A reliability generalization meta-analysis of Child Oral Impacts on Daily Performances (C – OIDP) questionnaire

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ABSTRACT

Aim: To evaluate the cumulative estimates of reliability and conduct reliability generalization meta-analysis of Cronbach's alpha for the Child Oral Impacts on Daily Performances (C-OIDP) questionnaire.
Methodology: Systematic search of four databases from inception to November 30th, 2019 was performed. Studies that reported Cronbach alpha for the C–OIDP were included. Cronbach's alpha for each publication was used for the meta-analysis. I^2 and Q statistics were calculated to assess heterogeneity. Meta-analysis was performed using a random-effects model to derive a pooled estimate of Cronbach's alpha.
Results: Out of 944 publications, data extraction was done from 33 publications after exclusion. The age range among the included publication was from 6 to 19 years. Cronbach's alpha ranged from 0.53 to 0.9. Majority of the publications (n = 21) reported alpha above the benchmark (0.7 and above). Only two publications used condition-specific C-OIDP questionnaires. Twelve publications used self-administered child-OIDP questionnaires. Most of the studies were at a low risk of bias (n = 29). The cumulative alpha was higher in publications with a low ROB (α = 0.74) than a moderate ROB (α = 0.65) The cumulative alpha was 0.73 (SE = 0.02) with a high heterogeneity among the included publications (I^2 = 99.28% and Q = 2048.68; P < 0.001).
Conclusion: Overall, the RG estimate of Cronbach's alpha for C-OIDP was above the widely accepted benchmark.

1. Introduction

Oral health is defined as a "standard of the oral tissues which contributes to overall physical, psychological and social well-being by enabling individuals to eat, communicate and socialize without discomfort, embarrassment or distress and which enables them to fully participate in their chosen social roles".[1]

Locker defined Oral health and subsequently introduced the concept of oral health-related quality of life (OHRQoL), which lead to the voluminous amount of research over the past few decades.[1,2] Oral health-related quality of life is defined as a "multidimensional concept that includes a subjective evaluation of the individual's oral health, functional well-being, expectations and satisfaction with care, and sense of self".[3] Over the last few decades, many questionnaires were developed to evaluate OHRQoL, which mainly focussed on adults and subsequently adapted to children and adolescents.

Oral conditions like caries, malocclusion, traumatic dental injuries, fluorosis can have a potential impact on OHRQoL among children and adolescents. There is a vast array of OHRQoL instruments made for use in children and adolescents. Such questionnaires are designed to be self-reported or interviewer-administered, condition-specific or generic, specific to age groups, etc. Many studies evaluated the validity and reliability across populations, disease conditions, cultures, and linguistic variations. One such measure which is commonly used in the literature to assess OHRQoL among children and adolescents is "Child Oral Impacts on Daily Performances" (C-OIDP).[4] It was based on the model of oral health consequence, which in turn was based on models of WHO and Locker.[1,5] It quantifies the impacts using frequency and severity and differs from the adult version in the recall period.

The C-OIDP is a self-administered questionnaire that measures the extent and impact of an individual's ability to perform regular physical, psychological and social activities that could be compromised due to poor oral health. Children were asked to assess any oral impacts in relation to the eight daily performances ("eating and enjoying food; speaking and pronouncing clearly; cleaning teeth; sleeping and relaxing; smiling; laughing and showing teeth without embarrassment;

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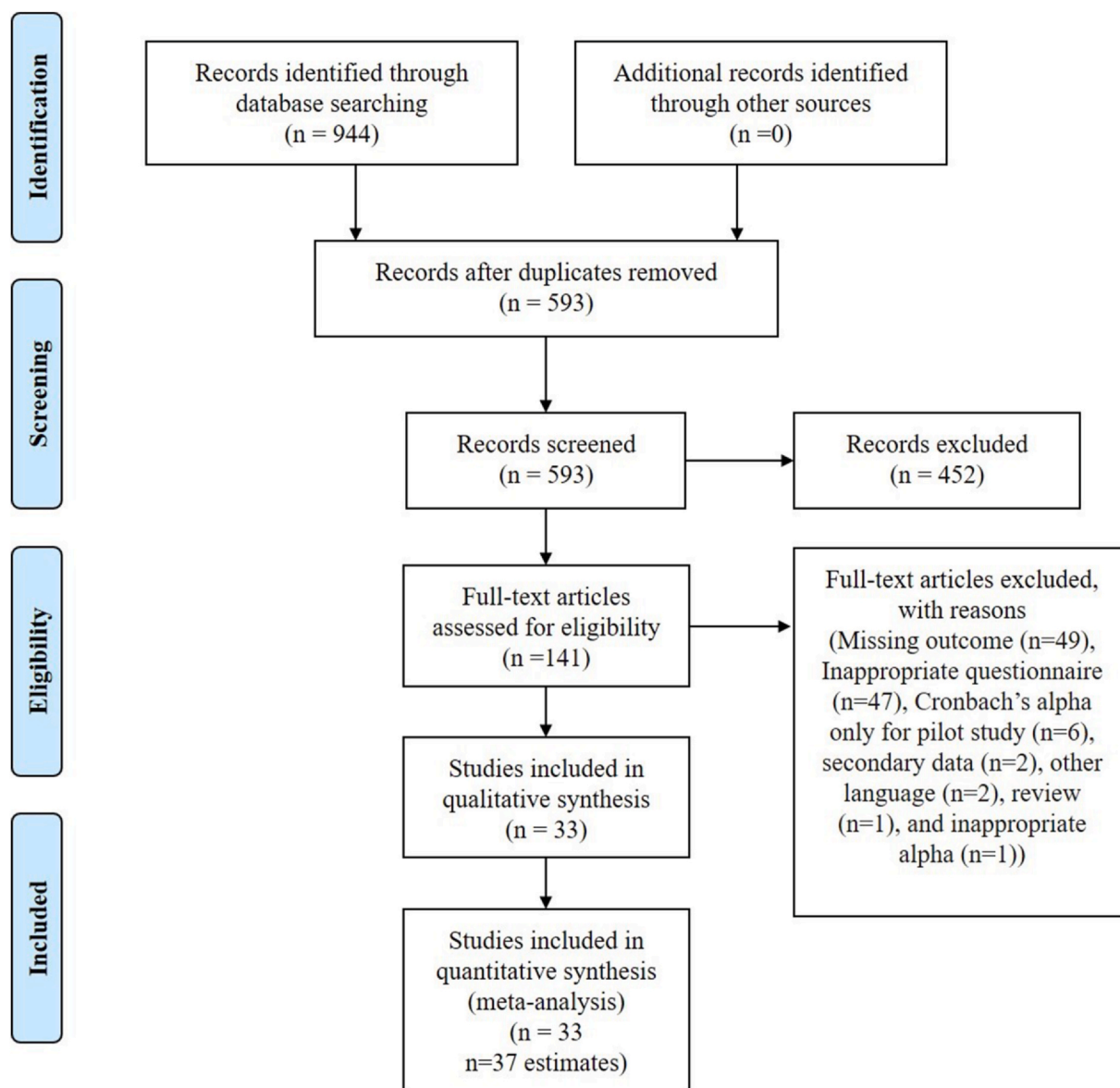
Fig. 1. Detailing of the publications as per the PRISMA guidelines.

maintaining usual emotional state without being irritable; study, including going to school and doing homework; and, enjoying contact with people") in the last three months on a Likert scale. Both the frequency and severity score can be calculated separately and multiplied for getting the total OIDP score.[4,6] C-OIDP was translated and adapted to many languages like Thai,[7] French,[8] Spanish,[9] Kiswahili,[10] Arabic,[11] Italian,[12] Brazilian,[13] Malay,[14] Hebrew,[15] Nepali,[16] Indonesian,[17] and Indian[18–21] (Hindi and Kannada) languages. Internal consistency (Cronbach's alpha) of the C-OIDP in the published studies ranged from 0.53 to 0.9.[18,22] Many studies used C-OIDP questionnaire and reported to be a valid and reliable tool to assess the OHRQoL.[4,8,10,15–18,21,23,24]

Systematic reviews, methodological quality assessment, and standardized comparisons of C-OIDP and other OHRQoL instruments specific for children and adolescents have been reported in the literature.[2,25–27] However, there was no systematic evaluation of the pooled estimates of the internal consistency reliability of C-OIDP.

Reliability generalization (RG) proposed by Vacha-Haase is the application of meta-analytical methods to explore the variability in the scores of reliability estimates of questionnaires.[28] It helps in characterizing the reliability coefficients and identifies the various characteristics of the studies that influenced the scales. It mainly helps in

estimating the average and variability of reliability coefficients and identify different associated study characteristics.

With this background, we aimed to evaluate the cumulative estimates of reliability and conduct reliability generalization meta-analysis of Cronbach's alpha for the Child Oral Impacts on Daily Performances (C – OIDP) questionnaire. We also aimed to investigate the various characteristics of the studies that might affect the reliability estimates.

2. Materials and methods

2.1. Selection criteria

Studies that reported Cronbach alpha for the C – OIDP questionnaire were included. Conference proceedings/abstracts, editorials, or letters and studies that reported Cronbach's alpha only for the pilot study were excluded.

2.2. Search strategy

A systematic search of four databases (Pubmed, Scopus, Embase, and CINAHL) from inception to November 30th, 2019 was performed

Table 1
Characteristics of the included studies.

Author and year	Alpha	N	Setting	Location	Mode of administration	ROB
Gherunpong et al., 2004[4]	0.65	1100	S	As	I	L
Tubert-Jeannin et al., 2005[8]	0.57	414	S	Eu	I	L
Yusuf et al., 2006[24]	0.58	228	S	Eu	I	L
Mtaya et al., 2007[10]	0.77	1601	S	Af	I	L
Bernabé et al., 2007[9]	0.62	805	S	SA	I	L
Castro et al., 2008[13]	0.63	342	S	SA	I	M
Tsakos et al., 2008[32]	0.54	72	O	Eu	I	M
	0.55	72			S	
Krisdapong et al., 2009[7]	0.67	1066	S	As	I	L
Mashoto et al., 2009[49]	0.85	837	S	Af	I	L
	0.84	908		Af		
Nurelhuda et al., 2010[11]	0.73	1109	S	Eu	I	L
Mashoto et al., 2010[50]	0.87	1768	S	Af	I	L
Mbawalla et al., 2010[33]	0.85	2412	S	Af	S	L
Bianco et al., 2010[12]	0.57	530	S	Eu	I	L
Rosel et al., 2010[22]	0.53	90	S	Eu	I	L
	0.53	87			S	
Cortés-Martinicorena et al., 2010[34]	0.68	425	S	Eu	S	L
Castro et al., 2011[44]	0.6	571	S	SA	I	L
Raymundo de Andrade et al., 2011[45]	0.65	59	O	SA	I	M
Yusof and Jaafar 2012[14]	0.8	132	S	As	S	M
Herkrath et al., 2013[31]	0.82	201	S	SA	I	L
Agrawal et al., 2013[20]	0.6	505	S	As	I	L
Pentapati et al., 2013[21]	0.88	359	O	As	S	L
Kushnir et al., 2013[15]	0.81	179	O	As	I	L
Carvalho et al., 2013[52]	0.7	300	S	SA	I	L
Basavaraj et al., 2014[19]	0.87	900	S	As	I	L
Vettore et al., 2016[42]	0.76	7208	S	SA	I	L
Åstrøm et al., 2016[36]	0.88	2412	S	Af	S	L
	0.88	1714				L
Duarte-Rodrigues et al., 2017[37]	0.79	300	S	SA	S	L
Singh et al., 2017[38]	0.86	423	S	As	S	L
Lazrak et al., 2017[23]	0.58	1064	S	Af	S	L
Saujanya et al., 2018[16]	0.75	1052	S	As	I	L
Arumrahayu et al., 2018[17]	0.72	502	S	As	S	L
Dhawan et al., 2019[18]	0.9	250	S	As	S	L
Kassim et al., 2019[51]	0.7	186	O	As	I	L

S: School/national survey; O: others; ROB: Risk of bias; L: Low risk; M: Moderate risk; I: Interviewer administered; S: self-administered; As: Asia; Af: Africa; SA: South America; Eu: Europe.

using keywords and free text words ("Oral impacts on daily performance" OR "OIDP" AND child OR children OR adolescents) along with limits like English publications. Title and abstract screening was performed in Rayyan website (https://rayyan.qcri.org/) by two review authors independently (PKC and HS) (Kappa = 0.95). Included publications were considered for full-text screening by two review authors (PKC and YSK) independently (Kappa = 0.93). The third review author clarified the discrepancies if any.

2.3. Evaluation of the risk of bias

All publications were subjected to risk of bias evaluation using a nine-item questionnaire.[29] The risk of bias questionnaire was assessed

Table 2
Subgroup analysis.

	Number of estimates	Number of studies	Estimate (95% CI)
Continent			
South America	8	8	0.7 (0.64–0.76)
Europe	9	7	0.60 (0.55–0.66)
Africa	8	6	0.82 (0.75–0.89)
Asia	12	12	0.77 (0.71–0.83)
Study setting			
School or national level survey	31	28	0.73 (0.69–0.77)
Others	6	5	0.71 (0.6–0.82)
Risk of Bias			
Low	32	29	0.74 (0.7–0.78)
Moderate	5	4	0.65 (0.55–0.75)

based on 9-itemed questionnaire which included questions on "representation of sample to the national population, true or close representation of sampling frame, random selection, non-response bias, data collection from subjects or proxy, use of acceptable case definition, reliability and validity of the study instrument, same method of data collection for all the subjects, appropriate use of numerator and denominator used for the parameter of interest." Each question was rated as low risk "0" and high risk as "1" and total score is calculated based on which the study was rated as low risk (0–3), moderate risk (4–6) and high risk of bias (7–9). Two reviewer authors (YSK and HS) have independently performed the assessment (ICC = 0.96), and discrepancies were clarified by a third review author.

2.4. Data extraction

Two review authors independently (YSK and PKC) extracted the data from all the publications, and discrepancies were clarified by a third review author. Reliability between the review authors was assessed using ICC for Cronbach alpha (0.99) and for age (1) and sex (1) and sample size (1). Variables included were age, gender, and geographic distribution, study setting (school/others), Cronbach's alpha, study design, type of administration (language, parent or child/self or interview administered/specific or generic), lowest and highest alpha for items in each study.

2.5. Statistical analysis

Cronbach's alpha for each publication was used for the meta-analysis. I^2 and Q statistics were calculated to assess heterogeneity. We used untransformed estimates of alpha, and inverse variance weighting. Meta-analysis was performed using a random-effects restricted maximum likelihood model to derive a pooled estimate of Cronbach's alpha and 95% confidence intervals. Mixed effect model was done to evaluate the role of moderator on the overall estimate of Cronbach's alpha. All the analysis was done using Jamovi software (Version 1.2 https://www.jamovi.org).[30] Sub-group analysis was performed as appropriate. Fail-Safe N analysis using the Rosenthal approach was used to assess the publication bias. The funnel plot was plotted using the coefficient of alpha on the x-axis and inverse standard error on the y-axis.

3. Results

We identified 944 publications from Pubmed (n = 288), Embase (n = 118), Scopus (n = 435) and CINAHL (n = 103) of which 593 publications were eligible for the title and abstract screening. A total of
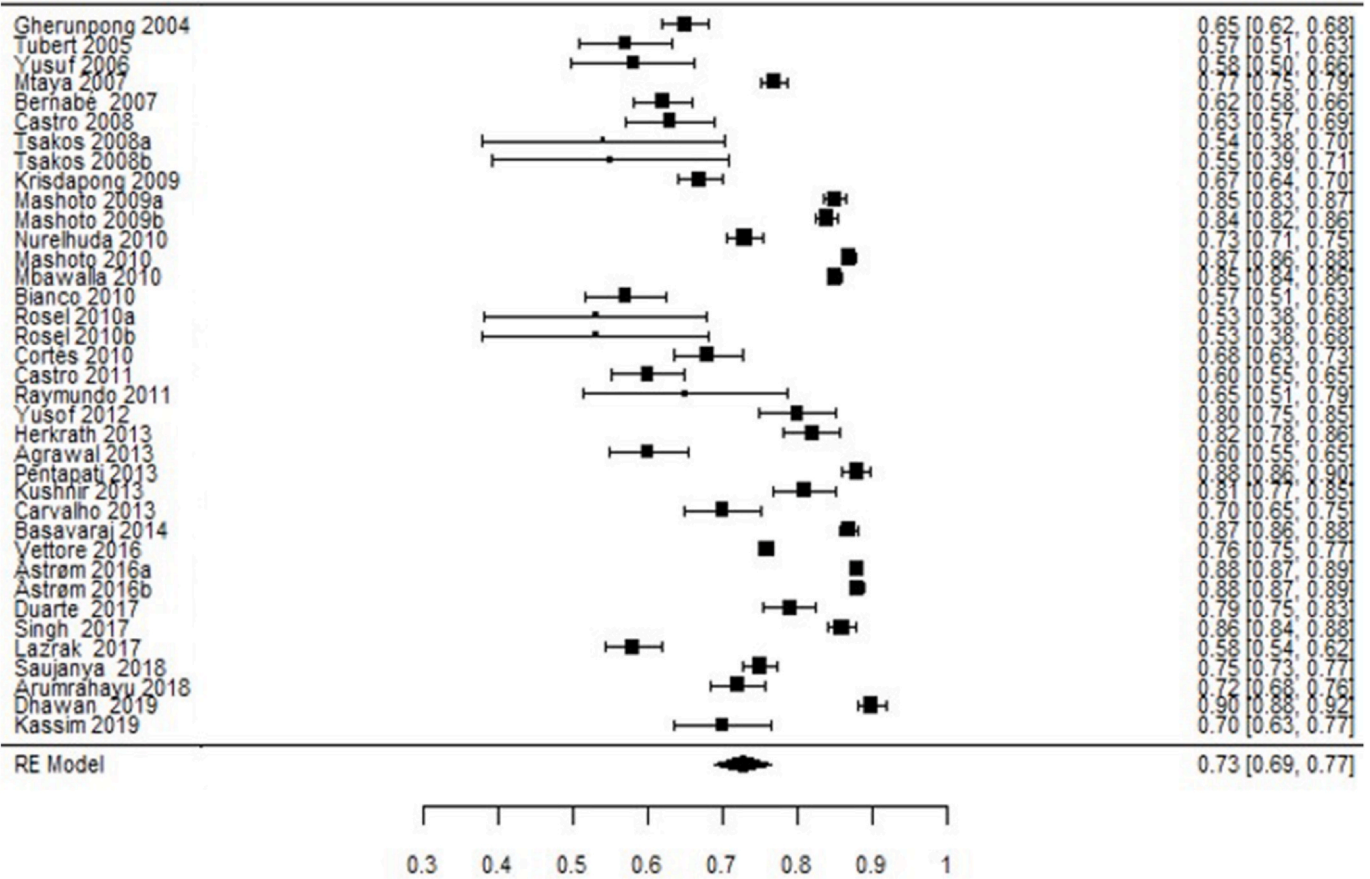
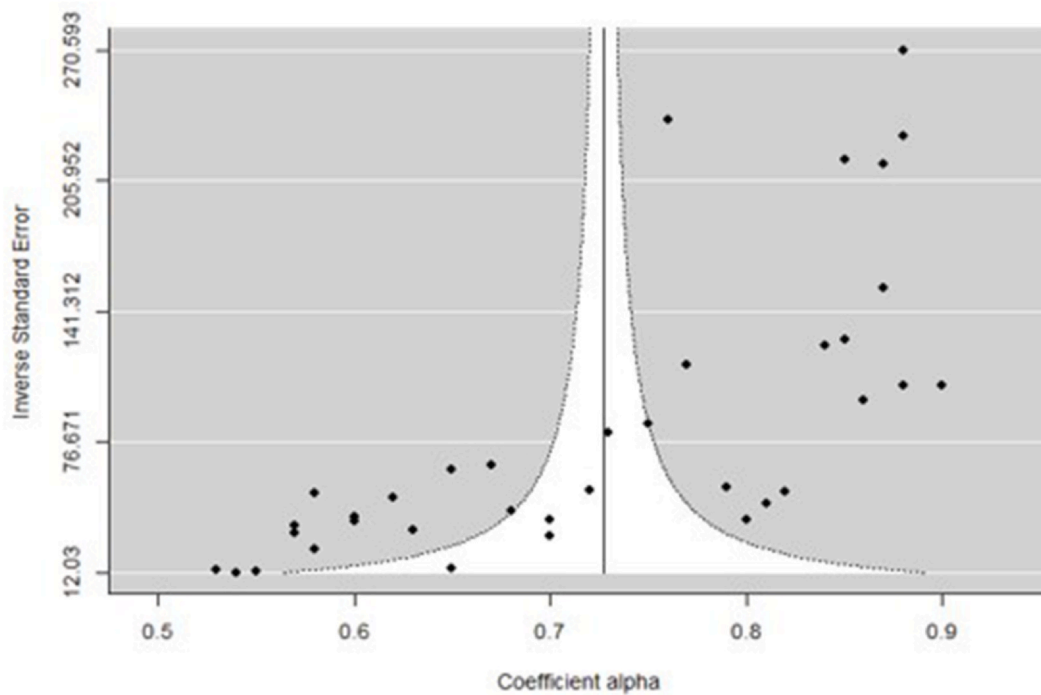**Fig. 2.** Forest plot for the reliability generalization of child-OIDP.

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

141 publications were included for full-text screening and 108 publications were excluded due to missing outcome (n = 49), adult OIDP questionnaire (n = 47), Cronbach's alpha only for the pilot study (n = 6), secondary data (n = 2), other languages (n = 2), review (n = 1), and inappropriate alpha (n = 1). Data extraction was done from 33 publications (Fig. 1).

The age range among the included publications was from 6 to 19 years. Only five publications did not report the distribution of gender. The sample size among the included publications ranged from 59 to 7208. Cronbach's alpha ranged from 0.53 to 0.9. The majority of the publications (n = 21) reported alpha above the benchmark (0.7 and above), and 12 publications reported 0.8 and above, and only one publication reported 0.9. Only two publications used condition-specific C-OIDP questionnaires.[9,31] Twelve publications used self-administered child-OIDP[14,17,18,21–23,32–34,36–38] questionnaires (see Table 1).

3.1. Study setting

A substantial number of studies were conducted in school settings or as part of the national surveys (n = 28) with a cumulative alpha of 0.73 (Table 2).

3.2. Geographic location

Majority of studies were reported from Asia (n = 12), followed by South America (n = 8), Europe (n = 7), with least being Africa (n = 6). The cumulative alpha was found to be highest among studies reported from Africa (α = 0.82) and least among studies from European countries (α = 0.6) (Table 2).

3.3. Risk of bias (RoB) assessment

Most of the studies were at a low RoB (n = 29). The cumulative alpha was higher in publications with a low RoB (α = 0.74) than a moderate RoB (α = 0.65) (Table 2).

Reliability generalization (meta-analysis of Cronbach's alpha coefficient and meta-regression):

The random-effects model was performed using a restricted Maximum-Likelihood method to calculate the cumulative estimates of Cronbach's alpha and confidence intervals. The number of participants in the included publications ranged from 59 to 7208 with 33 publications (37 estimates) of internal consistency with a combined sample size of 32, 183. The cumulative alpha was 0.73 (SE = 0.02) with a high heterogeneity among the included publications (I^2 = 99.28% and Q = 2048.68; P < 0.001) (Fig. 2). The funnel plot for the assessment of bias in publication showed asymmetry (P < 0.001) (Fig. 3).

Mixed model analysis was done using study setting, continent and RoB, age, and gender as the moderators. No significant effect was seen with study setting (Coefficient = 0.02; 95% CI: −0.09 – 0.13; R^2 = 0%), continent (Coefficient = 0.05; 95% CI: −0.04 – 0.13; R^2 = 37.59%), and RoB (Coefficient = −0.06; 95% CI: −0.19 – 0.07; R^2 = 0%). A total of 29 and 32 estimates reported the mean of age and gender distribution respectively which were used as a moderators. It was seen that age (coefficient = 0.03; 95% CI: 0.004–0.06; R^2 = 13.44%) and gender (coefficient = 0.496; 95% CI: 0.18–0.82; R^2 = 22.19%) have significant effect on the overall estimate.

4. Discussion

The coefficient of alpha is one of the essential and popular aspects of reliability assessment in psychometric research and a commonly reported method for indicating internal consistency. The popularity of the alpha could be attributed to its ability to provide estimates from a single questionnaire administered once,[39] a readily available tool in statistical software, and one or only reliability method taught to students.

RG is one of the accepted methods for combining the estimates of

alpha from multiple publications.[28] Our review used the RG method to calculate the cumulative reliability estimates of the child OIDP questionnaire. In general, the advantages of calculating the cumulative alpha help in understanding the integrity of the questionnaire and helps to quantify and predict the variance.

High heterogeneity was seen among the included publications, and results must be interpreted with caution. Overall, the RG estimate of Cronbach's alpha for C-OIDP was above the widely accepted benchmark (0.7).[40] Similar values of alpha were reported from national surveys.[7,42] George and Malley had provided multiple cut-off points with values < 0.5 is unacceptable, > 0.5 is poor, > 0.6 is questionable, > 0.7 is acceptable, > 0.8 is good and > 0.9 is excellent which also suggests that alpha values are acceptable when they were > 0.7.[43] There were no studies which reported alpha below < 0.5 and eight estimates from six publications had reported poor alpha values.[8,12,22–24,32] Eight publications showed values in the questionable category.[4,9,13,20,34,44,45,7]

A substantial number of publications have been excluded for the lack of reporting and clarity on the internal consistency coefficient (n = 49). STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement has not included the reporting of reliability and validity of the instruments or questionnaires used. Quality of reporting of the publications needs to be strengthened, and standard guidelines need to be developed and mandated concerning the reporting of questionnaire surveys. A systematic review of the reporting guidelines for survey research highlighted the deficiencies of STROBE guidelines. Few authors proposed reporting guidelines for surveys which incorporated the concepts of validity and reliability of the survey instruments.[46–48] Future research using questionnaires or surveys should incorporate these guidelines to improve the quality of reporting.

5. Conclusion

Our study highlights the inadequate reporting of the reliability coefficients in the published literature. Pooling of reliability estimates helps in understanding the psychometric properties of the questionnaire in diverse populations. It also helps in understanding the source of variation across studies. Overall, the pooled Cronbach's alpha for C-OIDP questionnaire yielded good reliability estimates. Age and gender have significant influence on the reliability estimates. Future studies should report reliability estimates when using questionnaires.

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