Peruvian children toothbrushing during the COVID-19 pandemic [version 2; peer review: 2 approved]

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Abstract

**Background:** Toothbrushing is a convenient, inexpensive, widespread and culturally accepted method, resulting in an ideal public health outcome. This study aimed to determine the impact of the COVID-19 pandemic on toothbrushing in Peruvian children.

**Methods:** This was a cross-sectional study conducted using a database of children aged 0 to 11 years, with a final sample of 39,124 participants, 15,974 in 2019 (62.03%) and 7088 in 2020 (55.54%). General toothbrushing, daily toothbrushing and minimum frequency of two times a day were dependent variables; the year was considered as the independent variable. In addition, other covariates such as geographical landscape, area of residence, place of residence, altitude, wealth index, health insurance cover, sex and age. Descriptive, bivariate and multivariate statistical analyses were applied.

**Results:** General toothbrushing was 96.19% (n=51 013), daily toothbrushing was 87.47% (n=42 246) and minimum toothbrushing two times a day was 84.53% (n=33 957). In multivariate form, the year presented a negative association with daily toothbrushing (RPa: 0.97; CI95%: 0.96-0.98; p<0.001) and minimum toothbrushing two times a day (RPa: 0.97; CI95%: 0.95-0.98; p<0.001), adjusted for the previously associated co-variables.

**Conclusions:** The year 2020 of the COVID-19 pandemic negatively impacted daily toothbrushing and minimum twice-daily toothbrushing of Peruvian children.

**Keywords**
COVID-19, Toothbrushing, Oral Health, Oral Hygiene, Peru
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- **Garcés-Elías MC**: Conceptualization, Formal Analysis, Investigation, Writing – Original Draft Preparation, Writing – Review & Editing
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Introduction

The World Health Organization (WHO) states that diseases of the oral cavity are associated with certain risk factors, including inadequate oral hygiene, which is a practice mediated by the social and commercial determinants of health, and which vary depending on each population. It is also established that this healthy habit should be adopted before the first year of life, which would strengthen its continuity over time; it is also recommended that this practice should be done at least twice a day together with the use of fluoride toothpaste, which is an effective measure for the prevention of early childhood caries. It is important to mention that toothbrushing is a convenient, economical, widespread and culturally accepted method, making it an ideal measure for public health.

On the other hand, the COVID-19 pandemic has caused substantial changes in governments and their populations, which were established to control the spread of the virus and its possible harmful effects on the health of individuals, in addition to avoiding the collapse of health systems. Consequently, many of these drastic measures, such as social immobilization, quarantines and cessation of economic activities, had adverse effects on the health and welfare of communities, especially in vulnerable population groups, such as children and adolescents, in whom sociodemographic factors such as age and economic status, in addition to their state of health and special needs, have mediated the magnitude of the impact that the health emergency has had on their daily lives. Likewise, these changes in lifestyles could have had repercussions on the exercise of habits that would influence the oral health of children, such as an adequate sleep routine, an increase in the frequency of consumption of foods and beverages with high sugar content and a reduction in the frequency of tooth brushing.

In Peru, previous reports have documented low adherence to the practice of toothbrushing, especially in individuals under five years of age belonging to families with low income and whose parents had the lowest level of education. In addition, it has been observed that the practice of this habit has been increasing in recent years, despite the fact that, in sectors such as the highlands of the country, there are still differences in its practice; however, there are few studies that expose this problem. This highlights the need for its analysis, especially in scenarios as complex as the one that occurred due to the COVID-19 pandemic. In this sense, the purpose of the present investigation was to determine the impact of the COVID-19 pandemic on tooth brushing in Peruvian children.

Methods

A cross-sectional study was carried out using the databases obtained from the Demographic and Family Health Survey (ENDES) for the years 2019 and 2020, developed by the National Institute of Statistics and Informatics of Peru (INEI); the survey was applied only once per year, through home interviews. The ENDES has a stratified two-stage cluster sample design representative at the national and regional levels, as well as according to rural and urban areas. It also includes information on general toothbrushing (if the child practices toothbrushing), daily toothbrushing and toothbrushing at least twice a day in children from 0 to 11 years of age. It should be mentioned that in both years (2019 and 2020), the same questions were applied to assess toothbrushing in the ENDES survey. In relation to the periods to be evaluated, the year 2019 considered a sample size of 36760 households; while for 2020, the sample size consisted of 37390 households. The primary databases contained a total of 167560 participants for 2019, and for 2020 a total of 177414; however, for this analysis only the records of those who answered the question on general toothbrushing, daily toothbrushing and toothbrushing at least twice a day were considered, establishing a final sample of 56816 subjects, 38203 for 2019 (67.24%) and 18613 for 2020 (32.76%).

On the other hand, general toothbrushing (Question: Does (NAME) brush his/her teeth with a toothbrush?; reference category: yes: 1; no: 0), daily toothbrushing (Question: Does (NAME) brush his/her teeth every day?; reference category: yes: 1; no: 0) and toothbrushing at least twice a day (Question: (NAME) how many times a day do you brush your teeth?; reference category: yes: 1; no: 0) were considered as dependent variables, while the year was taken as an independent variable, classified as 2019 and 2020, highlighting that the latter included the period of the COVID-19 pandemic in Peru. Additionally, other covariates were considered within the study, such as the geographical landscape, classified into Metropolitan Lima (capital of the country), rest of the coast, highlands and jungle; area of residence, classified into urban and rural; place of residence...
organized into capital, city, town and countryside; altitude defined as less than 2,500 meters above mean sea level (MAMSL) and from 2,500 MAMSL and more; in addition, a Wealth Index, a variable defined by the willingness of each household to use and consume goods and services. Then, through the method used in the Demographic and Health Survey Program of the United States, a score was assigned to each household, as well as to each of its inhabitants, which served to categorize each dwelling, following a hierarchy that goes from quintile one to quintile five (from the poorest to the richest). Likewise, the holding of health insurance was considered, considering that within Peru there are simultaneously public and private insurance institutions. The public sector includes: Integrative Health Insurance (SIS), Peruvian Social Security (EsSalud), Armed Forces Health Insurance and Police Forces Health Insurance; while in the public or private sector, Health Care Provider Companies (EPS) offer additional coverage to that provided by social security and its essential plan. On the other hand, the covariables sex and age, classified as 0 to 5 years and 6 to 11 years were also considered. Similarly, these have been analyzed in previously published research.

The databases were extracted from the INEI's official website, through multiple sources of information, and then unified into a single matrix to be analyzed in STATA v. 17 software. This was done using the complex sample module, since it is a national survey with possible representative estimates.

Statistical analysis
The statistical analysis began with a descriptive analysis for each of the variables to obtain their absolute and relative frequencies. Subsequently, we continued with a bivariate analysis using a Chi-square test that allowed us to find associations between the variables studied. Next, for multivariate analysis, tests such as Poisson regression were run to obtain crude prevalence ratios (PR) and adjusted prevalence ratios (aPR). It is worth mentioning the svy command was used to determine representative estimates, because the survey design was included in the data analysis, where the sampling patterns were differentiated in the stratum, primary sampling unit and weights. For this research, a confidence level of 95% and a value of p<0.05 was used as an indicator of statistical significance in all tests.

Ethical considerations
For the development of this study, the researchers used freely available information provided by the INEI which, since it is a secondary analysis of anonymous information, does not require ethical approval.

Results
General toothbrushing was 96.19% (n=51 013), daily toothbrushing was 87.47% (n=42 246) and minimum toothbrushing two times a day was 84.53% (n=33 957); the sample was mainly associated to metropolitan Lima with 34.20% (n=10 125), 77.53% (n=50 037) from urban areas, 34.20% (n=101 125) from the capital and 78.79% (n=52 378) residing at less than 2 500 MAMSL. According to the Wealth Index, 22.06% (n=19 244) were mainly poor participants, while 75.38% (n=228 594) had health insurance. A total of 74.51% (n=138 395) were male and 62.74% (n=25 194) were between six and 11 years of age (Table 1).

| Variables                      | n   | %   |
|-------------------------------|-----|-----|
| Year                          |     |     |
| 2019                          | 167560 | 66.32 |
| 2020                          | 177414 | 33.68 |
| General toothbrushing         |     |     |
| Yes                           | 51013 | 96.19 |
| No                            | 5803  | 3.81 |
| Daily toothbrushing           |     |     |
| Yes                           | 42246 | 87.47 |
| No                            | 8738  | 12.53 |
| Toothbrushing at least twice a day |     |     |
| Yes                           | 33957 | 84.53 |
| No                            | 8289  | 15.47 |
In a bivariate manner, general toothbrushing was associated with geographical landscape, area of residence, place of residence, altitude and age (p<0.05); daily toothbrushing was associated with year, geographical landscape, area of residence, altitude, Wealth Index and age (p<0.05); and minimum toothbrushing two times a day was associated with year, geographical landscape, area of residence, place of residence, altitude, Wealth Index, health insurance cover, sex and age (p<0.05) (Table 2). In multivariate form, the year presented a negative association with daily toothbrushing (RPa: 0.97; 95%CI: 0.96-0.98; p<0.001) and minimum toothbrushing two times a day (RPa: 0.97; 95%CI: 0.95-0.98; p<0.001) adjusted for the previously associated co-variables (Table 3).

**Discussion**

This research sought to analyze the results of the main health survey in Peru on the practice of toothbrushing and its considerations in the population under 12 years of age. Among the findings of this research, it was observed that the year of the COVID-19 pandemic outbreak negatively impacted daily toothbrushing and its practice frequency of at least twice a day. To explain this phenomenon, it should be recalled that the health emergency caused by the pandemic led the

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**Table 1. Continued**

| Variables                  | n   | %    |
|----------------------------|-----|------|
| Geographical landscape     |     |      |
| Metropolitan Lima          | 10125 | 34.20 |
| Rest of coast              | 21041 | 24.80 |
| Highlands                  | 27282 | 25.77 |
| Jungle                     | 17109 | 15.23 |
| Area of residence          |     |      |
| Urban                      | 50037 | 77.53 |
| Rural                      | 25520 | 22.47 |
| Place of residence         |     |      |
| Capital                    | 10125 | 34.20 |
| City                       | 20769 | 20.55 |
| Town                       | 19143 | 22.78 |
| Countryside                | 25520 | 22.47 |
| Altitude                   |     |      |
| Less than 2500 MAMSL       | 52378 | 78.79 |
| From 2500 MAMSL and more   | 23179 | 21.21 |
| Wealth index               |     |      |
| Very poor                  | 21084 | 20.02 |
| Poor                       | 19244 | 22.06 |
| Medium                     | 15181 | 21.34 |
| Rich                       | 11901 | 19.27 |
| Very rich                  | 8820  | 17.31 |
| Health insurance           |     |      |
| With insurance             | 228594 | 75.38 |
| Without insurance          | 54545  | 24.62 |
| Sex                        |     |      |
| Man                        | 138395 | 74.51 |
| Woman                      | 144744 | 25.49 |
| Age                        |     |      |
| From 0 to 5 years old      | 37431  | 37.26 |
| From 6 to 11 years old     | 25194  | 62.74 |

n: Absolute frecuency. %: Relative frecuency.
### Table 2. Toothbrushing according to characteristics of Peruvian children under 12 years old.

| Variables                  | General toothbrushing | Daily toothbrushing | Toothbrushing at least twice a day |
|----------------------------|-----------------------|---------------------|-----------------------------------|
|                            | Yes | No | p* | Yes | No | p* | Yes | No | p* | Yes | No | p* |
|                            | n   | %  |    | n   | %  |    | n   | %  |    | n   | %  |    | n   | %  |    | n   | %  |    | n   | %  |    | n   | %  |    | n   | %  |    |
| Year                       |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |
| 2019                       | 34198 | 96.32 | 4005 | 3.68 | 0.202 | 28444 | 86.29 | 5735 | 13.71 | 0.009 | 23060 | 85.44 | 5384 | 14.56 | <0.001 |
| 2020                       | 16815 | 95.94 | 1798 | 4.06 | 13802 | 88.05 | 3003 | 11.95 | 10897 | 82.66 | 2905 | 17.34 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Geographical landscape     |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Metropolitan Lima Lima     | 3903 | 97.42 | 172 | 2.58 | <0.001 | 3488 | 90.80 | 412 | 9.20 | <0.001 | 2972 | 86.57 | 516 | 13.43 | <0.001 |
| Rest of coast              | 9153 | 96.11 | 532 | 3.89 |     | 8081 | 90.31 | 1065 | 9.69 | 6784 | 86.22 | 1297 | 13.78 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Highlands                  | 10319 | 95.41 | 736 | 4.59 |     | 7719 | 79.15 | 2593 | 20.85 | 6121 | 80.72 | 1598 | 19.28 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Jungle                     | 7792 | 95.08 | 502 | 4.92 |     | 6878 | 89.69 | 910 | 10.31 | 5565 | 83.00 | 1313 | 17.00 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Area of residence          |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Urbano                     | 21670 | 99.09 | 1091 | 0.91 | 0.002 | 18872 | 89.46 | 2780 | 10.54 | <0.001 | 15580 | 85.35 | 3292 | 14.65 | <0.001 |
| Rural                      | 9497 | 98.62 | 851 | 1.38 |     | 7294 | 80.65 | 2200 | 19.35 | 5862 | 81.43 | 1432 | 18.57 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Place of residence         |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Capital                    | 3903 | 99.45 | 172 | 0.55 | <0.001 | 3488 | 90.80 | 412 | 9.20 | <0.001 | 2972 | 86.57 | 516 | 13.43 | <0.001 |
| City                       | 9193 | 98.83 | 446 | 1.17 |     | 8030 | 89.09 | 1155 | 10.91 | 6541 | 84.64 | 1489 | 15.36 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Town                       | 8574 | 98.82 | 473 | 1.18 |     | 7354 | 87.90 | 1213 | 12.10 | 6067 | 84.19 | 1287 | 15.81 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Countryside                | 9497 | 98.62 | 851 | 1.38 |     | 7294 | 80.65 | 2200 | 19.35 | 5862 | 81.43 | 1432 | 18.57 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Altitude                   |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Less than 2500 MAMSL       | 22434 | 99.13 | 1303 | 0.87 | <0.001 | 19765 | 90.14 | 2654 | 9.86 | <0.001 | 16427 | 85.66 | 3338 | 14.34 | <0.001 |
| From 2500 MAMSL and more   | 8733 | 98.47 | 639 | 1.53 |     | 6401 | 77.74 | 2326 | 22.26 | 5015 | 79.77 | 1386 | 20.23 |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |    |    |     |
| Variables               | General toothbrushing |                  |                  | Daily toothbrushing |                  |                  | Toothbrushing at least twice a day |                  |                  |                  |
|-------------------------|-----------------------|------------------|------------------|---------------------|------------------|------------------|-----------------------------------|------------------|------------------|------------------|
|                         | Yes       | No     | p*     | Yes    | No     | p*     | Yes   | No     | p*     |
|                         | n         | %      |        | n      | %      |        | n     | %      |        |
| Wealth index            |           |        |       |        |        |       |        |        |       |
| Very poor               | 7965      | 98.78  | 760   | 1.22   | 0.179  |        | 6104  | 80.62  | 1861  | 19.38  | <0.001 | 4899  | 82.15  | 1205  | 17.85  | <0.001 |
| Poor                    | 7852      | 99.01  | 475   | 0.99   |        |        | 6546  | 84.72  | 1303  | 15.28  |        | 5299  | 83.03  | 1247  | 16.97  |        |
| Medium                  | 5982      | 99.22  | 307   | 0.78   |        |        | 5182  | 88.87  | 792   | 11.13  |        | 4266  | 84.78  | 916   | 15.22  |        |
| Rich                    | 4468      | 98.94  | 182   | 1.06   |        |        | 3952  | 90.59  | 514   | 9.41   |        | 3278  | 84.87  | 674   | 15.13  |        |
| Very rich               | 3239      | 98.81  | 121   | 1.19   |        |        | 2980  | 94.11  | 256   | 5.89   |        | 2595  | 89.70  | 385   | 10.30  |        |
| Health insurance        |           |        |       |        |        |       |        |        |        |        |       |        |        |        |        |       |
| With insurance          | 40792     | 99.01  | 4710  | 0.99   | 0.403  |        | 33679 | 87.60  | 7091  | 12.40  | 0.472  | 27262 | 85.33  | 6417  | 14.67  | <0.001 |
| Without insurance       | 10221     | 98.90  | 1093  | 1.10   |        |        | 8567  | 87.06  | 1647  | 12.94  |        | 6695  | 82.03  | 1872  | 17.97  |        |
| Sex                     |           |        |       |        |        |       |        |        |        |        |       |        |        |        |        |       |
| Man                     | 28374     | 98.95  | 2621  | 1.05   | 0.280  |        | 23686 | 87.46  | 4673  | 12.54  | 0.990  | 19323 | 85.12  | 4363  | 14.88  | 0.013  |
| Woman                   | 22639     | 99.09  | 3182  | 0.91   |        |        | 18560 | 87.47  | 4065  | 12.53  |        | 14634 | 82.83  | 3926  | 17.17  |        |
| Age                     |           |        |       |        |        |       |        |        |        |        |       |        |        |        |        |       |
| From 0 to 5 years old   | 26283     | 97.44  | 5339  | 2.56   | <0.001 |        | 20764 | 83.00  | 5502  | 17.00  | <0.001 | 15963 | 81.01  | 4801  | 18.99  | <0.001 |
| From 6 to 11 years old  | 24730     | 99.74  | 464   | 0.26   |        |        | 21482 | 89.66  | 3236  | 10.34  |        | 17994 | 86.12  | 3488  | 13.88  |        |

n: Absolute frequency. %: Relative frequency. p: Statistical significance.
*Chi-square test.
Table 3. Association between toothbrushing and year of the COVID-19 pandemic in children under 12 years old in Peru.

| Variables                     | General toothbrushing (Yes: 1; No: 0) | Daily toothbrushing (Yes: 1; No: 0) | Toothbrushing at least twice a day (Yes: 1; No: 0) |
|-------------------------------|----------------------------------------|-------------------------------------|---------------------------------------------------|
|                               | PR 95%CI p                              | aPR 95%CI p                          | PR 95%CI p                                        |
| Year                          |                                        |                                     |                                                   |
| 2019                          | Ref.                                   | Ref.                                | Ref.                                              |
| 2020                          | 1.00 0.99-1.00 0.212 0.99 0.99-1.00 0.654 | 0.98 0.97-0.99 0.010 0.97 0.96-0.98 <0.001 | 0.97 0.95-0.99 <0.001 0.97 0.95-0.98 <0.001 |
| Metropolitan landscape        |                                        |                                     |                                                   |
| Rest of coast                 | 0.99 0.95-1.02 0.484 - - -             | 0.99 0.95-1.03 0.549 - - -           | 0.99 0.94-1.03 0.499 - - -                         |
| Highlands                     | 0.97 0.94-1.01 0.170 - - -             | 0.84 0.80-0.87 <0.001 - - -         | 0.94 0.89-0.97 0.001 - - -                         |
| Jungle                        | 0.98 0.94-1.02 0.325 - - -             | 0.99 0.95-1.03 0.544 - - -          | 0.95 0.91-0.99 0.023 - - -                         |
| Area of residence             |                                        |                                     |                                                   |
| Urban                         | 0.96 0.95-0.97 <0.001 - - -            | 0.90 0.89-0.92 <0.001 - - -         | 0.95 0.94-0.97 <0.001 - - -                         |
| Rural                         |                                        |                                     |                                                   |
| Capital                       | 1.00 0.99-1.00 0.202 - - -             | 0.98 0.96-1.00 0.057 - - -          | 0.98 0.95-1.00 0.064 - - -                         |
| Town                          | 0.99 0.98-0.99 0.010 - - -             | 0.97 0.95-0.99 0.001 - - -          | 0.97 0.95-0.99 0.022 - - -                         |
| Countryside                   | 0.96 0.95-0.97 <0.001 - - -            | 0.89 0.87-0.91 <0.001 - - -         | 0.94 0.92-0.96 <0.001 - - -                         |
| Less than 2500 MAMSL          |                                        |                                     |                                                   |
| From 2500 MAMSL and more      | 0.99 0.98-0.99 0.001                   | 0.86 0.85-0.88 <0.001               | 0.93 0.91-0.95 <0.001                             |
| Wealth index                  |                                        |                                     |                                                   |
| Very poor                     |                                        |                                     |                                                   |
| Poor                          | 1.03 1.00-1.07 0.050 - - -             | 1.09 1.05-1.13 <0.001 - - -         | 1.01 0.97-1.05 0.665 - - -                         |
| Medium                        | 1.04 1.01-1.08 0.016 - - -             | 1.13 1.09-1.17 <0.001 - - -         | 1.03 0.98-1.07 0.225 - - -                         |
| Rich                          | 1.05 1.01-1.09 0.006 - - -             | 1.15 1.11-1.20 <0.001 - - -         | 1.03 0.99-1.08 0.145 - - -                         |
| Very rich                     | 1.06 1.01-1.10 0.009 - - -             | 1.20 1.15-1.26 <0.001 - - -         | 1.09 1.03-1.14 0.001 - - -                         |
| Health insurance              |                                        |                                     |                                                   |
| Without insurance             |                                        |                                     |                                                   |
| With insurance                | 1.01 0.99-1.01 0.072 - - -             | 1.01 0.99-1.02 0.478 - - -          | 1.04 1.02-1.06 0.001 - - -                         |
| Sex                           |                                        |                                     |                                                   |
| Man                           |                                        |                                     |                                                   |
| Woman                         | 1.00 0.99-1.01 0.297 - - -             | 1.00 0.98-1.02 0.990 - - -          | 0.97 0.95-0.99 0.018 - - -                         |
| Age                           |                                        |                                     |                                                   |
| From 0 to 5 years old         |                                        |                                     |                                                   |
| From 6 to 11 years old        | 1.09 1.08-1.10 <0.001 - - -            | 1.08 1.06-1.10 <0.001 - - -         | 1.06 1.04-1.08 <0.001 - - -                         |

PR: Prevalence ratio; aPR: Adjusted prevalence ratio; 95% CI: 95% confidence intervals; p: Statistical significance.

a: Adjusted for Geographical landscape, Area of residence, Place of residence, Altitude and Age.
b: Adjusted for Geographical landscape, Area of residence, Place of residence, Altitude, Wealth Index and Age.
c: Adjusted for Geographical landscape, Area of residence, Place of residence, Altitude, Wealth Index, Health Insurance, Sex and Age.
Peruvian government to respond with containment measures to limit the number of infections and deaths; however, these
guidelines were indiscriminate and affected with greater emphasis the lower income population, who suffered from pre-
existing precarious conditions in their housing, health and sanitation. In addition, these groups were forced to comply
with the sanitary authority's requirements, moving to their jobs, even though a strict quarantine was maintained in the
country, motivated by the need to generate money. This situation was common in many Peruvian families, since more
than three quarters of the Peruvian economy is informal. In addition, Peru became the country with the highest COVID-19
case fatality rate in the world, despite the efforts made by the government, evidencing the collapse of its health
system.14–16 From all the above, it can be understood that the residents of Peru had to survive a complex and challenging
context, which not only put their lives and those of their families at risk, but also compromised the economic stability of
their homes; therefore, the performance of practices that did not need to be addressed urgently, such as dental brushing for
children, was delayed.

About the strengths and weaknesses in the study, the nature of the design should be considered: being a cross-sectional
study, does not allow establishing causal relationships to the phenomenon studied. In addition, since the information was
obtained from secondary sources, inaccuracies in the results are a possibility, due to possible errors at the time of
collection, as well as the emergence of recall bias, due to self-reporting by the participants. Likewise, the literature reports
certain factors related to toothbrushing in children; however, these are not considered at the time of applying the ENDES
survey, which makes it difficult to compare them with those published internationally. Despite the above, ENDES
continues to be an important source of information on the oral health situation with national representativeness.

Some studies evaluated whether the changes caused by the COVID-19 pandemic would have affected oral health habits,
finding a reduction in the frequency of toothbrushing. Gotler et al. reported that approximately a quarter of the subjects
studied reduced the frequency of this practice both during the day and at night; they also observed that this phenomenon
was reported mainly in older children.6 Additionally, in another study applied to parents in the same context, the
proportion of children whose oral health had worsened was remarkable, despite their brushing practices. Furthermore,
they highlighted that, in order to maintain adequate oral hygiene, there are mediating factors such as the degree of
awareness, socioeconomic level, access to health services, among others.17

Likewise, another study in Brazil evaluated whether the modification of sleeping habits would influence the oral hygiene
of children during the period of confinement, observing that the emergence of changes in the family routine of parents or
caregivers would be relevant in the oral hygiene of the child, especially in the younger pediatric population, who depend
on adults to perform tooth brushing.18 On the other hand, Folayan et al. reported that in the COVID-19 pandemic,
one tenth of the adult individuals evaluated reported having reduced the regularity with which they brushed their teeth;
likewise, the interruption of this healthy habit would be linked to the development of disorders such as anxiety and
decreased psychological well-being.19 From the aforementioned, it can be derived that the modification of such an
important daily routine due to such complex scenarios as a health emergency would influence the deterioration of oral
hygiene maintenance.

Regarding general brushing, this research determined that there is an association between this type of practice and the
geographical characteristics surrounding the children, such as geographical landscape, area, place of residence and
altitude. In 2017, Hernández-Vásquez et al. concluded that a considerable fraction of Peruvian children under 12 years
of age did not practice toothbrushing, especially those settled in the highlands and urban sectors of Peru; likewise the
absence of this habit was observed with greater predominance in those wiofth five years of age or younger.7 A study
applied in the United Arab Emirates showed that children whose day-care centers were located in rural areas had a greater
experience of caries and a higher amount of visible plaque compared to other geographical areas; in addition, the same
publication established infrequent tooth brushing as a factor associated with the high prevalence of dental caries in that
community,20 which could explain the health conditions of these children.

In addition, it is noted that age is also associated with general toothbrushing, in line with previous studies such as that of
Sun et al. in China, where it was found that slightly less than half of the participating children brushed their teeth less than
once a day, showing the great risk to which children in China under five years of age are exposed; there was also a marked
relationship between the age of initiation of toothbrushing and the experience of childhood caries.21 However, as an
indicator, general toothbrushing is generic, due to it only evaluating the performance or not of this practice, without
considering its regularity.

On the other hand, in addition to the characteristics previously mentioned, the Wealth Index also presents statistical
differences when evaluating daily toothbrushing; it was observed that the greater the purchasing power, the greater the
frequency of this type of brushing. A study in Brazil showed that, for the most part, the frequency of brushing in children
was twice a day; however, those who brushed only once during this period predominantly belonged to families with a low
socioeconomic level. Furthermore, the researchers ratified the fact that compliance with this preventive habit depended on the commitment and collaboration of parents or caregivers. In addition, Chen et al. reported an evident positive gradient between the frequency of child toothbrushing and the educational levels of the parents, observing that the children of parents with a higher level of education had a higher propensity to brush twice a day or more, implying the relationship between a higher level of education and economic stability.

Toothbrushing at least twice a day together with toothpaste with fluoride levels equal to or higher than 1000 parts per million, turns out to be an adequate preventive practice as established in the Peruvian regulations, through the Clinical Practice Guidelines for the prevention, diagnosis and treatment of dental caries in girls and boys, in force since 2017. Within this research, it was mentioned that exercising this habit twice a day presents association with all the variables analyzed, such as geographical landscape, area and place of residence, altitude, Wealth Index, health insurance cover, sex and age. In this regard, a previous study using the ENDES determined that between 2013 and 2018 in Peru, there was a progressive trend of adequate brushing frequency, defined as the exercise of tooth brushing from twice a day to more. However, in the rural communities of the country, the percentage of children who exercise this practice is significantly lower, which can also be observed in the Sierra region. Likewise, Soltani et al. documented that by 2014, toothbrushing frequency in Iranian children aged four to six years was low; in addition, it was associated with socioeconomic and demographic factors, and access to health services, a similar result to those presented in this study. In this sense, it was noted that the evaluation of the habit of brushing two or more times presents a greater number of associated factors, and it is observed that the better the living conditions, the higher the frequency of tooth brushing. In this sense, it is understood that national surveys provide essential information on the performance of hygiene practices necessary for oral health care; however, there are indicators that show greater precision and degree of compliance with the expected result, such as the one that evaluates the performance of the practice as established by the health authority, and not only analyzes without considering the continuity and precision of the preventive habit.

Certain limitations were generated by the study, where the nature of the design should be considered: being a cross-sectional study, does not allow establishing causal relationships to the phenomenon studied. In addition, since the information was obtained from secondary sources, inaccuracies in the results are a possibility, due to possible errors at the time of collection, as well as the emergence of recall bias, due to self-reporting by the participants. Despite the above, the ENDES continues to be an important source of information on the oral health situation with national representativeness. It is important to consider toothbrushing as a fundamental hygiene habit for the prevention of diseases of the oral cavity, so the establishment and maintenance of this habit should begin as early as possible, in order to promote optimal conditions of health and quality of life that are sustainable over time. Despite this, in Peru there have been conditions and social characteristics that have established differences in the practice of this preventive habit. However, as a result of the COVID-19 pandemic and its consequent provisions, the oral hygiene practices of Peruvian children under 11 years of age were affected, especially in those facing conditions of greater vulnerability, which already existed prior to the health emergency, but which during this complex situation have worsened and extended to a greater part of the population. It is necessary to address this problem from a multidisciplinary perspective, involving the participation of health professionals, parents, teachers and other stakeholders. Furthermore, the political decision-makers must ensure compliance with their programs and interventions in oral health and monitor the results achieved, paying special attention to indicators based on scientific evidence, which will reveal with certainty whether the oral health of Peruvian children is at risk.

In this sense, the year 2020 of the COVID-19 pandemic negatively impacted daily toothbrushing and minimum twice daily toothbrushing of Peruvian children; the associated factors being geographical landscape, area of residence, place of residence, altitude, health insurance coverage, Wealth Index, sex and age.

Data availability
The data analyzed are freely accessible and provided by the National Institute of Statistics and Informatics of Perú, for 2019 (https://www.datosabiertos.gob.pe/dataset/encuesta-nacional-demograf%C3%ADa-y-salud-familiar-endes-2019-instituto-nacional-de-estad%C3%ADstica-4/) and 2020 (https://www.datosabiertos.gob.pe/dataset/encuesta-demogr%C3%A9fica-y-de-salud-familiar-endes-2020-instituto-nacional-de-estad%C3%ADstica-e-2). The data analyzed are freely accessible and provided by the National Institute of Statistics and Informatics of Perú, for 2019 (https://www.datosabiertos.gob.pe/dataset/encuesta-nacional-demograf%C3%ADa-y-salud-familiar-endes-2019-instituto-nacional-de-estad%C3%ADstica-4/) and 2020 (https://www.datosabiertos.gob.pe/dataset/encuesta-demogr%C3%A9fica-y-de-salud-familiar-endes-2020-instituto-nacional-de-estad%C3%ADstica-e-2).

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I consider that the authors have made the requested clarifications, improving the methodology and discussion sections. The article shows an interesting result and recommends its indexing.

Delete paragraph in discussion: “Certain limitations were generated by the study, where the nature of the design should be considered: being a cross-sectional study, does not allow establishing causal relationships to the phenomenon studied. In addition, since the information was obtained from secondary sources, inaccuracies in the results are a possibility, due to possible errors at the time of collection, as well as the emergence of recall bias, due to self-reporting by the participants. Despite the above, the ENDES continues to be an important source of information on the oral health situation with national representativeness”, due to these aspects being included in the second paragraph of the discussion in the new version.

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Oral Pathology and Inequalities in Oral Disease

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.
The authors complete all the suggestions. The article provides essential information about sanitary measures for covid-19 in oral health.

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Public health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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**Introduction**

The pandemic for covid-19 has relevant implications for population health; one of them relates to oral health. This article addresses a pertinent topic for dentistry; it is well-written and articulates the research problem very well.

It is necessary to introduce other characteristics related to toothbrushing practices in children, supported by literature, to be part of the discussion of the results. In the last phrase of the introduction section, the authors write, “there are few studies that expose this problem,” but there are no references to those studies.

**Methods**

The design is according to the objective of the study. The authors explain the process followed to get the results. It is recommended to define the reference category for statistical procedures.

**Results**

It is well-written; the description of the tables is accurate and highlights relevant results for the
study.

Discussion

The discussion section shows other factors related to toothbrushing practice unavailable in this study because of source information. In this sense, it is essential to consider this limitation in the study conclusions.

The discussion section should be oriented to explicate this study's results more than comparing them.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 04 Nov 2022

MARIA CLAUDIA GARCES ELIAS, Universidad Peruana Cayetano Heredia, Lima, Peru

Dear reviewer, we appreciate your suggestions, recommendations and corrections. These were answered below:

1. Introduction: In the last phrase of the introduction section, the authors write, “there are few studies that expose this problem,” but there are no references to those studies. Accepted and the change was made.
2. Methods: It is recommended to define the reference category for statistical procedures. Accepted and the change was made.

3. Discussion: The discussion section shows other factors related to toothbrushing practice unavailable in this study because of source information. In this sense, it is essential to consider this limitation in the study conclusions. Accepted and included within the study limitations.

4. The discussion section should be oriented to explicate this study's results more than comparing them. It is accepted and in the main findings paragraph information is added and an explanation of the findings is written.

**Competing Interests:** There is no competing interest between the reviewer and the article authors.
Discussion
The text of the discussion seems a bit long and it does not contain the most appropriate order. I suggest considering a reorder the discussion[1]. The first paragraph of the discussion should briefly reiterate what the study did and what it showed, statement of principal findings. The second paragraph should address the Strengths and weaknesses of the study. The paragraphs which follow should then discuss how the findings support or refute the current literature. The final paragraph should tie it all together – so what? Where next? What are the implications for practice? Unanswered questions and future research.

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Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Oral Pathology and Inequalities in Oral Disease

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 04 Nov 2022

MARIA CLAUDIA GARCES ELIAS, Universidad Peruana Cayetano Heredia, Lima, Peru

Dear reviewer, we appreciate your comments, suggestions and corrections. We will respond to them below:
1. Explain what is the meaning of the variable “general tooth brush”, write in methods the questions (dependent variables) used in the surveys 2019 and 2020 and mention if they are the same questions used in both years, mention the reference categories in dependent variables.

We accepted what was suggested and the modifications were made in the indicated sections (materials and methods and Table 3).

2. Reorder the discussion, the first paragraph of the discussion should briefly reiterate what the study did and what it showed. The second paragraph should address the strengths and weaknesses of the study. The paragraphs which follow should then discuss how the findings support or refute the current literature. The final paragraph should tie it all together – so what? Where next? What are the implications for practice? Unanswered questions and future research.

Suggestions were accepted and the order of the discussion was modified as recommended by the reviewer. The first and second paragraphs were modified as indicated and the penultimate paragraph, where the final idea is rounded off and recommendations are made, was maintained.

**Competing Interests:** There is no competing interests between the reviewer and the article authors.