect harms have arisen because of the saturation of health systems, lockdown policies, and economic struggle.

Evidence indicates that children seldom develop a severe clinical presentation of SARS-COV2 infection and are less prone to transmit it than adults (1–4). For example, in China, more than 90% of the infected children had a mild or moderate clinical presentation, a finding consistent with later reports (5,6). During the first three months of the pandemic, Mexico reported a 12.6% positivity rate for SARS-COV2 infection in tested children and a case-fatality rate of 1.9% (7).

Despite the apparent low risk of severe disease in children, policies to mitigate the transmission rate in all age strata populations have restricted activities and settings essential for child optimal well-being and development. Therefore, accurate estimates of the health risks associated with SARS-COV2 infection in the pediatric population are necessary to design policies that optimize children’s well-being and development while protecting more susceptible groups.

This analysis aims to describe the epidemiology of SARS-COV2 in Mexico City
with a focus on the children and adolescent population to appraise the specific health risks of this age stratum.

Methods

Data for SARS-COV2 cases and deaths were extracted from the open-access data published by the General Epidemiology Direction (DGE) of the Mexican Ministry of Health, which includes data from all tested individuals (8). Cases were computed as the sum of the following categories in the final classification’ variable: 1) virologically confirmed cases (positive PCR or antigenic test) plus 2) confirmed cases by epidemiologic association (symptomatic contact of a virologically confirmed SARS-COV2 case), plus 3) cases without a valid virologic test confirmed by expert judgment. Deaths from any of these cases were recorded.

The DGE database includes information on the presence of specific comorbidities and risk factors, such as male sex, diabetes, immunosuppression, systemic hypertension, obesity, chronic renal disease, asthma, chronic obstructive pulmonary disease (COPD), tobacco use, or a report for “other comorbidity.” We calculated the frequency of each of these factors by age stratum and computed the risk of death in both the “comorbidity-free” population and the population having any of the reported comorbidities by age-stratified groups.

The adjusted odds ratio (OR) for death in SARS-COV2 cases was calculated by logistic regression. We included factors significantly associated with death in the bivariate analysis.

We computed all-cause general mortality in 2019 and annualized COVID-19 mortality from February 22th, 2020 to March 31, 2021, using population data from
The National Institute of Geography and Statistics (9)(10). We calculated the ratio of COVID-19 annualized mortality rate against 2019- all-cause mortality rate by age strata.

Analysis was performed using Stata software, version 13.0 (StataCorp), and graphs were made with GraphPad Prism version 9.1.0 for Windows (GraphPad Software).

RESULTS

The DGE database includes 6,412,677 records of people tested for SARS-COV2 from February 20 to April 18, 2021 (422 days), of which 629,527 were confirmed as COVID-19 cases by any of the following three means: 1) clinical- epidemiological association (n= 83,997), 2) by an expert committee judgment (n=2281) or 3) a positive virological test (n=543,249). Overall positivity rates in those tested for SARS-COV2 were 34.5% and 19.7% for those tested with RT-PCR and antigen test, respectively.

Total cases, deaths, and frequency of comorbidities by age group are reported in Table 1. The significant differences in incidence and case-fatality rate between pediatric and adult age strata are noticeable, with a case-fatality rate below 0.3% in population between 1 and 20 years old and of 2.2% in infants younger than one.

The frequency of specific registered comorbidities in the pediatric age group was very low, as most of them were coded as “other comorbidities.” Incidence and mortality by million people, case-fatality rate, and COVID-19/2019 all-cause-mortality ratio, are shown in Figure 1. The highest incidence of COVID-19 was observed in the 40-59 years old age group, with the case-fatality rate sharply increasing with age. COVID-19 mortality has surpassed more than 50% of the all-
cause mortality in 2019 in age groups older than 40, while it has been less than 6% for those younger than 20.

The adjusted OR for death in SARS-COV2 infected individuals for each comorbidity and risk factor reported in the database can be consulted in Table 2. Relative risk attributable to the presence of comorbidities was highest among children and adolescents, comorbidities being accountable for 80-98% of the age-specific mortality. In children under ten years of age, comorbidities associated with increased mortality were mainly those coded as “other comorbidities.” In those between 11 to 20 years old, diabetes, obesity, immunosuppression, and chronic renal disease were the most significant associated factors. Data for asthma, COPD, and tobacco use were not included because they had no statistical association with death risk in almost any stratum.

Discussion.

This study describes the epidemiology of SARS-CoV-2 in the pediatric population in Mexico as related to the epidemiology of other age strata. COVID-19 incidence and case-fatality rate in children younger than ten years are several times lower than in the adult population. Our results confirm those observed by others about the low frequency of the disease and the low rate of complications and deaths in this age group (5)(6). Besides, the case-fatality rate in youngsters is very strongly associated with present comorbidities, which is mirrored by mortality several orders of magnitude lower than that observed in adults.
The interpretation of these results is limited by the quality of the information provided by the DGA. Mexico is one of the countries with fewer SARS-COV2 tests relative to population (53.2 tests per 1000 people) (11), leading to a significant sub-estimation of cases. To increase the reliability of the information, we chose to limit the analysis to Mexico City since it is one of the Mexican entities with more comprehensive testing policies (283 tests per 1000) (12). Besides, while estimates about COVID-19 epidemiology are uncertain, the relative estimates between age-strata are still informative.

The risk of death attributable to comorbidities in the younger age strata highlights two reflections: the first is related to the small probability of death because of SARS-COV2 infection in a healthy young population. This low risk should be interpreted along with other data related to child health. While COVID-19 mortality represents a substantial proportion of the expected deaths in the pre-pandemic years or has almost equaled it in older age groups, there is no excess mortality rate in the pediatric age group. Yet, other more critical preventable risks for the pediatric population should not be disregarded. For example, before the COVID-19 pandemic, in Mexico City, the risk of death from preventable causes such as congenital infections (1871 deaths per million in <1 age), violence (16 deaths per million in 1-4 year-olds), accidents (15 deaths per million in 5-14-year-olds) and suicide (47 deaths per million in 15-19-year-olds)(9,10) was equal to or greater than the risk of death from a SARS-COV2 infection in the pediatric age groups.
On the other hand, there is an alarming decrease in vaccination coverage: complete immunization schedule in <1 year age and 12-23 months-old children has dropped from 30.4% and 22% in 2019 to 8.4% and 14.5% respectively in 2021 (13), leaving a high number of children susceptible to suffering a vaccine-preventable disease. In addition, some countries have reported the impact of the COVID-19 pandemic in perinatal services, with an increase in preterm births and low APGAR scores, and a decrease in positive breastfeeding practices (14)(7). Besides, pediatric oncology services worldwide have communicated substantial disruptions in cancer diagnosis and management programs (15). Furthermore, lockdown policies have restricted many children’s access to educational, nutritional, and sanitary services, which may aggravate some of these preexistent public health problems. For example, in Mexico, schools have been closed for about 50 million children and adolescents for longer than a year. Increasing evidence suggests that prolonged school closure, home confinement, and social restrictions could have significant consequences for the mental health of both children and adolescents (13)(8)(15).

The second reflection from our results is related to the lack of systematized information on the factors that increase the risk of death in the pediatric age group. In some centers designated for COVID pediatric ases, SARS-COV2 associated deaths have occurred mostly in children with serious comorbidities such as premature neonates with major congenital anomalies, disabled children with chronic neurological diseases, and cancer patients (personal communications). There is a need to establish the causal role of SARS-Cov 2 in these deaths,
including whether the SARS-COV2 infection was an incidental finding in a severely ill child, a contributing agent in a vulnerable patient, a nosocomial infection in a person hospitalized for another severe disease or indeed a major cause of death. It is of utmost importance to get systematized information to solve these issues in the Mexican pediatric population.

In conclusion, the risk of death from SARS-COV2 infection in children is low and strongly associated with comorbidities. The low risk of direct health injury from SARS-COV2 infection in this age group should be balanced against other prevalent health risks exacerbated by the pandemic mitigating measures. Decisions about social restriction policies, including the reactivation of in-site schools, are complex and have to take into account the direct risks of SARS-COV2 infection and, at the same time, the health risks imposed by continued social restrictions.

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| Age Group   | Total Cases | Total Deaths | Share of Total Deaths | Male Sex (%) | Indigenous (%) | Diabetes (%) | Immunosuppressed (%) | Systemic Hypertension (%) | Obesity (%) | Chronic Renal Disease (%) | Chronic Obstructive Pulmonary Disease (%) | Asthma (%) | Smoker (%) | Other comorbidities (%) |
|------------|-------------|--------------|-----------------------|--------------|----------------|--------------|-----------------------|---------------------------|-------------|--------------------------|------------------------------------------|------------|------------|------------------------|
| <1 year    | 743         | 16           | 0.05%                 | 53.6         | 3 (0.4)        | ND^{2}       | ND        | 48 (0.3)                | 117 (0.4)    | 14 (0.2)                 | 4 (0.5)                                  | 11 (1.5)   | ND         | 15 (2.0)               |
| 1-4 years  | 2,741       | 6            | 0.02%                 | 52.1         | 9 (0.3)        | 18 (0.3)     | 19 (0.7)  | 37 (0.3)                | 117 (0.4)    | 14 (0.2)                 | 3 (0.1)                                  | 33 (1.2)   | ND         | 36 (1.3)               |
| 5-9 years  | 6,683       | 9            | 0.03%                 | 51.7         | 48 (0.3)       | 52 (0.4)     | 20 (0.3)  | 107 (0.3)               | 448 (3.2)    | 19 (0.1)                 | 14 (0.2)                                 | 5 (0.2)    | 62 (0.44) | 32 (0.5)               |
| 10-14 years| 14,223      | 5            | 0.02%                 | 50.2         | 88 (0.3)       | 120 (0.4)    | 42 (0.3)  | 117 (0.4)               | 1085 (3.8)   | 53 (0.2)                 | 14 (0.2)                                | 899 (0.4)  | ND         | 32 (0.5)               |
| 15-19 years| 28,042      | 16           | 0.05%                 | 49.6         | 1003 (0.4)     | 4536 (1.9)   | 61 (0.2)  | 6152 (2.6)              | 22693 (9.5)  | 53 (0.2)                 | 19 (0.1)                               | 899 (0.4)  | ND         | 26 (0.1)               |
| 20-39 years| 239,952     | 1,488        | 4.7%                  | 48.3         | 1230 (0.5)     | 30153 (13.0) | 805 (0.3) | 6152 (2.6)              | 23693 (9.5)  | 899 (0.4)                | 26 (0.1)                               | 289 (0.12) | 10 (0.4)  | ND         |
| 40-59 years| 232,254     | 9,937        | 31.1%                 | 47.4         | 1230 (0.5)     | 30153 (13.0) | 805 (0.3) | 6152 (2.6)              | 23693 (9.5)  | 899 (0.4)                | 26 (0.1)                               | 289 (0.12) | 10 (0.4)  | ND         |
| 60-79 years| 92,846      | 16,420       | 51.3%                 | 49.9         | 1230 (0.5)     | 30153 (13.0) | 805 (0.3) | 6152 (2.6)              | 23693 (9.5)  | 899 (0.4)                | 26 (0.1)                               | 289 (0.12) | 10 (0.4)  | ND         |
| 80-99 years| 12,043      | 4,106        | 12.8%                 | 47.3         | 1230 (0.5)     | 30153 (13.0) | 805 (0.3) | 6152 (2.6)              | 23693 (9.5)  | 899 (0.4)                | 26 (0.1)                               | 289 (0.12) | 10 (0.4)  | ND         |

1 Includes all those who self-identified as indigenous or spoke an indigenous language
2 No data
### Table 2. Death risk in SARS-COV2 confirmed cases by comorbidities

| N=629,518 | Lethality if any present comorbidity % (n) | Lethality if no reported comorbidity % (n) | RR for death if comorbidity present (95% CI) | Attributable risk relative to comorbidity | Adjusted Odds Ratio for Death |
|------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|-------------------------------------------|-------------------------------|
|            | Lethality if no reported comorbidity        | Lethality if any present comorbidity         |                                              |                                            | Males | Diabetes | Immunosuppression | Hypertension | Obesity | Chronic Renal Disease | Other comorbidities |
| <1 year    | 5.8% (154)                                  | 1.2% (589)                                  | 4.9% (4.2-101.0)                             | 79%                                       | 5.3² | -        | -                | -            | -      | -                  | 5.4                |
| 1-4 years  | 2.4% (3/127)                                | 0.1% (3/2614)                               | 20.6% (10.6-39.9)                            | 96%                                       | 0.95 | -        | -                | -            | -      | -                  | 475⁵               |
| 5-9 years  | 0.5% (2/378)                                | 0.1% (7/6296)                               | 46% (10.6-23.3)                              | 80%                                       | 1.4  | -        | -                | 5.7          | -      | -                  | 52.5³              |
| 10-14 years| 0.4% (4/1097)                               | 0.01% (1/1326)                              | 47.9% (5.4-427.8)                            | 98%                                       | 2.9  | 111²     | 6.6               | 1.93         | -      | -                  | 141.7²             |
| 15-19 years| 0.3% (9/3271)                               | 0.03% (7/24921)                             | 10.3% (3.8-27.6)                             | 90%                                       | 1.7  | 0.9      | 38.7²             | 0.02         | 8.8²   | 46.7²              | 4.04               |
| 20-39 years| 1.3% (808/60904)                            | 0.4% (680/179048)                           | 35% (3.2-3.9)                                | 69%                                       | 2.7  | 4.7³     | 1.9³              | 2.7³         | 2.94³  | 9.2³               | 4.5³               |
| 40-59 years| 6.6% (6157/92828)                           | 2.7% (3780/139426)                          | 25% (2.4-2.5)                                | 59%                                       | 2.7  | 2.4³     | 18²               | 1.7³         | 1.93³  | 4.89³              | 3.0³               |
| 60-69 years| 20.7% (11224/54236)                         | 13.4% (5186/38610)                          | 15% (15.1-15.6)                              | 35%                                       | 1.9³ | 1.5³     | 1.2³              | 1.2³         | 1.6³   | 2.94³              | 2.9³               |
| 80-99 years| 36.5% (2834/7763)                           | 29.7% (1272/4280)                           | 12% (12.1-13.1)                              | 19%                                       | 1.8³ | 1.2³     | 1.2³              | 1.2³         | 1.44³  | 146³               | 2.2³               |

¹ (Lethality if comorbidity present – Lethality if no comorbidity) / Lethality if comorbidity present. ²P <0.05, ³P<0.001
FIGURE 1. COVID-19 annualized incidence and mortality rates per 1000000 people, case-fatality rate, and COVID-19/2019 all-cause mortality ratio by age strata.