



# COVID-19 pandemic reduces the negative perception of oral health-related quality of life in adolescents

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## Abstract

**Purpose** As people around the world are facing the Covid-19 outbreak, their perception of oral health problems could be changed. This study aimed to evaluate the immediate effects of the Covid-19 pandemic on oral health-related quality of life (OHRQoL) of adolescents.

**Methods** A cohort study with schoolchildren from southern Brazil was conducted. Data on adolescents' OHRQoL were collected from December 2019 to February 2020 (T1), before the Brazilian Covid-19 outbreak. Posteriorly, the data were collected again in June and July of 2020 (T2), under the Brazilian Covid-19 outbreak. The OHRQoL was assessed using the Brazilian short version of the CPQ11-14. Demographic and socioeconomic characteristics and the degree of social distancing were also assessed. Changes in OHRQoL between T1 and T2 were evaluated by adjusted Multilevel Poisson regression models for repeated measures.

**Results** From 290 individuals evaluated at T1, 207 were reevaluated at T2 (response rate of 71.3%). The overall CPQ11-14 mean score was significantly lower during the pandemic, reducing from 10.8 at T1 to 7.7 at T2. This significant reduction was also observed for all CPQ domains, indicating a lower negative impact of oral conditions on adolescents' quality of life during the pandemic. Adolescents from families that had a middle or low degree of social distancing during the pandemic and whose parents were harmed in employment had higher CPQ11-14 scores.

**Conclusion** Overall and specific-domains CPQ-14 scores were significantly lower during the Brazilian Covid-19 outbreak, indicating a decrease in the perception of oral health problems by adolescents over that period.

**Keywords** Covid-19 · Coronavirus · Child · Quality of life · Oral health · Longitudinal studies

## Plain English summary

The world is currently in a pandemic scenario and the impacts of Covid-19 on oral health measures in this context are still unknown. This study aimed to evaluate the effects of the Covid-19 pandemic on the oral health-related quality of life of adolescents. This study was conducted on schoolchildren from southern Brazil that were evaluated from December 2019 to February 2020 (before the pandemic) and in June and July of 2020 (during the pandemic). The quality of life and characteristics and the degree of social distancing were assessed. The sample consisted of 207 adolescents assessed before and after the Covid-19 pandemic. The findings indicating an improvement in the oral health quality of life of adolescents during the pandemic. In conclusion, there

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was a reduction in the negative perception of oral health problems by adolescents over that period.

## Introduction

The world is currently in a complex pandemic scenario [1, 2]. In late December 2019, an outbreak of pneumonia of uncertain etiology occurred in Wuhan, China [1]. Subsequently, the outbreak spread to other regions causing different respiratory symptoms and deaths, with the SARS-CoV-2 virus being the etiologic agent. In this context, around 30th January 2020, the World Health Organization (WHO) classified the "Corona Virus Disease 2019 (COVID-19)" as an international health emergency, and by the end of March, the virus had already reached more than 201 countries in the world [2].

In Brazil, the first case of Covid-19 was detected in late February, and currently (end of September 2020), the total number of cases is 4,558,068 and about 137,272 deaths [3]. Like many parts around the world, the Brazilian territory has adopted measures of social distancing to reduce the contamination by the new Coronavirus [2, 4]. In this scenario, both in Brazil and in other countries, the individuals' lives have significantly changed, mainly regarding its social and economic aspects [2, 4, 5]. Especially considering school-age individuals, there were several changes, since classroom lessons have been suspended in the school environment [4, 5].

In this context, concerns about adolescents' behaviors related to general and oral health, as well as psychosocial and subjective aspects have come into discussion in the face of this pandemic scenario [6–8]. One of these aspects is related to the oral health-related quality of life (OHRQoL), an important subjective measure linked to oral health, especially in this stage of the individual's life transition [9, 10]. OHRQoL is described as a multidimensional construct that reflects individuals' satisfaction with their oral health [11]. Thus, OHRQoL is an important outcome that results from the interaction between oral health conditions, general health, social and environmental factors [12].

Since OHRQoL can be affected by numerous factors, it is relevant to study the impact of a pandemic, with social and school isolation, on adolescents' subjective aspects. To our knowledge, no study has assessed the impact of the pandemic on the OHRQoL in school-age adolescents. This knowledge is extremely important since the impacts of Covid-19 on oral health measures as well as the needs for action in this scenario are still unknown. Thus, the aim of this longitudinal study was to evaluate the immediate effects of the Covid-19 pandemic in adolescents' OHRQoL. We hypothesized that the negative impact of oral health problems on the adolescents' quality of life would change during the outbreak. We were able to test this hypothesis through

the present cohort study since we had collected the baseline data on OHRQoL in adolescents of a southern Brazilian city from December to February 2020, just before the beginning of the Covid-19 pandemic in Brazil.

## Methods

### Ethical issues

This project was approved by the Research Ethics Committee (CEP) of the Federal University of Santa Maria (protocol CAAE 11,765,419.1.0000.5346). All participants were informed regarding the methodology, risks, and benefits of the research. They agreed to participate and their caregivers signed the free and informed consent form from the original cohort.

### Study design and sample

This cohort study was conducted in the city of Santa Maria, southern Brazil. According to official data, Santa Maria had an estimated population of 282,123 inhabitants in 2019 [13]. A random sample of children was selected in 15 basic health units in the city of Santa Maria, on the national day of Child Vaccination, in 2010 when they were 1 to 5 years of age. Since then, these children have been periodically assessed for oral health outcomes. Data on the first epidemiologic survey as well as the results obtained throughout the follow up steps have already been published [14, 15]. In December 2019, we started to collect data of 10 years of follow-up, when we had to suspend the study due to the Covid-19 pandemic in February 2020.

This longitudinal study was performed into two stages: baseline (T1) and follow-up (T2). T1 was composed of 290 school-age adolescents who had been followed within the mentioned cohort, at the end of 2019 and the beginning of 2020. Subsequently, in view of the global pandemic COVID-19 scenario, all these adolescents were contacted again (T2), in order to evaluate possible impacts of the pandemic on oral health-related measures.

The sample size requirements were evaluated according to the power calculation for this study's sample. The power calculation accounted for an alpha error probability of 0.05, overall CPQ11-14 scores of 10.8 (standard deviation [SD] 8.1) at T1 and 7.7 (SD 7.5), at T2, resulting in a sample power of 98%.

### Data collection

Baseline data collection (T1) was performed from December 2019 to February 2020. Data were collected by 12 trained interviewers at the schools or homes of the individuals

participating in the cohort study. Posteriorly, in the months of June and July of 2020—approximately 3 months after the beginning of the Covid-19 pandemic in Brazil [3]—all adolescents previously assessed were contacted by telephone call, as well as their caregiver, for a new data collection (T2). The phone calls were made by 3 trained interviewers [16]. In both evaluations, demographic, socioeconomic, behavioral, and OHRQoL characteristics were assessed.

At baseline and follow-up, OHRQoL was assessed using the short form of the Child Perceptions Questionnaire 11–14 (CPQ11-14) [17], which was culturally adapted and transcribed for using in Brazilian adolescents in that age group [18]. The reduced version of CPQ11-14 has 16 questions divided into 4 domains: oral symptoms, functional limitations, social well-being, and emotional well-being. Five answer options are given for each question: (0) “never”; (1) “Once or twice”; (2) “Sometimes”; (3) “Frequently”; and (4) “Every day/Almost every day”. The final score is obtained by the sum of all items and the total result ranges from 0 to 64 points. The higher the score obtained, the worse the OHRQoL.

Demographic and socioeconomic variables were used to describe the sample, as: sex (girls or boys), age (in years), skin color, maternal education, and household income. Skin color was assessed using the criteria established by the Brazilian Institute of Geography and Statistics (IBGE), through the following question: “Which race do you consider yourself? (0) white; (1) brown; (2) black; (3) yellow; or (4) indigenous?”; and later dichotomized into white (0) and non-white (1, 2, 3, and 4) [19]. The monthly household income was collected in Brazilian currency (*Reais*) and subsequently dichotomized according to the Brazilian minimum wages (BMW)—a BMW is the equivalent of \$ 192 USD per month. Maternal education was assessed in years and dichotomized in < 8 years or  $\geq$  8 years of formal education.

At baseline, previously calibrated examiners ( $n=7$ ) evaluated dental caries through the index of decayed, missing, and filled teeth (DMFT index) [20]. For the analysis, the adolescents were dichotomized according to the presence of untreated caries (component D of the DMFT greater than or equal to 1). The kappa coefficients inter and intra examiners ranged from 0.7 to 0.92.

At follow-up, some variables related to the Covid-19 pandemic were collected. The degree of social distancing was assessed through the question used in the Epi-Covid Brazilian national survey: “Regarding the social distance that is being recommended by health authorities, that is, staying at home and avoiding contact with other people, how much do you think you are doing? (0) practically isolated; (1) quite; (2) middle; (3) little; (4) very little [21]. For the analysis, the degree of social distancing variable was dichotomized into high (0 and 1) or middle/low (2, 3 and 4). A question related to job loss was also assessed: “Has anyone in the

family lost their job or been economically harmed due to the pandemic?”, posteriorly categorized as no, yes or harmed (economic damage for those who were informal workers or who had their own business).

## Statistical analysis

Data analyses were performed using STATA 14.0 (Stata Corporation, College Station, TX, USA). A descriptive analysis of the sample was carried out according to the characteristics evaluated at T1 and T2. The comparison between followed and dropouts’ individuals was assessed using the Chi-square test.

Changes in overall CPQ11–14 scores and in its four domains before and during the Covid-19 pandemic were evaluated by adjusted Multilevel Poisson regression models for repeated measures with random effect. Multilevel analysis has been described as an appropriate model in longitudinal data since it can be viewed as two-level data [22]. In the multilevel structure, the OHRQoL repeated measures over time (level 1) were nested in the adolescents (level 2). Variables that presented  $p < 0.20$  in the unadjusted analysis were included in the adjusted model. The same analytical construction was used to assess the impact of social distancing, loss of employment, and associated factors on the changes in overall CPQ11-14 scores during the pandemic. The results were presented as incidence rate ratio (IRR) and 95% confidence interval (95% CI).

## Results

From 290 individuals evaluated at T1, 207 were reevaluated at T2 (response rate of 71.3%). The reason for the loss of follow-up was due to the inability to contact the participants by phone ( $n=83$ ). Regarding the followed and non-respondents’ adolescents, there was no difference regarding to sex ( $p=0.66$ ), household income, ( $p=0.19$ ) maternal education ( $p=0.61$ ), skin color ( $p=0.37$ ), and untreated dental caries ( $p=0.06$ ).

Table 1 shows the sample characteristics before and after 3 months from the beginning of the Covid-19 pandemic in Brazil. Approximately 52.2% were male sex, 50.2% had white skin color and the age ranged from 10 to 15 years old. Regarding socioeconomic characteristics, most of the adolescents were from families with household income greater than 1 BMW (74.7%) and whose mothers had 8 years or more of formal education (72.8%). According to information obtained at T2, 65.7% of the families were performing high social distancing, and 26.1% and 6.3% had lost their employment or have been harmed in some way, respectively.

Overall and domain-specific CPQ11–14 scores and changes between baseline and follow-up are presented in

**Table 1** Sample characteristics before and after 3 months from the beginning of the Covid-19 pandemic in Brazil (n=207)

Variables	N	%
<i>Baseline (T1) characteristics</i>		
Sex		
Girls	99	47.8
Boys	108	52.2
Age		
10–12	100	48.3
13–15	107	51.7
Skin color		
White	103	50.2
No-white	102	49.8
Maternal education		
≥ 8 years of formal education	145	72.1
< 8 years of formal education	56	27.9
Household income		
≤ 1BMW	50	25.3
> 1BMW	148	74.7
Untreated dental caries		
Absent	150	72.5
Present	57	27.5
<i>Follow-up (T2) characteristics</i>		
Household income		
≤ 1BMW	59	28.5
> 1BMW	148	71.5
Social distancing		
High	136	65.7
Middle/Low	71	34.3
Loss of employment		
No	140	67.6
Yes	54	26.1
Harmed	13	6.3

Values less than 207 are due to missing data; BMW, Brazilian minimum wages

**Table 2.** All CPQ-14 scores (total and domains) were significantly lower after the beginning of the Covid-19 pandemic**Table 2** Changes in overall and domain-specific CPQ11–14 scores in the sample, before and after 3 months from the beginning of the Covid-19 pandemic in Brazil, determined by Multilevel Poisson regression model for repeated measures

Outcome (CPQ11-14)	Baseline (T1) Mean (SD)	Follow-up (T2) Mean (SD)	Adjusted* IRR (95% CI)	p value
Oral symptoms	3.7 (2.5)	3.2 (2.5)	0.87 (0.78–0.97)	< 0.01
Functional limitations	2.7 (2.8)	2.0 (2.7)	0.72 (0.63–0.81)	< 0.01
Emotional well-being	2.6 (3.3)	1.5 (2.8)	0.58 (0.50–0.66)	< 0.01
Social well-being	1.6 (2.3)	0.9 (1.9)	0.57 (0.49–0.70)	< 0.01
Total score	10.8 (8.1)	7.7 (7.5)	0.71 (0.67–0.76)	< 0.01

SD standard deviation, IRR incidence rate ratio, CI confidence interval

\*Adjusted for the variables sex, age, household income and untreated dental caries. Reference category: before the Covid-19 pandemic (T1)

( $p < 0.01$ ), indicating a lower negative impact on OHRQoL. Regarding total scores, the overall CPQ11-14 was 10.8 (SD 8.1) at T1 and 7.7 (SD 7.5) at T2, with a reduction in the means of approximately 29% (IRR 0.71; 95% CI 0.67–0.76). In addition, all CPQ11-14 domains showed reduced means at T2, with the larger change in scores observed in the emotional well-being domain (IRR; 0.58 95% CI 0.50–0.66), which were 42% lower from T1 to T2.

Table 3 presents the overall CPQ11–14 scores during the Covid-19 pandemic in Brazil according to the degree of social distancing, loss of employment, and associated factors. In adjusted analysis, adolescents from families that had a middle/low degree of social distancing during the pandemic had higher overall CPQ scores (IRR 1.33 95%CI 1.01–1.77) when compared to the counterparts that had high social distancing. In relation to employment, the OHRQoL was significantly poorer in adolescents whose families have harmed economically at employment due to the Covid-19 pandemic (IRR 2.18; 95%CI 1.27–3.72). In addition, the overall CPQ-11-14 scores were also higher in individuals whose family lost their jobs during the pandemic, although not significant.

## Discussion

This longitudinal study aimed to investigate the impact of the Covid-19 pandemic in the adolescents' OHRQoL. As the main result, overall and specific-domains CPQ-14 scores were significantly lower after the beginning of the Covid-19 pandemic, indicating a lower negative impact of oral conditions on adolescents' quality of life. In addition, adolescents from families that had a low degree of social distancing during the pandemic presented higher CPQ11-14 scores. Although some studies have raised discussions about general and oral health measures in this context [6–8], the real impact of the pandemic in quality of life has not been explored yet.

The adolescents' OHRQoL scores were significantly lower after 3 months at the beginning of the Covid-19

**Table 3** Changes in overall CPQ11–14 scores during the Covid-19 pandemic in Brazil according to the degree of social distancing, loss of employment and associated factors, determined by Multilevel Poisson regression model for repeated measures

Variables	CPQ11-14 total score			
	Baseline	Follow-up	Unadjusted	Adjusted
	Mean (SD)	Mean (SD)	IRR (95% CI)	IRR (95% CI)
Sex				
Girls	12.5 (9.1)	9.2 (8.3)	1.00	1.00
Boys	9.1 (6.5)	6.4 (3.5)	0.77 (0.62–0.95)	0.71 (0.54–0.94)*
Age				
10–12	11.9 (8.1)	7.8 (7.6)	1.00	–
13–15	9.8 (7.8)	7.7 (7.5)	0.84 (0.69–1.04)	
Skin color				
White	10.8 (8.7)	7.4 (6.7)	1.00	–
No-white	10.7 (7.3)	8.2 (8.4)	1.07 (0.86–1.33)	
Maternal education				
≥ 8 years of formal education	10.7 (8.0)	7.4 (7.4)	1.00	–
< 8 years of formal education	11.1 (7.7)	8.8 (8.0)	1.15 (0.91–1.44)	
Household income				
≤ 1BMW	12.8 (7.3)	10.7 (9.6)	1.00	1.00
> 1BMW	10.1 (9.0)	6.7 (6.3)	1.03 (0.90–1.19)	0.83 (0.61–1.13)
Untreated dental caries				
Absent	10.7 (8.0)	7.3 (6.8)	1.00	1.00
Present	11.1 (8.0)	8.8 (9.1)	1.11 (0.88–1.39)	1.15 (0.85–1.56)
Social distancing				
High	10.5 (8.4)	7.1 (7.3)	1.00	1.00
Middle/Low	11.4 (7.3)	9.0 (7.8)	1.31 (0.97–1.76)	1.33 (1.01–1.77)*
Loss of employment				
No	10.3 (8.2)	6.9 (7.2)	1.00	1.00
Yes	11.0 (7.1)	11.7 (7.9)	1.29 (0.93–1.77)	1.21 (0.89–1.66)
Harmed	14.3 (9.4)	12.4 (7.4)	2.14 (1.23–3.73)	2.18 (1.27–3.72)*

BMW Brazilian minimum wages, SD standard deviation, IRR incidence rate ratio, CI confidence interval

\* $p < 0.05$

pandemic in Brazil, in agreement with a previous study that evaluated the general quality of life [23]. Explanations for this finding can be explored by different theories. First, OHRQoL measures the impact of oral health on individuals' daily lives [12]. In this sense, during the Covid-19 pandemic, school-age individuals stopped attending school due to social distancing [5]. Therefore, some factors that could have impacted OHRQoL before the pandemic may have changed or decreased in this period. Previous studies have shown that factors related to the school environment are associated with OHRQoL [24, 25]. In addition, oral health measures, such as dental shame, impact on the occurrence of dental bullying among schoolchildren [26]. In this context, as social distancing prevented daily contact among adolescents, it is believed that OHRQoL was less affected in this period, especially in the emotional well-being and social well-being domains, as demonstrated in our findings.

Another possible explanation for this finding is related to theories surrounding social capital. Recent studies have

shown an increase in family ties and social support during the Covid-19 pandemic [27, 28], as well as previously demonstrated in other disaster situations [29]. Social capital has been highlighted as an important protective factor against the stress through access to social support, as well as through feelings of security and belonging [30]. Moreover, the literature has demonstrated that social support is related to better OHRQoL in children [14]. Thus, this support interacts with people's natural coping style and resilience, and can act as a 'buffering factor' for stress in the health and well-being of individuals [30]. In this sense, since the adolescents were at home and closer to their family members, it is hypothesized that they may have received greater social support in this period and, consequently, reported a better OHRQoL.

In addition to the explanations mentioned, another potential source for reducing the negative perception of oral problems can be explained by the decreased use of dental services during the Covid-19 pandemic [31, 32]. A recently published study demonstrated that pandemic

significantly affected the number of pediatric dental procedures performed in Primary Health Care in Brazil [31]. In this context, several school-aged individuals were left without dental care during the Covid-19 pandemic in Brazil [31]. Thus, it is hypothesized that the lack of dental care may have made individuals less aware of their oral problems, thus reducing the impact of these conditions on OHRQoL.

Adolescents from families that had a middle or low degree of social distancing during the pandemic had poorer OHRQoL. Families that were able to comply with social distancing may be those more benefited in terms of social support and positive changes about habits and perceptions regarding their health [6, 23, 28]. In addition, in front of adverse and risk situations, such as the Covid-19 pandemic [1, 2], certain oral problems, when present, may become less important in people's lives. In this context, it is assumed that adolescents whose families were able to adhere to a greater degree of social distancing and were able to understand the gravity of the pandemic scenario had the impacts of oral health conditions on their well-being alleviated, and consequently, presented a better OHRQoL.

The OHRQoL was significantly poorer in adolescents whose families had economic loss in their business due to the Covid-19 pandemic. The overall CPQ-11-14 scores were also higher in individuals from families with job loss cases during the pandemic. A justification for these findings is that families with harmed jobs presented more psychosocial stress due to this situation, which may impact subjective outcomes [33, 34], such as OHRQoL. Likewise, adolescents from families with economical harm had their income reduced, which has previously been recognized as a predictor of negative impact on OHRQoL [11, 14, 15, 25].

This study has some limitations. First, only a part of the individuals in the initial cohort was included in this study, which may limit the external validity of our findings. Another factor that may have influenced the results was the application of the OHRQoL questionnaire via telephone in the follow-up. However, a previous study has shown that there is no difference between applying OHRQoL questionnaire face to face or by telephone [16]. In addition, we cannot control other factors, such as dental caries at follow-up, that possibly may have impacted OHRQoL during this period. However, due to the pandemic and social distancing, there was no other possible form of assessment.

Our study showed for the first time the influence of the Covid-19 pandemic context on changes in the OHRQoL of school-age adolescents using data before and during this period. This finding is relevant since it allows us to understand the effect of an unknown scenario on a specific outcome, as well as guide the adoption of appropriate measures, if necessary. In addition, studying this aspect in adolescents is extremely important, since factors that affect this age

group, especially psychosocial issues, can persist and impact throughout life [35].

## Conclusion

In conclusion, our findings suggest that overall and specific domains CPQ-14 scores were significantly lower during the Brazilian Covid-19 outbreak, indicating a decrease in the perception of oral health problems by adolescents over that period. In addition, adolescents from families with a low degree of social isolation and whose families have been harmed on employment due to pandemic presented poorer OHRQoL.

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**Author contributions** K conceptualized and designed the study, collected data, performed the statistical analyzes, drafted the initial manuscript, and revised the manuscript. B and T designed the study, collected data, performed the statistical analyzes and revised the manuscript. V, C and G collected data and revised the manuscript. A and M designed the study and critically reviewed the manuscript. A designed the study, coordinated and supervised the data collection and critically reviewed the manuscript. All authors have approved the final manuscript as presented and agree to be accountable for all aspects of the paper.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflicts of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the Human Research Ethics Committee of Federal University of Santa Maria (protocol CAAE 11765419.1.0000.5346), Brazil.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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