EFFECT OF COVID-19 ON ORAL HEALTH-RELATED QUALITY OF LIFE OF CHILDREN AND ADOLESCENTS: A SYSTEMATIC REVIEW

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PALAVRAS-CHAVE: Adolescentes. Criança. COVID-19. Qualidade de vida. Revisão sistemática.

RESUMO

Introdução: A interrupção dos cuidados dentários durante a pandemia da COVID-19 veio enfatizar a importância crítica da prevenção de doenças e da manutenção da saúde oral. **Objetivo**: Esta revisão sistemática teve como objetivo determinar os efeitos da pandemia COVID-19 na Qualidade de Vida Relacionada à Saúde Bucal de crianças e adolescentes. **Fonte de dados:** Foram incluídos estudos observacionais. A pesquisa foi realizada nas bases de dados Embase, PubMed, Psycinfo, LILACS, Scopus, Web of Science, Google Scholar e ProQuest Dissertations and Thesis. O efeito da pandemia da COVID-19 na Qualidade de Vida Relacionada à Saúde Bucal (QVRSB) de crianças e adolescentes foi o principal resultado. O risco de viés foi determinado usando o JBI Critical Appraisal Checklist. **Síntese de dados:** Cinco estudos foram incluídos, abrangendo 4085 crianças e adolescentes. A faixa etária, relatada em três estudos, permitiu o cálculo de uma idade média de 8,8 anos (±4,61). Dois estudos tiveram um efeito negativo na QVRSB (através de associações), dois deles não apresentaram dados que justificassem o efeito e o outro teve um efeito negativo baixo. Nenhum dos estudos não descreveram os fatores de confusão e como lidar com eles (risco de viés). **Conclusão:** A evidência permanece inconclusiva quanto ao impacto negativo da pandemia de COVID-19 na QVRSB de crianças e adolescentes.

KEYWORDS: Adolescents. Child. COVID-19. Quality of life. Systematic Review.

ABSTRACT

Introduction: The interruption of dental care during the COVID-19 pandemic has underscored the critical importance of disease prevention and the maintenance of oral health. **Objective:** This systematic review aimed to determine the effects of the pandemic on the Oral Health-related Quality of Life of children and adolescents. **Sources of Data:** Observational studies were included. The search was carried out Embase, PubMed, Psycinfo, LILACS, Scopus, Web of Science, Google Scholar, and ProQuest Dissertations and Thesis. The effect of the COVID-19 pandemic on oral health-related quality of life (OHRQoL) of children and adolescents was the main outcome. The risk of bias was determined by using the JBI Critical Appraisal Checklist. **Synthesis of Data:** A total of five studies were included, encompassing 4085 children and adolescents. The age range, reported in three studies, allowed for the calculation of a mean age of 8.8 years (±4.61). Two studies had a negative effect on OHRQoL (through associations), two of them did not present data to justify the effect and the other had a low negative effect. All studies failed to describe confounders and how to deal with them (risk of bias). **Conclusion:** The evidence remains inconclusive regarding the negative impact of the COVID-19 pandemic on the OHRQoL of children and adolescents.

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INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by SARS-CoV-2 and was first identified in 2019 in Wuhan, China.[1] The search for SARS-CoV-2 vaccines took several months, and although some vaccines were developed, they were not available in sufficient quantities for all countries.[2] Various restrictive measures were proposed to control the spread of the virus, including avoiding social interactions and non-essential activities.[2] These proposals harmed the psychological well-being of people, largely due to the lack of social interaction.[3] Consequently, social isolation has increased rates of anxiety, depression, and disruptions in sleeping and eating patterns, potentially harming people's quality of life.[3]

COVID-19 had a significant impact on various services, including dental care.[4] As a result, the maintenance of oral health care has become mainly dependent on hygiene practices conducted at home during periods of social isolation.[5] Good oral health is essential for the performance of daily activities like eating, chewing, and breathing properly. It also contributes to psychosocial aspects such as self-confidence, well-being, and the ability to socialise without experiencing shame or embarrassment.[6] Therefore, oral health care can have direct and indirect effects on an individual's well-being and quality of life.[6] A population-based study reported that children and adolescents experienced a decline in oral health care during the COVID-19 period.[7] Moreover, children and adolescents who experienced reduced social interaction and whose families encountered economic restrictions due to the pandemic exhibited lower related to oral health-related quality of life (OHRQoL) scores.[7]

Childhood and adolescence represent developmental stages marked by social interaction and self-comparison, making it crucial for individuals to navigate these periods healthily.[6,8] To better comprehend the psychological state of children and adolescents during the pandemic, it is crucial to conduct studies that can gather the most reliable evidence available. Hence, this systematic review aimed to determine the effects of the COVID-19 pandemic on the Oral Health-Related Quality of Life (OHRQoL) of children and adolescents.

METHODS

This systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number: CRD42023444187. And it is reported following the Preferred Reporting Items for Systematic Reviews and Meta-analyses 2020 (PRISMA).[9]

Eligibility criteria

Eligibility criteria were defined based on the PEOS acronym, as follows: Participants: children and adolescents (under 18 years old, according to what was described by the term MeSH); Exposition: COVID-19 Pandemic; Outcome: Oral Health-Related Quality of Life, and Studies: observational studies (cross-sectional and cohort). Therefore, the research question was: "How did the COVID-19 pandemic affect the oral health-related quality of life in children and adolescents?"

This review focused primarily on assessing how the COVID-19 pandemic affected oral health-related quality of life (OHRQoL) in children and adolescents. Secondary outcomes were the influence of COVID-19-related anxiety, parental employment, parental education level and access to dental services during the pandemic on OHRQoL.

The following exclusion criteria were used: study design not matching eligibility criteria (letters, editorials, case reports or series, randomized and non-randomized clinical trials, and reviews), studies not assessing or reporting information about the OHRQoL or the effect of COVID-19 on OHRQoL, studies that did not have validated OHRQoL questionnaires, and studies that were analyses based on mathematical simulation models.

Information sources and search strategy

A preliminary search strategy was developed with the aid of a librarian using controlled (DeCS/MeSH/Emtree terms) and free vocabulary. Afterwards, this strategy was adapted according to the specifics of each database used in the search. More details about the search strategy are presented in Supplementary Table 1.

Electronic searches were conducted on August 1st, 2024, in the following databases: Embase, PubMed, Psycinfo, Latin American and Caribbean Health Sciences (LILACS), Scopus, and Web of Science. Additionally, the gray literature was searched through Google Scholar and ProQuest Dissertations and Thesis databases. To ensure literature recovery, experts were contacted requesting unpublished studies, through the Scopus database by searching for the terms "Oral Health-Related Quality of Life" AND "Child". Moreover, the reference lists of the included studies were checked. There was no time and language restriction when performing the searches. References were managed using the Endnote Desktop where duplicates were removed.

Selection process

A two-phase selection process was done. First, two independent reviewers performed an initial screening by reading the titles and abstracts using the Rayyan Software.[10] The same reviewers then read the full text of the potentially eligible studies to check their eligibility. A third reviewer contributed to the selection decision in case of disagreement.

Data collection process and data items

Two reviewers were previously trained and independently performed data collection using a specific form. A third reviewer cross-checked all collected data. The data collected consists of publication details (authorship, year, country) study design, sample details (number of participants, sex, age, skin color, parents' employment status, parents' educational level, responsible for answering the questionnaire), point or period of prevalence, questionnaire for OHRQoL assessment (type, number of questions and domains, score interpretation, OHRQoL overall score and domains score, OHRQoL results and interpretation) and main findings.

Study Risk of Bias

The risk of bias of the included studies was assessed using the JBI critical appraisal checklist for analytical cross-sectional studies and cohort studies.[11,12] The JBI checklist for analytical studies consists of eight questions for cross-sectional studies and eleven questions for cohort studies. The answers to each question can be Yes, No, Unclear or Not applicable. The same two reviewers independently assessed the risk of bias of each included study, and a third reviewer resolved by consensus or made the final decision in case of disagreement.

Effect measures and synthesis methods

A meta-analysis of proportions was originally planned for data synthesis. However, after a thorough review of the full studies, it was found that an analysis was not feasible due to the different questionnaires and domains used in the studies. In addition, the proportion of people who experienced a decline in OHRQoL was not reported in the included studies. Therefore, information was compiled following the Synthesis Without Meta-Analysis Guideline (SWiM) and reported in a narrative form (SWIM).[13]

Associated factors (secondary outcomes) were selected when reported. Fear of COVID-19, parents' employment, parents' level of education and access to dental care during lockdown were used to assess whether they were negatively or positively associated with OHRQoL.

RESULTS

Study Selection

A total of 2,126 references were identified by electronic searches. No additional studies were retrieved by contacting experts or checking the reference list of articles included. After removing the duplicates, 1,528 (1,039 from databases and 489 from gray literature) references were screened by title and abstract reading. Afterward, nine studies remained for full-text reading. During this phase, three studies were excluded: one focused on analyzing Health-Related Quality of Life (HRQoL),[14] another utilized a non-validated questionnaire,[15] and the third employed a mathematical model to simulate an impact on quality of life.[16] The studies by Knorst *et al.*[7] and Pohl *et al*.[17] were included for full reading.[7,17] Upon detailed assessment, it was identified that these two reports refer to the same study population and methodology, with the only difference being the follow-up period. Specifically, Pohl *et al.*[17] included an additional period (T3- 15 months after the start of the pandemic- June and July 2021). Given the methodological overlap, the results from both reports were considered complementary and were pooled for the analysis. Consequently, although six reports were assessed in full, five studies met the inclusion criteria and were included in the systematic review. Figure 1 provides an overview of the study selection process.

Study Characteristics

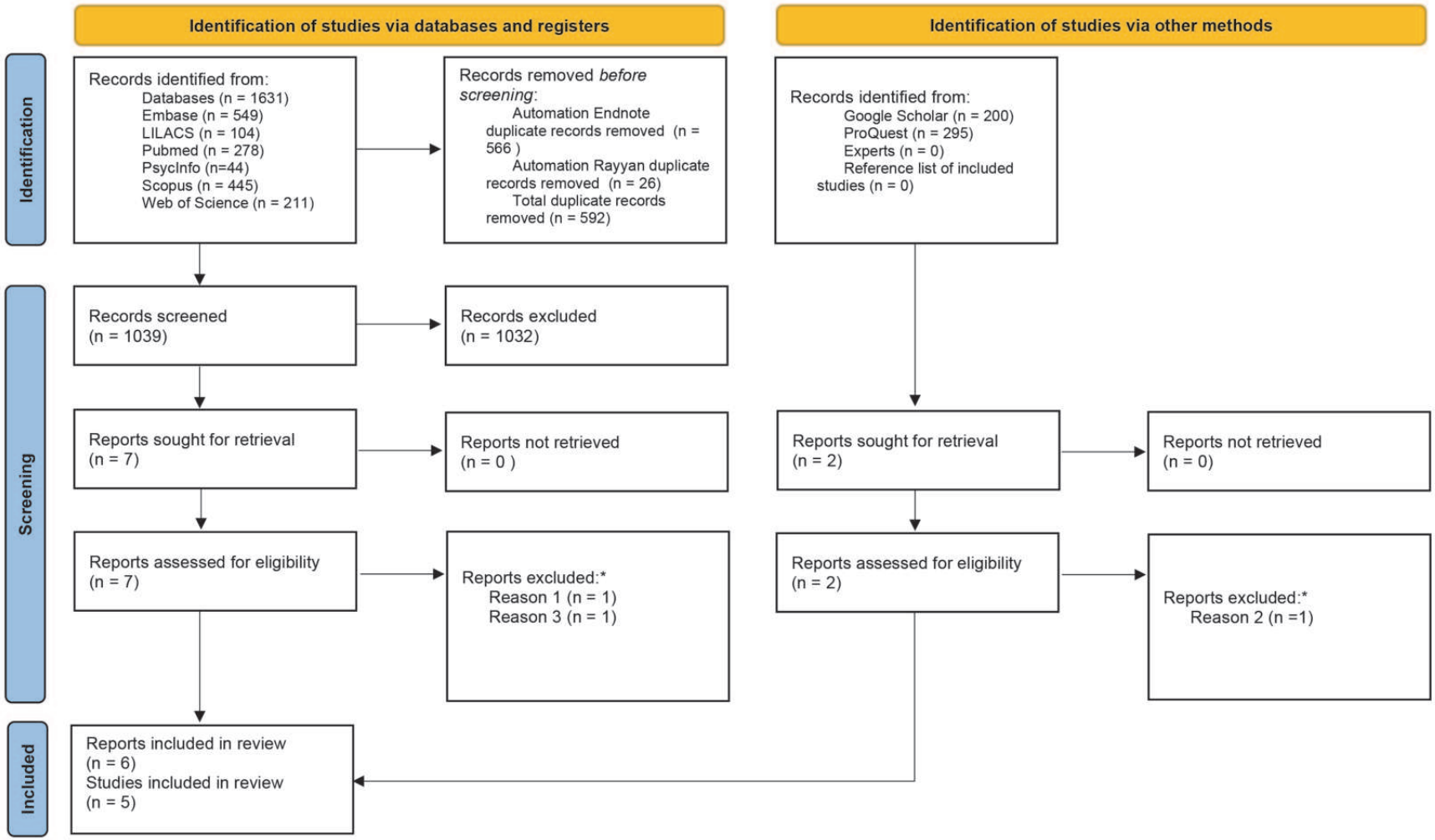
Table 1 summarises the main characteristics of the included studies. The data from the two cohort studies were combined as they were from the same population, and the table was organised in ascending order, with the studies that had no negative effect on OHRQoL at the top, divided according to the type of study[4,7,18,19] as suggested by SWiM.[13] The study by Li *et al*.[20] presented OHRQoL data combining the adult and adolescent samples, so the authors were contacted, and they sent the T1 (during the suspension of dental services within the data of adults and adolescents separated).

A total of 4085 children and adolescents were assessed for the OHRQoL outcome. The age range was reported in three studies, making it possible to calculate an average of 8.8 (±4.61) years. Two studies reported an age range of 14-18 years[20] and 10-15 years.[7]

The questionnaires used to assess OHRQoL were: the Arabic version of Child Oral Health Impact Profile (COHIP),[18] the 14-item Oral Health Impact Profile (OHIP-14),[20] Early childhood oral health impact scale 13a (ECOHIS)[4] and PedsQL Oral Health Scale[19] for cross-sectional studies and the short form of the Child Perceptions Questionnaire 11–14 (CPQ11-14)[7,17] for the cohort study.

In all included studies, dental care was suspended due to the COVID-19 pandemic. Consequently, the OHRQoL questionnaires were administered before and after the implementation of restrictive measures due to the pandemic. AlHayyan *et al.*[18] conducted their study on patients who had previously visited the clinic before March 2020 and returned after pandemic restrictions, coinciding with the onset of the Omicron variant, after the first wave of COVID-19. Li *et al*.[20] administered the questionnaire online for data collection, while Tofangchiha *et al*.[19] collected data via an online platform facilitated by schools during the study period. Samuel *et al*.[4] conducted their study by administering the questionnaire to parents and children visiting the Dental Institute when other services were not available. Knorst et al.[7] and Pohl *et al*.[17] initiated their study in December 2019 but had to suspend it due to the pandemic. As a result, telephone calls were used for follow-up.

Figure 1: *PRISMA 2020 flow diagram*



*Note: *Exclusion criteria: (1) Performed the Health-Related Quality of Life (HRQoL) assessment. (2) No validated questionnaire for Oral Health-Related Quality of Life (OHRQoL). (3) Mathematical model analysis simulating a situation of decline in quality of life.*

Table 1 - Summary of descriptive characteristics of included articles.

Author, Year; Country Study design	Sampling strategy Data collection	Sample Size (female/ male)	Age group Age range (mean age ± SD) Skin color	Parents' educational level Parents' employment status	Who answered	Objectives	Point or Period of prevalence	OHRQoL – Questionnaire type Number of questions and domains Score interpretation	OHRQoL Overall Score Mean (SD) Domains Score Mean (SD)	Additional outcomes	OHRQoL results Interpretation Positive impact on OHRQoL (+) Negative impact on OHRQoL (-)	Additional Outcomes Interpretation	Conclusions
COHORT													
The higher the questionnaire score, the worse the oral health-related quality of life													
Knorst et al. 2021; Brazil and Pohl et al., 2024; Brazil *Cohort*	A random sample of children was selected in 15 basic healthunits in the city of Santa Maria, in 2010, when they were 1 to 5 years of age. Since then, these children have been periodically assessedfor oral health outcomes. T1: Data were collected by 12 trained interviewers at the schools or homes of the individuals. T2: The phone calls were made by 3 trained inter viewers T3: The phone calls were made by 3 trained interviewers	T1 (Baseline) 290 (Not informed) T2 (Follow up) 207 (99/108) T3 (Follow up) Total evaluated: 204 There was a sample loss between T2 and T3 of 25 adolescents, corresponding to 6.4% T1 + T2 + T3: 182 (88/94)	Age T2: Adolescents 10 -15 years 10–12 (100/ 207)13–15 (107/207) T3: The sample was balanced in relation to sex and skin color. Skin color T2:White (103/205) No-white (102/ 205) T3: The sample was balanced in relation to sex and skin color.	Parents' educational level T2: Maternal education = 8 years of formal education (145/201) < 8 years of formal education (56/201) T3: Maternal education = 8 years of formal education (47/177) < 8 years of formal education (130/177) Parents' employment status T2: Loss of employment No (140/207) Yes (54/207) Harmed (13/207) T3: Loss of employment No (118/182) Yes (64/182	School-age adolescent	Knorst et al. 2021 To evaluate theimmediate effect of the Covid-19 pandemic in adolescents' OHRQoL Pohl et al., 2024 To assess the temporal impact pattern of COVID-19 on the OHRQoL ofadolescents, considering animmediate and long-term evaluation after the start of this scenario.	T1: December 2019 to February 2020. T2: June and July 2020. T3: June and July 2021.	Short form of the Child Perceptions Questionnaire 11–14 (CPQ11-14) 16 questions Four domains: oral symptoms, functional limitations, social well-being, and emotional well-being. The final score is obtainedby the sum of all items and the total result ranges from 0to 64 points. The higher the score obtained, the worse theOHRQoL.	Knorst et al. 2021 CPQ11-14 score T1 Overall CPQ11-14 10.8 (±8.1) Oral symptoms 3.7 (±2.5) Functional limitations 2.7 (±2.8) Emotional well-being 2.6 (±3.3) Social well-being 1.6 (±2.3) T2 Overall CPQ11-14 7.7 (±7.5) Oral symptoms 3.2 (±2.5) Functional limitations 2.0 (±2.7) Emotional well-being 1.5 (±2.8) Social well-being 0.9 (±1.9) Pohl et al., 2024	Changes in overall CPQ 11–14 scores Social distancing High T1 10.5 (±8.4)T2 7.1 (±7.3) Middle/Low T111.4 (±7.3) T2 9.0 (±7.8) Loss of employment No T1 10.3 (±8.2) T2 6.9 (±7.2) Yes T111.0 (±7.1) T211.7 (±7.9) Harmed T114.3 (±9.4) T2 12.4 (±7.4)Changes in overall and specific-domain CPQ11-14 scores during the Covid-19 pandemic T2: Overall CPQ11-140.71 (0.66–	The higher the score obtained, the worse the OHRQoL. Knorst et al. 2021 T1- 10.8 (±8.1) T2- 7.7 (±7.5) All CPQ-14 scores (total and domains) were significantly lower after the beginning of the Covid-19 pandemic ($p < 0.01$), indicating a lower negative impact on OHRQoL. The overall CPQ11-14 presented a reduction in the means of approximately 29% (IRR 0.71; 95% CI	Knorst et al. 2021 Loss of 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. Social distancing	Knorst et al. 2021 Overall and specific domains CPQ-14 scores were significantly lower during the Brazilian Covid-19. This data demonstrated a decrease in the perception of oral health problems by adolescents over that period. Pohl et al., **2024** Our findings indicated that OHRQoL scores were significantly lower 3 months after the beginning of the pandemic in Brazil,

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COHORT													
The higher the questionnaire score, the worse the oral health-related quality of life													
—	—	—	—	—	—	—	—	T1Overall CPQ11-1411.0 (8.0)Oral symptoms 3.7 (2.5)Functional limitations 2.9 (2.8)Emotional well-being 2.7 (3.4)Social well-being 1.6 (2.3) T2Overall CPQ11-148.3 (7.8)Oral symptoms 3.3 (2.6)Functional limitations 2.2 (2.8)Emotional well-being 1.7 (3.0)Social well-being 1.0 (2.0)T3Overall CPQ11-1412.8 (8.8)Oral symptoms4.2 (2.5)Functional limitations2.9 (2.9)Emotional well-being3.6 (3.8)Social well-being2.1 (2.6)	T1 Overall CPQ11-14 11.0 (8.0) Oral symptoms 3.7 (2.5) Functional limitations 2.9 (2.8) Emotional well-being 2.7 (3.4) Social well-being 1.6 (2.3) T2 Overall CPQ11-14 8.3 (7.8) Oral symptoms 3.3 (2.6) Functional limitations 2.2 (2.8) Emotional well-being 1.7 (3.0) Social well-being 1.0 (2.0) T3 Overall CPQ11-14 12.8 (8.8)	0.75)Oral symptoms0.86 (0.77–0.95)Functional limitations0.73 (0.65–0.83)Emotional well-being0.57 (0.50–0.66)Social well-being0.56 (0.47–0.68) T3:Overall CPQ11-141.11 (1.05–1.17)Oral symptoms1.09 (0.99–1.20) Functional limitations 1.00 (0.90–1.13) Emotional well-being 1.25 (1.12–1.40) Social well-being1.17 (1.01–1.35)	0.67–0.76). 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. Pohl et al., 2024 T1- 11.0 (8.0) T2- 8.3 (7.8) T3-12.8 (8.8) The overall CPQ11-14 scores presented a mean reduction of about 24% from T1 to T2, and a relative increase of 16.3% from	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. Pohl et al., 2024 Loss of employment About 31.2% and 35.2% of the adolescents were from families whose members lost their jobs for the duration of the pandemic at	demonstrating a reduction in the negative perception of oral problems by adolescents in an immediate evaluation

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COHORT													
The higher the questionnaire score, the worse the oral health-related quality of life													
—	—	—	—	—	—	—	—	—	Oral symptoms 4.2 (2.5) Functional limitations 2.9 (2.9) Emotional well-being 3.6 (3.8) Social well-being 2.1 (2.6)	—	T1 to T3. All specific CPQ11-14 domain scores showed reduced means from T1 to T2, with the larger change observed in the emotional well-being domain. All domain-specific CPQ11-14 scores decreased at T3 compared to T1, except the functional limitations domain, which remained the same.	T2 and T3, respectively. Social distancing 64.8% of households were performing high social distancing at T2. However, high social distancing declined to 45% at T3.	—

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CROSS-SECTIONAL													
The higher the questionnaire score, the worse the oral health-related quality of life													
Li et al., 2023;China Cross-Secional	The study was performed at the orthodontic departmentof the Hospital of Stomatology, Guanghua School of Stomatology, Sun Yat-sen University. Assessments of OHRQoL wereconducted during the suspension of dental services (T1)andafter a year of dental service reinstatement (T2).	Total: 356 Adolescents: 90 Adults: 234 (Adolescents gender not informed)	Age 14-18 years old Skin Color Not informed	Not Informed	Adolescents	To assess the level of OHRQoL in orthodontic patientsusing OHIP-14 both during the suspension of dental servicesand after a year of dental service reinstatement.	March 2020 toSeptember 2020 and from March 2021 to September 2021.	Online questionnaire with four sections. Chinese version of OHIP-14 The frequency of oral problems described in the 14 items was respectively determined on a five-point Likert scale (0 = never, 1 = almost never, 2 = occasionally, 3 = quite often, 4 = very often). A total of seven domains were collected: functional limitation, physical pain,	T1 (Adolescents) OHIP-14 total score4.93 (± 4.63) Functional limitation 0.56 (±1.55)Physical pain1.03 (± 0.76) Psychological discomfort (0.79 ± 1.09)Physical disability 0.82 (± 1.07) Psychological disability 0.59 (± 0.75)Social disability 0.70 (± 1.02)Handicap 0.44 (± 1.02)	Fixed-appliance wearersshowed statistically significantly poorer OHRQoL comparedwith clear-aligner wearers (OR: 0.577, 95% CI: 0.345–0.965,p = 0.036).Those who less frequently brushed teeth or used dentalfloss or water flossers generally had poorer OHRQoL at T1 (toothbrushing, occasional vs more than twice: OR: 2.180, 95%CI: 1.291–3.680, p = 0.004; seldom vs more than twice: OR:3.545, 95% CI: 1.345–9.342, p = 0.010/	The higher the score obtained, the worse the OHRQoL. 4.93 (± 4.63) Negative impact of the suspension of dental services during COVID-19 on the OHRQoL in orthodontic patients in all the psychosocial domains	Fixed appliance wearers rather than clear-aligner wearers reported higher OHIP-14 scores in the physical pain, psychological discomfort, physical disability, psychological disability, social disability as well as handicap domains (p < 0.05). Clear-aligner wearers tended to more frequently brush their teeth and use dental floss or water flossers, and reported fewer	Negative impact of the suspension of dental services during COVID-19 on the OHRQoL Type of appliance, age, delays in follow-up visits and oral hygiene habits could be the associated factors for OHRQoL in orthodontic patients during the suspension of dental services.

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CROSS-SECTIONAL													
The higher the questionnaire score, the worse the oral health-related quality of life													
—	—	—	—	—	—	—	—	psychological discomfort, physical disability, psychological disability, social disability, and handicap. Higher scores represented poorer OHRQoL.	—	**Use of dental floss orwater flossers**, occasional vs always: OR: 1.861, 95% CI: 1.091–3.173, p =0.023; seldom vs more than twice: OR: 2.628, 95% CI:1.319–5.239, p = 0.006).	—	appliance-related problems, than did fixed-appliance wearers at T1 (p < 0.001, p = 0.031, p = 0.030).	—

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CROSS-SECTIONAL													
The higher the questionnaire score, the worse the oral health-related quality of life													
Samuel et al., 2020 India Cross-sectional	The study was conducted among parent–child dyads who visited a dental institute from March to June 2020 to manage their child's dental pain as dental services were not available elsewhere in the city. A convenience sampling was employed, and all parent–child visiting the centre were invited to participate.	222 (68/154)	Age Children 2-6 years 4.58 years (1.18) Skin Color Not informed	Parents 'educational level Not Informed Parents' employment status Almost 45% of the caregivers reported annual family income of less than four lakh rupees (5555.5 USD)	Children and Parents	Evaluated the impact of child's dental pain, parental distress, and parental fear of SARS-CoV-2 on the OHRQOL of 2- to 6-year-old children visiting emergency care in a tertiary dental institution during the COVID-19 pandemic in Chennai, India.	March to June 2020	Caregivers reported the impact of child's oral health on their child (child impact-9 item) and family (family impact-4 item) using early childhood oral health impact scale (ECOHIS-13a item). Four domains: symptoms, function, psychological, self-image/ social interaction ECOHIS-13 13 items and total result ranges from 0 to 52 points. Child impact ranges from 0 to 36 points Family impact ranges from 0 to 16 points Higher scores denoting a greater oral health impact and/or poorer OHRQoL.	ECOHIS-13Overall Score29.72 (±6.48) Child impact 20.25 (±4.28) Family impact 16) = 9.47 (±2.48)	Dental Pain of Children with Pieces of Hurt scale. Pain score 3.11 (±0.77) Fear of COVID With Fear of Covid scale FCV-19S (27.93 (±3.11) 64% had high fear of SARS-CoV-2 infection Parental distress 10.65 (±1.75)	All the variables (child's age, dmft score , pain score, fear of COVID-19, parental distress, gender, treatment provided, accompanying caregiver, annual family income) were significantly associated with OHRQOL, except child's age and gender.	Higher pain scores reported by the child increased the risk of poorer OHRQOL by almost two times (OR, 1.9; 95% CI 2.6-16.8). Greater parental distress (OR, 4.1; 95% CI, 1.3-12.7) and fear towards COVID-19 among parents were significantly increasedthe risk of poor OHRQOL of the child by almost four	Greater parental distress and fear of COVID-19 among caregivers, higher self-perceived dentalpain among children and caries experience was associatedwith poor OHRQOL of preschool children during the COVID-19 pandemic lockdown in South India.

Table 1 - Summary of descriptive characteristics of included articles.

Author, Year; Country Study design	Sampling strategy Data collection	Sample Size (female/ male)	Age group Age range (mean age ± SD) Skin color	Parents' educational level Parents' employment status	Who answered	Objectives	Point or Period of prevalence	OHRQoL – Questionnaire type Number of questions and domains Score interpretation	OHRQoL Overall Score Mean (SD) Domains Score Mean (SD)	Additional outcomes	OHRQoL results Interpretation Positive impact on OHRQoL (+) Negative impact on OHRQoL (-)	Additional Outcomes Interpretation	Conclusions
CROSS-SECTIONAL													
The higher the questionnaire score, the worse the oral health-related quality of life													
AlHayyan et al., 2023; Saudi Arabia and Kuwait Cross-Sectional	The participants were randomly collected from patients list of the pediatric dentistry clinic in Riyadh Elm University Hospital, Riyadh city, Saudi Arabia, and pediatric dentistry department at Al Jahra Specialized Dental Center (ASDC), Kuwait	Overall 756 (290/466) Riyadh 511 (220/291) Kuwait City 245 (70/175)	Age Children 5-9 years (6.8±1.3 years) Skin Color Not informed	Parents' educational level Not informed Parents' employment status Not informed	Parents	To compare the parentally reported OHRQoL of children aged 5–9 years old in two cites, Kuwait City and Riyadh (Saudi Arabia)	February to March 2022	Arabic version of Child Oral Health Impact Profile (COHIP). 34 questions Five domains: self-image, school environment, socioeconomic well-being, functional well-being, and oral symptoms. High COHIP scores reflect a positive OHRQoL, while lower scores reflect negative OHRQoL	COHIP score Kwait City Overall COHIP 51.88 (±1.07) Oral symptoms 13.17 (± 0.36) Functional well-being 6.62 (±0.29) Socioeconomic well-being 6.22 (±0.40) School environment 5.62 (±0.20) Self-image 20.24 (0.22) Riyadh Overall COHIP 49.71 (±0.79) Oral symptoms 13.05 (±0.27) Functional well-being 6.25 (±0.21) Socioeconomic well-being 5.49 (±0.27) School environment 5.41 (±0.15) Self-image 19.510.18	Gender differences in OHRQoL - Overall COHIP score Kuwait City Male 50.61 (±1.27) Female 55.06 (±1.93) p=0.030** Riyadh Male 50.43 (±1.05) Female 48.75 (±1.20) p=0.295** Differences significant at p<005.	It was observed higher mean scores of COHIP in Kuwait City than in Riyadh	Gender differences: There were no significant differences in overall scores in Riyadh. There were higher scores for females in Kuwait City in the self-image domain (0.019) but not in the other domains. Impact of age: It was observed that OHRQoL scores decreased with age in both Riyadh and Kuwait City.	The COVID-19 pandemic has impacted OHRQoL in both Kuwait and Saudi Arabia. There was a greater gender difference and age correlation of OHRQoL among the population studied in Kuwait City when compared to those in Riyadh.

Table 2 *– Risk of Bias assessed by the JBI Critical Appraisal tools - Checklist for Analytical Cross-Sectional Studies.*

Author, Year	Q1	Q2	Q3	Q4	Q5	Q6	Q 7	Q8
AlHayyan *et al.,* 2023	N	U	Y	Y	N	N	N	N
Li *et al.,* 2023	Y	Y	Y	U	N	N	Y	Y
Samuel *et al.,* 2020	Y	Y	Y	Y	N	N	Y	Y
Tofangchiha *et al.,* 2022	N	Y	Y	Y	N	N	Y	Y
Total % Y	50	75	100	75	0	0	75	75

Note: ***Q1-*** *Were the criteria for inclusion in the sample clearly defined?;* ***Q2-*** *Were the study subjects and the setting described in detail? ;* ***Q3-*** *Was the exposure measured in a valid and reliable way?;* ***Q4-*** *Were objective, standard criteria used for measurement of the condition?;* ***Q5-*** *Were confounding factors identified?;* ***Q6-*** *Were strategies to deal with confounding factors stated?;* ***Q7-*** *Were the outcomes measured in a valid and reliable way?;* ***Q8-*** *Was appropriate statistical analysis used?;* ***Y:*** *Yes,* ***N:*** *No,* ***U:*** *Unclear;* ***NA:*** *Not Applicable.*

Table 3 *– Risk of Bias assessed by the JBI Critical Appraisal tools - Checklist for Analytical Cohort Studies.*

Author, Year	Q1	Q2	Q3	Q4	Q5	Q6	Q 7	Q8	Q9	Q10	Q11
Knorst *et al.,* 2021 and Pohl *et al.,*2024	Y	Y	Y	U	U	Y	Y	Y	Y	U	Y

Note: ***Q1-*** *Were the two groups similar and recruited from the same population?;* ***Q2-*** *Were the exposures measured similarly to assign people to both exposed and unexposed groups?;* ***Q3-*** *Was the exposure measured in a valid and reliable way?;* ***Q4-*** *Were confounding factors identified?;* ***Q5-*** *Were strategies to deal with confounding factors stated?;* ***Q6-*** *Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?;* ***Q7-*** *Were the outcomes measured in a valid and reliable way?;* ***Q8-*** *Was the follow up time reported and sufficient to be long enough for outcomes to occur?;* ***Q9-*** *Was follow up complete, and if not, were the reasons to loss to follow up described and explored?;* ***Q10-*** *Were strategies to address incomplete follow up utilized?;* ***Q11****- Was appropriate statistical analysis used?;* ***Y:*** *Yes,* ***N:*** *No,* ***U:*** *Unclear;* ***NA:*** *Not Applicable.*

Risk of Bias

The risk of bias of each study is detailed in Tables 2 and 3, and the classification criteria previously defined by the systematic review team are presented in Supplementary Table 2 and Supplementary Table 3.

For cross-sectional studies (Table 2), only question 3 (Was the exposure measured in a valid and reliable way?) received all positive responses. Questions 5 (Were confounding factors identified?) and 6 (Were strategies to deal with confounding factors stated?) received no positive responses, indicating that all studies did not describe confounders and how they were managed.

For the cohort studies included (Table 3), there were eight positive responses, with unclear responses regarding confounders and strategies to deal with incomplete follow-up.

Synthesis of Results

When assessing OHRQoL, each study reported the minimum and maximum scores of the questionnaire used and presented the results as a mean. The studies had two different scoring styles: "the higher the questionnaire score, the worse the OHRQoL"[4,7,20] and "the higher the questionnaire score, the better the OHRQoL".[18,19]

Cohort study

The higher the questionnaire score, the worse the oral health-related quality of life

In Knorst *et al*.,[7] two assessment periods were conducted: T1 - from December 2019 to February 2020; and T2 - June and July 2020, during the pandemic. The data from the study by Pohl *et al.*[17] study combined all participants who completed the questionnaire at T1, T2 and T3 with a total of 182 participants. From T2 to T3 there was a sample loss of 25 adolescents, or 6.4%.

The CPQ11-14 questionnaire was applied to assess oral symptoms, functional limitations, social well-being, and emotional well-being, providing a final score derived from the sum of all items, ranging from 0 to 64 points. The overall mean CPQ11-14 scores decreased significantly (p<0.01) from T1 (10.8) to T2 (7.7). Moreover, all domains of the CPQ11-14 demonstrated a statistically significant decrease (p<0.01), indicating a lower negative effect. Adolescents who practiced low to moderate levels of social distancing exhibited higher overall scores (IRR 1.33, 95% CI 1.01-1.77) compared to those who practised high levels of social distancing, suggesting a potentially greater negative effect on their OHRQoL.

Considering the three times, when compared to T1, adolescents had 29% lower overall CPQ11-14 scores at T2 (IRR 0.71 95% CI 0.66–0.75) at T2 and 11% higher scores at T3 (IRR 1.11 95% CI 1.05–1 0.17).

Considering T1, T2 and T3, the overall CPQ11-14 scores showed a decrease of about 24% from T1 to T2 and an

increase of 16.3% from T1 to T3. All scores for the CPQ11-14 domains showed a decrease from T1 to T2, with the greatest change observed in the emotional well-being domain. All specific scores for the CPQ11-14 domains decreased in T3 compared to T1, except for the functional limitations' domain, which remained unchanged.

Cross-sectional studies

The higher the questionnaire score, the worse the oral health-related quality of life.

Li *et al*.[20] used the OHIP-14 questionnaire without reporting the maximum and minimum scores. However, the authors cited a related study in which the score ranged from 0 to 56.[21] This questionnaire assesses functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. The study revealed the mean total scores, illustrating differences in participants' scores between T1 and T2. Participants reported higher total scores at T1 (5.63 ±4.50) compared to T2 (3.73 ±1.76), signifying that OHRQoL was worse at T1 than at T2 (p<0.01). In the material provided by Li et al., [20] the mean overall score of the OHIP-14 at T1 for adolescents did not show a significant association, reporting a total score of 4.93 (p=0.025). Notably, only the "psychological discomfort" domain was affected in this group, revealing more substantial psychological discomfort in adults (1.32 ±1.58) compared to adolescents (0.79 ±1.09) (p<0.009).

In Samuel *et al*.,[4] the ECOHIS-13 questionnaire was used. This questionnaire comprises four descriptive domains within the child impact section: symptoms, function, psychological, and self-image/social interaction, with total scores ranging from 0 to 52.[22] The study reported an overall mean score of 29.72 (±6.48), with a maximum and minimum score of 18 and 42, respectively. Higher self-reported pain and caries experience among children, parental fear of SARS-CoV-2, and parental distress during the pandemic were found to be negatively associated with children's OHRQoL. The higher the questionnaire score, the better the oral health-related quality of life

In AlHayyan *et al*., [18] the Arabic version of the COHIP questionnaire was used. However, the study did not specify the minimum and maximum scores. To ascertain this information, a study validating the Arabic version of the COHIP was consulted.[23] This questionnaire assesses domains including self-image, school environment, socioeconomic well-being, functional well-being, and oral symptoms, with total OHRQoL scores ranging from 0 to 136.[23] The study compared two cities, Riyadh and Kuwait City, with reported mean scores of 41.79 and 51.88, respectively. Analysis showed a significant difference between the two cities in the self-image domain (p=0.01). However, the other domains did not show statistical significance in the comparison.

In Tofangchiha *et al*.,[19] the PedsQL Oral Health Scale was used, with total scores ranging from 0 to 100. This scale assesses domains including physical functioning, emotional functioning, social functioning, and school functioning.[24] The study reported an overall mean score of 73.44 (±27.54). It revealed a negative association between the PedsQL Oral Health Scale scores and factors such as dental anxiety, fear of COVID-19, depression, anxiety, and stress.

Associated factors (secondary outcomes)

Fear of COVID-19 measures

Fear of COVID-19 was not measured in the included cohort study. Two of cross-sectional studies,[4,19] the Fear of COVID-19 Scale (FCV-19S) questionnaire was utilized to measure the fear of COVID-19. This questionnaire consists of seven items that evaluate feelings of fear, discomfort in thinking about, and concern regarding COVID-19. Total scores on this scale range from 7 to 35, with higher scores indicating greater levels of anxiety associated with COVID-19.

In Samuel *et al*.,[4] fear of COVID-19 among parents was linked to a nearly fourfold increase in the risk of the child having poor OHRQoL compared to parents with a lower fear of COVID-19 (OR 3.8; 95% CI 1.1-13.0). In Tofangchiha et al. [19] fear of COVID-19 was significantly associated with several factors: dental anxiety (B = 0.316; bias corrected bootstrapping 95% CI = 0.282, 0.349), depression (B = 0.302; bias-corrected bootstrapping 95% CI = 0.259, 0.347), stress (B = 0.282; bias-corrected bootstrapping 95% CI = 0.237, 0.328) and OHRQoL (B = -0.354; bias-corrected bootstrapping 95% CI = -0.530, -0.183).

Parents' employment and parents 'educational level

The expected association could not be made due to the difference in the data presented. Regarding the cohort study, Knorst *et al*.[7] presented parental employment and found that OHRQoL was significantly worse in adolescents whose families lost employment due to the COVID-19 pandemic (IRR 2.18; 95% CI 1.27-3,72). Knorst et al.[7] also presented the parental education and found that most mothers in the sample had more than 8 years of education (72.1%), but no association was found with changes in total CPQ11-14 scores during the COVID-19 pandemic in Brazil. Considering the data presented by Pohl *et al*., 2024, regarding parents' employment, 31.2% and 35.2% of adolescents were from families where members lost their jobs at T2 and T3, respectively. The educational level of the parents remained the same at T1, T2 and T3.

In cross-sectional studies, Li *et al*.[20] demonstrated the years of schooling based on a prevalence, in which the majority (58%) had college followed by senior high school

(21.6%). The work situation was equivalent to working outside the home (21.9%), working or studying at home (61.4%) and not yet working or studying (16.7%). Both data were available with adults and adolescents grouped together, making extraction impossible.

Parental education was presented by Tofangchiha *et al*.[19] as an average (fathers' years of education - 10.22 ± 5.30 and mothers' years of education - 8.23 ± 5.37), but no association was made.

Access to dental attendance during lockdown

None of the studies collected information on the sample's search for dental care during the COVID-19 pandemic. Therefore, it was also not possible to make an association with the data extracted from the included studies.

However, two cross-sectional studies collected data from the last dental visit[19,20]. Li *et al*.[20] presented the data by logistic regression and with data from adults and adolescents together and showed that adults with shorter follow-up achieved a worsening of OHRQoL at T1 (15 to 20 weeks versus 12 to 15 weeks, p=0.021; more than 20 weeks versus 12 to 15 weeks, p=0.001. Tofangchiha *et al*.[19] presented data as a percentage, with the majority not having visited the dentist for 1-2 years (28%).

DISCUSSION

This systematic review set out to assess the effect on the OHRQoL of children and adolescents during the COVID-19 pandemic. The primary hypothesis was that there would be a decrease in OHRQoL due to lack of dental care and pandemic-related restrictions. However, our comprehensive findings suggest that it is inconclusive to state definitively whether the COVID-19 pandemic had a negative effect on OHRQoL.

Recognising the potential impact of COVID-19 on perceptions of oral health is significant. Now that the pandemic is officially over, it allows appropriate guidance to be given to children and adolescents returning for dental assessment and treatment based on their individual needs, fears and perceptions. Numerous questionnaires are available to assess the OHRQoL, and for this review, studies using validated questionnaires were included. However, it should be noted that each included study used a different assessment tool, making it difficult to group results. Nevertheless, there were some methodological flaws, and three studies reported the scores obtained from the questionnaires, but the result was given by comparison [18] and association [4,19] which was a limitation to understanding the conclusions of the included studies. However, the total score was extracted to analyse the effect of each.

Li *et al*.[20] highlighted a negative impact on psychological domains compared to adults. Combining adolescents and adults in the study might pose a methodological flaw for our review due to the challenges in data extraction. The authors presented separate data for adolescents and adults. However, the overall result encompassed an analysis of both groups, indicating no statistical difference. Consequently, the reliability of the results may be compromised, given that the participants spanned ages from 14 to over 18 years old (without specifying an upper age limit). It is crucial to note that these age groups represent distinct life stages, particularly in social and psychological aspects. The study's findings indicate a negative impact of suspended dental services during COVID-19 on OHRQoL concerning psychosocial domains. Nevertheless, the study lacks additional data beyond the comparison of adults with adolescents.

AlHayyan *et al*.[18] demonstrated that the COVID-19 pandemic affected OHRQoL in both Kuwait and Saudi Arabia, yet without providing a thorough explanation for the observed negative effect. Notably, when comparing the two cities, a negative effect was observed in only one domain. This discrepancy may be attributed to the cultural similarities between the two countries.

Tofangchiha *et al*.[19] established associations wherein OHRQoL exhibited negative association with dental anxiety, fear of COVID, and depression. The authors explained that dental anxiety can significantly influence self-perception of general well-being, which may be related to depression and stress. Alternatively, the results could imply that heightened levels of dental anxiety coupled with difficulties in seeking dental care during the pandemic might have contributed to various psychological issues. From the proposed analysis, it can be inferred that a negative effect ensued. Samuel *et al*.[4] found an overall questionnaire result indicating a negative effect. As previously mentioned, this study primarily focused on associations to assess the effect on OHRQoL. It reported that self-reported pain, experience with dental caries (cavities), fear of SARS-CoV-2, and parental distress were associated with low OHRQoL, although not as a comprehensive outcome.

Knorst *et al*.[7] and Pohl *et al*.[17] were the most appropriate studies with comprehensive reporting of questionnaire results. The assessment before the onset of COVID-19 (T1) and after 3 months (T2) can be considered as a short-term effect. All domains exhibited lower scores after the onset of COVID-19, indicating a low negative effect. After a thorough examination of the full texts and evaluation of the results, a hypothesis emerges suggesting that the COVID-19 pandemic may have affected children's and adolescents' perceptions of oral health. This suggests that they might

have become more complacent regarding their oral hygiene without regular, which reinforces the importance of prevention and treatment. Consequently, this lack of attention could exacerbate OHRQoL issues such as pain, eating difficulties, and sensitivity, among others. However, it is essential to consider that some aspects evaluated by the questionnaire rely on daily social interactions, which were disrupted due to pandemic restrictions and mask mandates. This introduces a further hypothesis that children and adolescents may not have been fully aware of the extent of their oral health problems, potentially minimising the impact on their OHRQoL.

The long-term impact assessed at T3 by Pohl *et al*.[17] show an increase in CPQ11-14 scores between T1 and T3, reflecting a worsening of the OHRQoL. This pattern of decrease followed by an increase in OHRQoL scores was also evident in the emotional and social well-being domains. This characteristic can be justified by the decrease in the availability of public and private dental care in Brazil.

Despite the attempt to answer the main question, it should be noted that it is not possible to separate the results by domain and it is still difficult to define the effect of OHRQoL during COVID-19 using the results of each questionnaire.

The results should be interpreted cautiously due to methodological inconsistencies among the included studies, as well as variations in sample sizes and study locations. Furthermore, the studies had several methodological limitations. It is important to note that, because these are observational studies, it is not possible to establish a cause-and-effect relationship—only associations between variables, which may be influenced by external factors. In addition, the studies lacked clear descriptions of the questionnaires used and had a low number of positive ratings in the risk of bias assessment. These issues were further compounded by the difficulties of conducting in-person research during the pandemic.

CONCLUSION

The data were insufficient to determine the impact of the COVID-19 pandemic on the Oral Health-Related Quality of Life (OHRQoL) of children and adolescents. Attempts to establish associations between OHRQoL and factors such as fear of COVID-19, parents' employment, parents' educational level, and access to dental care during lockdown faced obstacles due to disparities in the results of the included studies. Reaching more definitive conclusions would require additional research using standardized questionnaires and improved methodological approaches.

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