

# Child Oral Health Impact Profile Questionnaire: A Reliability Generalization Meta-analysis of Cronbach's Alpha

Kalyana C Pentapati<sup>1</sup>, Deepika Chenna<sup>2</sup>, Vijay S Kumar<sup>3</sup>, Nanditha Kumar<sup>4</sup>, Saurabh Kumar<sup>5</sup>

## ABSTRACT

**Background and aim:** To evaluate the pooled estimates of Cronbach's alpha for the Child Oral Health Impact Profile (COHIP) questionnaire using reliability generalization meta-analysis.

**Methods:** We have conducted a systematic search of literature from PubMed, Scopus, Excerpta Medica Database (EMBASE), and Cumulative Index to Nursing and Allied Health Literature (CINAHL) from inception till 31<sup>st</sup> May 2023. Studies in English and those that have reported Cronbach's alpha for the COHIP questionnaire were included. Screening was performed by two review authors independently. Information on authors, year, country, sample size, age, sex, target population, language and mode of administration, conditions studied for, study setting, and study design were recorded. The risk of bias was assessed using the CONsensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist for internal consistency. Meta-analysis was performed using the random effects model to derive a pooled estimate of Cronbach's alpha.

**Results:** A total of 626 studies were available for title and abstract screening after the removal of duplicates, and 106 studies were included for full text screening. A total of 25 estimates were obtained from 22 studies which yielded a total sample size of 10,639. The overall pooled Cronbach's alpha was 0.87 (95% CI = 0.85–0.88) with a high heterogeneity among the included publications ( $I^2 = 95.74\%$ ). Similarly, the parent or the caregiver reported COHIP also showed pooled Cronbach's alpha of 0.9 (95% CI: 0.87–0.93). Meta-regression showed no significant effect of sex (coefficient:  $-0.12$ ), age (coefficient:  $-0.007$ ), language (coefficient:  $0.003$ ), study setting (coefficient:  $-0.001$ ), risk of bias (coefficient:  $-0.01$ ), and continent (coefficient:  $-0.04$ ) on the overall estimate.

**Conclusion:** The COHIP questionnaire showed good internal consistency and can be used in research and practice among children.

**Keywords:** Children, Child Oral Health Impact Profile, Cronbach's alpha, Oral health, Quality of life.

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## INTRODUCTION

"Oral Health-related Quality of Life" (OHRQoL) characterizes individuals' views on how oral health could affect their overall well-being and ability to perform daily activities.<sup>1</sup> OHRQoL assessment is considered an acceptable measure to evaluate the individual's well-being, and outcomes of oral health care programs. The improvement in the OHRQoL can also be used to assess the success of the interventions and public health activities. The tools that are used to assess the OHRQoL have many advantages: self-reported, readily available and accessible, easily understandable content, noninvasive, inexpensive, repeatable, valid, and reliable.

Many OHRQoL instruments like "Social impacts of dental disease," "Geriatric oral health assessment index," "Oral health impact profile," "dental impacts on daily living," and "oral impacts on daily performances" have been developed in the past.<sup>2</sup> These instruments have been validated among diverse populations, in different languages, across different age-groups, and among individuals having a variety of oral conditions. Questionnaires for children and adolescents have also been developed to evaluate the specific issues that arise during growth and development. They include the "Child Perception Questionnaire," "the Early Childhood Oral Health Impact Score," "Pediatric Oral Health-Related Quality of Life," "Child Oral Impacts on Daily Performances (C-OIDP)," and the "Child Oral Health Impact Profile (COHIP)." Most of these instruments are specific to certain age-groups while C-OIDP and COHIP can be used among children and adolescents.<sup>3</sup>

The COHIP questionnaire is a self- or parent/caregiver-reported 34-item questionnaire with five subscales ("oral health,"

<sup>1</sup>Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, India

<sup>2</sup>Department of Immunohematology and Blood Transfusion, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, India

<sup>3</sup>Department of Public Health Dentistry, Amrita School of Dentistry, Amrita Vishwa Vidyapeetham, Kochi, Kerala, India

<sup>4</sup>Department of Prosthodontics, JSS Dental College and Hospital, JSS Academy of Higher Education and Research, Mysuru, Karnataka, India

<sup>5</sup>Department of Pedodontics and Preventive Dentistry, Manipal College of Dental Sciences, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, India

**Corresponding Author:** Kalyana C Pentapati, Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, India, Phone: +91 9916036303, e-mail: kalyan.cp@manipal.edu

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"functional well-being," "social-emotional well-being," "school environment," and "self-image") which can be used among children and adolescents of 8–15 years with a variety of oral conditions

like caries,<sup>4-8</sup> malocclusion, overjet and orthodontic treatment need,<sup>5,9-12</sup> and craniofacial conditions.<sup>10,13-22</sup> The oral health subscale consists of 10 items on specific oral symptoms. The functional well-being subscale includes six items on the ability to carry out specific daily activities. Social-emotional well-being subscale has eight items related to peer interactions and mood states. The school environment incorporates four items on tasks connected with the school environment. The subscale on self-image consists of six items linked to positive feelings about self. The experiences of the participants over the past 3 months were recorded on a five-point Likert scale ("never," "almost never," "sometimes," "fairly often," and "almost all of the time"). The COHIP is a recently developed OHRQoL questionnaire and a refinement of the Child Perception Questionnaire. The COHIP questionnaire was used among diverse populations like dental out-patients,<sup>11,19,20</sup> orthodontic patients,<sup>9,10,23</sup> craniofacial conditions, and orofacial clefts,<sup>9,10,21,22,24</sup> cleft lip and palate patients,<sup>14-18</sup> and school children.<sup>4-8,10,12,24,25</sup> It has been validated in different languages like Amharic,<sup>17</sup> Arabic,<sup>18</sup> Chinese,<sup>22</sup> Dutch,<sup>11,13,14,23,24</sup> English,<sup>8-10,16</sup> French,<sup>7,9</sup> Hindi,<sup>25</sup> Italian,<sup>19,20</sup> Korean,<sup>5,12</sup> Malayalam,<sup>8</sup> Persian,<sup>4,6</sup> Spanish,<sup>9,10,16</sup> and Thai.<sup>17</sup> The internal consistency ranged between 0.79 and 0.98 for children and 0.83 and 0.96 for parents or caregivers reported COHIP.

Systematic reviews, reliability generalization (RG), and quality assessment reviews on various OHRQoL instruments conducted on children and adolescents exist in the literature.<sup>26-29</sup> However, there were no reports on the pooled estimates Cronbach's alpha of COHIP. Hence, we aimed to pool the estimates of Cronbach's alpha of the COHIP questionnaire using RG meta-analysis (MA).

## METHODS

This systematic review was reported as per the REliability GEneralization Meta-Analysis (REGEMA) guidelines.<sup>30</sup> The protocol was registered in international prospective register of systematic reviews (PROSPERO) (CRD42023439339).

### Search Strategy

We have conducted a systematic search of literature from "PubMed," "Scopus," "Excerpta Medica Database (EMBASE)," and "Cumulative Index to Nursing and Allied Health Literature (CINAHL)" from inception till 31<sup>st</sup> May 2023. A combination of search terms and free text were used ("Child Oral Health Impact Profile" or "COHIP" and "Child" or "Children" or "Adolescent").

### Inclusion and Exclusion Criteria

Studies in English and those that reported internal consistency of the COHIP questionnaire were included. Studies that were reported as letters, conference proceedings or abstracts, short communications, and commentaries were excluded. Studies that induced reliability were excluded.

### Screening

Search results were imported to Rayyan—a web-based tool (<https://rayyan.qcri.org/>). Screening of titles and abstracts was performed independently by two individuals (KCP and VK;  $\kappa = 0.9$ ). Eligible studies were screened for full text followed by data extraction by two individuals independently ( $\kappa = 0.93$ ). Data extraction included authors' names, year, country, and continent, total number of individuals, age, sex, language and mode of administration, conditions studied, study setting, study design, sampling, Cronbach's alpha, and the number of items in the

questionnaire. Any discrepancies between the reviewers were resolved by the third review author (CD). The quality assessment was done using the "Consensus-based Standards for the selection of health Measurement INstruments (COSMIN) risk of bias (RoB) tool" for internal consistency.<sup>31</sup> Studies were evaluated using questions related to design requirements and statistical methods rated on a four-point scale ("very good," "adequate," "doubtful," or "inadequate"). The overall score for quality assessment was obtained by worst score counts method.

### Statistical Analysis

Reliability generalization-meta-analysis was conducted using "Jamovi software" (version 1.2 <https://www.jamovi.org>).<sup>32</sup> Heterogeneity was assessed using  $I^2$  and  $Q$  statistics. Random effects model with restricted maximum likelihood method was used to pool the untransformed Cronbach's alpha. Subgroup analysis was performed based on the geographic location, study setting, language, and risk of bias. Egger's regression test and the funnel plot (x-axis Cronbach's alpha and y-axis inverse standard error) were used for the evaluation of publication bias. Moderator analysis was conducted using the mixed effects model.

## RESULTS

The search yielded a total of 1,274 studies from "PubMed" ( $n = 433$ ), "Scopus" ( $n = 350$ ), "EMBASE" ( $n = 437$ ), and "CINAHL" ( $n = 54$ ). After the removal of potential duplicates, 626 studies were available for the title and abstract screening. Overall, 106 studies were screened for full text, of which 28 had missing outcomes, 52 had used modified or shorter versions of the COHIP questionnaire, 3 were secondary data of prior publications, and 1 reported Cronbach's alpha for a pilot study. Overall, 22 studies were included for data extraction that yielded 25 estimates (Fig. 1).

The Cronbach's alpha for all the studies was above the accepted cutoff ( $>0.7$ ). Eight studies used parent or caregiver COHIP along with a self-reported COHIP questionnaire.<sup>10,13,14,17,20-23</sup>

### Age Distribution

The ages of the participants ranged from 7 to 18 years. Age range was not reported in three reports<sup>11,14,19</sup> and mean age was not reported in six reports (Table 1).<sup>4,8,13,15,18,25</sup>

### Sex Distribution

Only one study has not reported the male and female distribution.<sup>13</sup> A total of 5,370 males and 5,240 females were included in this review (Table 1).

### Study Setting and Design

All the included studies were cross-sectional and only nine studies were conducted in school or community settings.<sup>4-8,10,12,24,25</sup> The cumulative alpha for school or community-based settings was 0.87 (Table 2).

### Geographic Location

A total of nine studies were from Asia<sup>4-6,8,12,15,17,22,25</sup> and eight were from Europe,<sup>7,11,13,14,19,20,23,24</sup> and three were reported from North America.<sup>9,10,16</sup> The cumulative alpha for Asian, European, and North American studies were 0.863, 0.857, and 0.886, respectively (Table 2).

### Language

The COHIP questionnaire was translated into different languages like Amharic,<sup>17</sup> Arabic,<sup>18</sup> Chinese,<sup>22</sup> Dutch,<sup>11,13,14,23,24</sup> English,<sup>8-10,16</sup>

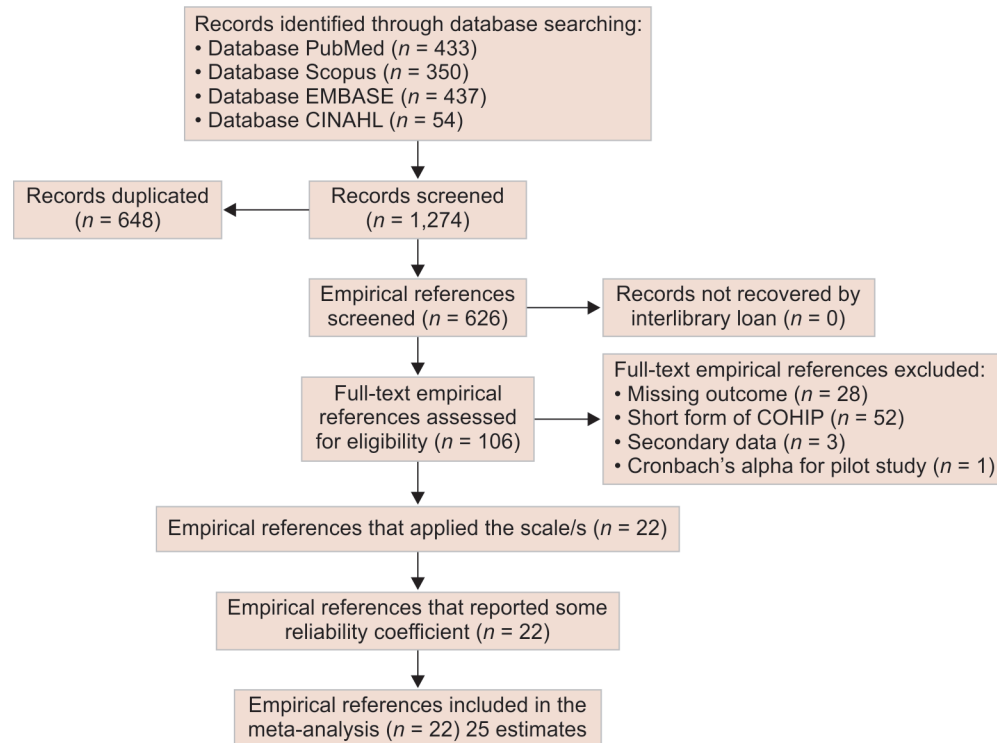


Fig. 1: REGEMA flowchart

Table 1: Characteristics of the included studies

Author	Continent	Sample size	Age	Male	Female	Language	Number of items	Child reported alpha	Parent or caregiver reported alpha	ROB
Broder et al.	NA	524	11.6 (1.6)	255	269	English, French, or Spanish	34	0.91		0
Geels et al.	Europe	498	10.99 (0.8)	250	248	Dutch	32	0.87		0
Geels et al.	Europe	29				Dutch	38	0.86	0.91	0
Bos et al.	Europe	182	12 (1.46)	91	91	Dutch	26	0.79	0.83	0
Ravahi et al.	Asia	234		105	129	Persian	34	0.9		1
Bos and Prahl	Europe	122	11.9 (2.2)	69	53	Dutch	29	0.81	0.88	0
Broder et al.	NA	205	11.8 (2.9)	113	92	English/Spanish	34	0.87		1
Broder et al.	NA	108	12.7 (2)	54	54	English/Spanish	34	0.86		1
Broder et al.	NA	863	11.9 (3)	467	396	English/Spanish	34	0.88	0.87	1
Ahn et al.	Asia	2,236	11.8 (2.5)	1,174	1,062	Korean	34	0.88		0
Asgari et al.	Asia	597	14.9 (1.2)	281	316	Persian	34	0.89		0
Eslami et al.	Asia	50		24	26		38	0.79		0
Broder et al.	NA	1,200	11.6 (3.1)	526	674	English/Spanish	34	0.89		0
Konan et al.	Asia	140	11.76 (2.29)	70	70	Thai	34	0.9	0.94	0
El et al.	Europe	236	12.02 (0.31)	106	130	French	34	0.88		0
Kragt et al.	Europe	243	11.6 (1.58), 12.1 (1.84)	121	122	Dutch	38	0.87		0
Kumar et al.	Asia	281		123	158	English, Malayalam	34	0.81		1
Abebe et al.	Africa	41	12.37 (2.5)	21	20	Amharic	38	0.979	0.958	0
Lin et al.	Asia	120	11.65	71	49	Chinese	31	0.85	0.9	0
Ali et al.	Africa	225		138	87	Arabic	34	0.81		0
Payak et al.	Asia	300		135	165	Hindi	34	0.81		1
Defabianis et al.	Europe	53	11.1 (2)	30	23	Italian	34	0.855	0.859	1
Defabianis et al.	Europe	71	11.91 (2.74)	40	31	Italian	34	0.861		1
Defabianis et al.	Europe	71	11.87 (2.65)	40	31	Italian	34	0.88		1
Kim et al.	Asia	2,010	11.9 (2.5)	1,066	944	Korean	34	0.88		1

French,<sup>79</sup> Hindi,<sup>25</sup> Italian,<sup>19,20</sup> Korean,<sup>5,12</sup> Malayalam,<sup>8</sup> Persian,<sup>4,6</sup> Spanish,<sup>9,10,16</sup> and Thai.<sup>17</sup> Studies reported in English showed a pooled estimate of 0.87 (Table 2).

### Risk of Bias

A total of 15 studies showed a low RoB ( $\alpha = 0.87$ )<sup>5-7,9,11,13-18,21-24</sup> and 7 studies ( $n = 10$  estimates) showed a high RoB ( $\alpha = 0.86$ ) (Tables 1 and 2).<sup>4,8,10,12,19,20,25</sup>

### Meta-analysis and Meta-regression

A total of 25 estimates were obtained from 22 studies which yielded a total sample size of 10,639 (sample size range: 29–2,236). The overall pooled Cronbach's alpha from the MA was 0.87 (95%

CI = 0.85–0.88) with a high heterogeneity ( $I^2 = 95.74\%$ ;  $Q = 496.9$ ) (Fig. 2). Similarly, the parent or the caregiver reported COHIP also showed pooled Cronbach's alpha of 0.9 (95% CI: 0.87–0.93;  $n = 8$ ;  $I^2 = 92.58\%$ ;  $Q = 105.46$ ). Meta-regression (using a mixed-method model) evaluated the potential role of moderators on the overall estimates. There was no significant effect of sex (coefficient:  $-0.12$ ; 95% CI:  $-0.48$  to  $0.24$ ), age (coefficient:  $-0.007$ ; 95% CI:  $-0.01$  to  $0.03$ ), language (coefficient:  $0.003$ ; 95% CI:  $-0.04$  to  $0.04$ ), study setting (coefficient:  $-0.001$ ; 95% CI:  $-0.04$  to  $0.03$ ), risk of bias (coefficient:  $-0.01$ ; 95% CI:  $-0.04$  to  $0.02$ ) and continent (coefficient:  $-0.04$ ; 95% CI:  $-0.1$  to  $0.02$ ) on the overall estimate (Table 3).

### Publication Bias

Publication bias using Egger's regression test showed statistical significance (coefficient =  $-3.79$ ;  $p < 0.001$ ). The funnel plot (x-axis Cronbach's alpha and y-axis inverse standard error) showed asymmetry (Fig. 3).

### DISCUSSION

Cronbach's alpha is one of the most popular and important tools to assess the internal consistency of a questionnaire and is

**Table 2:** Subgroup analysis of the cumulative Cronbach's alpha

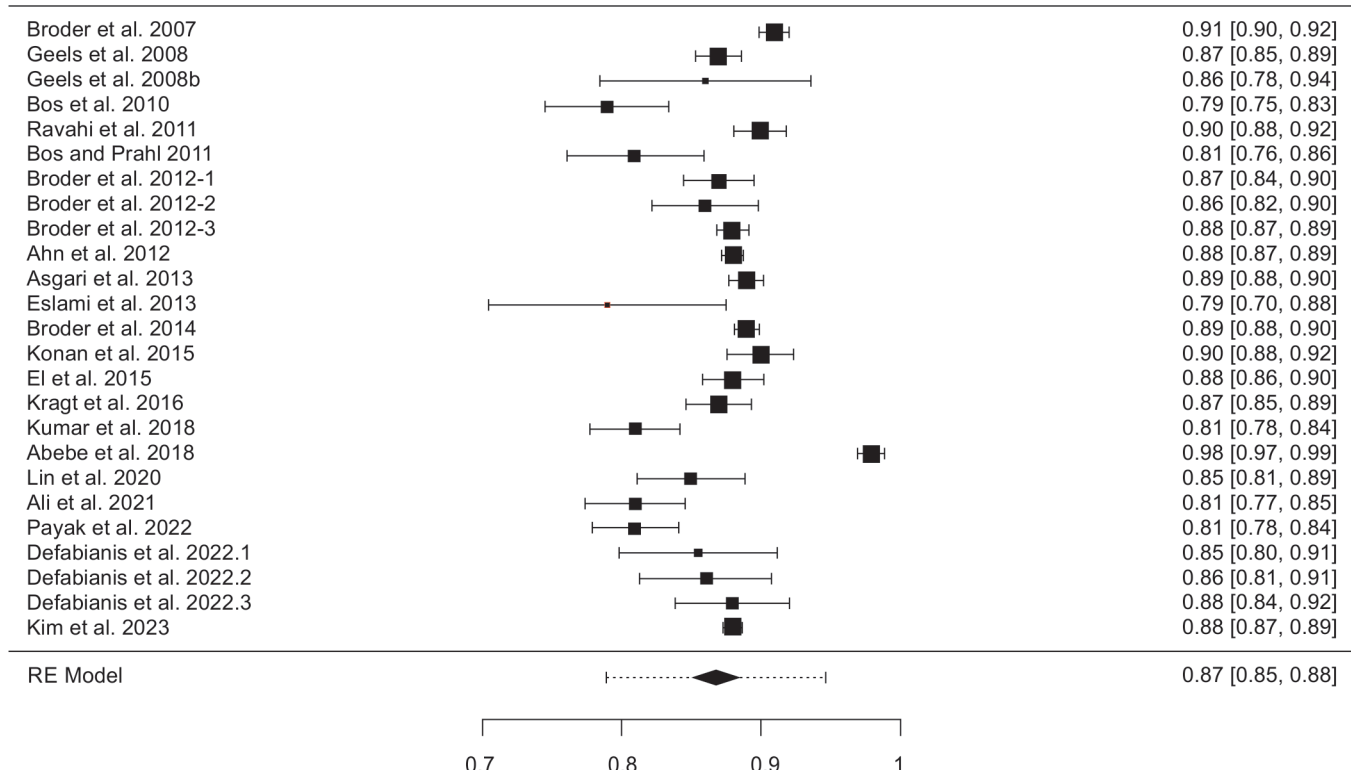
	N	Estimate	SE	95% CI
Continent				
Asia	9	0.863	0.0128	0.84–0.89
Europe	9	0.857	0.0102	0.837–0.88
North America	5	0.886	0.00806	0.87–0.9
Language				
Others	18	0.868	0.0106	0.85–0.89
English	6	0.873	0.0134	0.85–0.9
Study setting				
School or community	9	0.868	0.00990	0.85–0.89
Others	16	0.867	0.0125	0.84–0.89
Risk of bias				
High	10	0.863	0.00994	0.84–0.88
Low	15	0.870	0.0127	0.85–0.9

N, number of estimates; SE, standard error; CI, confidence interval

**Table 3:** Meta-regression using mixed model

	N	Coefficient	p-value	95% CI	R <sup>2</sup>
Sex <sup>†</sup>	24	$-0.12$	0.52	$-0.48$ to $0.24$	0
Mean age	19	0.01	0.53	$-0.01$ to $0.03$	0
Language	24	0.003	0.87	$-0.04$ to $0.04$	0
Study setting	25	0.001	0.95	$-0.04$ to $0.03$	0
Risk of bias	25	$-0.01$	0.56	$-0.04$ to $0.02$	0
Continent	25	$-0.04$	0.21	$-0.1$ to $0.02$	2.15

N, number of estimates; CI, confidence interval; <sup>†</sup>Proportion of males



**Fig. 2:** Forest plot showing the cumulative Cronbach's alpha

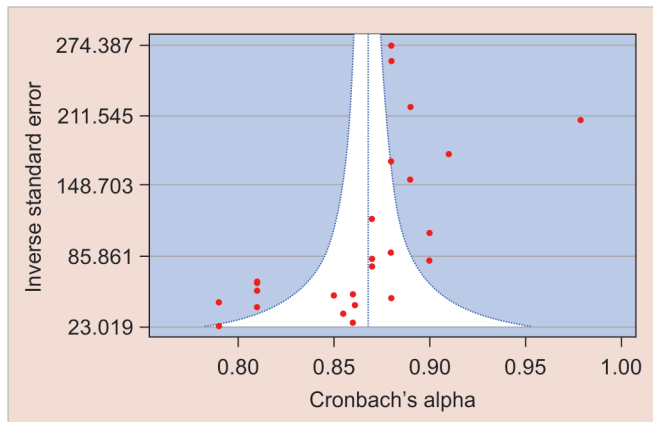


Fig. 3: Funnel plot for the assessment of publication bias

the most common metric used in psychometric research. It has gained popularity as it readily provides a reliability estimate of a questionnaire that has been administered once,<sup>33</sup> ease of availability in the statistical software, and a commonly taught method in academia. RG is a method to combine individual reliability estimates like Cronbach's alpha and helps us to understand the overall internal consistency of the questionnaire. Hence, in this meta-analysis, we used RG meta-analysis to understand the overall consistency of the COHIP questionnaire.

Meta-analysis showed that the cumulative Cronbach's alpha values of the self-reported COHIP (0.87) and parent or caregiver-reported COHIP (0.9) were much above the benchmark (0.7)<sup>34</sup> and can be graded as good to excellent based on the cutoffs provided by George and Mallery.<sup>35</sup> These values were higher than previously reported RG estimates of the C-OIDP questionnaire which is a similar OHRQoL instrument with a smaller number of items.<sup>29</sup>

The heterogeneity was high and the findings have to be interpreted with caution. Subgroup analysis was used to identify the potential sources of heterogeneity. It was seen that there was not much variation in Cronbach's alpha between the various subgroups when compared with the overall estimate. Meta-regression was conducted to evaluate the role of potential moderators that might influence the results. It was seen that none of the factors that were evaluated showed significant association.

Many studies were excluded due to the lack of reporting of Cronbach's alpha ( $n = 26$ ) which could have influenced the overall estimates. Future psychometric studies should report the findings based on the guidelines that incorporate the reporting of validity and reliability.<sup>36–38</sup> Further studies are needed to evaluate the validity, reliability, and temporal stability of COHIP questionnaires among diverse populations, oral conditions, and languages to better understand the psychometric properties. One of the limitations of this review was the exclusion of non-English articles. Within the limits of this review, the COHIP questionnaire showed good internal consistency and can be used in research and practice among children.

### Clinical Significance

The estimates of this meta-analysis can be helpful for researchers in selecting the choice of instruments, sample size calculations, and sources of measurement errors. It should be noted that Cronbach's alpha although popular may not be the best tool to identify measurement errors, transient errors, or rater-specific errors. Also, it is encouraged that authors report Cronbach's

alpha along with 95% confidence intervals or standard errors of their study rather than citing from previous research. The current estimate can be used as a benchmark for the reliability of the COHIP questionnaire for comparing estimates obtained in future studies. If the reliability estimates fall outside the confidence intervals, then there is a need to examine the interitem correlations and relevant moderation.

### AUTHOR CONTRIBUTIONS

Conceptualization: PKC, CD, SK, and NK; Screening: PKC, VSK, and SK; Data extraction: PKC and NK; Data analysis: PKC, CD; Initial draft: PKC, NK, SK, CD, and VSK; Final draft: PKC and CD.

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