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Dental anxiety, child-oral health related quality of life and self-esteem in children and adolescents: a systematic review and meta-analysis

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Aim: To identify the directions, strength and associations between dental anxiety, COHRQoL and self-esteem in children and adolescents. ***Basic research design***: PRISMA guidelines were followed and the review registered (PROSPERO CRD42019140037). MEDLINE, Cochrane Library, Scopus, Science Direct, CINAHL, Joanna Briggs Institute (JBI), Grey Literature Report, and British Library EThOS using MeSH terms and keywords were searched. Three reviewers examined the abstracts of all articles, excluded duplicates and those not meeting inclusion criteria. All full-text papers were read by all reviewers. Meta-analysis association data including Pearson's or Spearman's correlation coefficient were extracted and effect sizes estimated. ***Results***: Twelve papers met the inclusion criteria, 7 assessed the relationship between child dental anxiety and COHRQoL; four between COHRQoL and self-esteem and one between child dental anxiety and self-esteem. Significant relationships were found between COHRQoL and the other child-related outcomes measures. An inverse relationship was shown for dental anxiety and COHRQoL. The meta-analysis found small associations between child dental anxiety and COHRQoL and moderate associations between COHRQoL and self-esteem. High heterogeneity between COHRQoL and self-esteem was noted. The association between child dental anxiety and self-esteem was limited. No source reported associations between all three variables. ***Conclusion***: The studies were of varying quality and the degree of heterogeneity meant that only limited conclusions were possible. There is a need for high-quality evidence to underpin intervention designs to promote COHRQoL and self-esteem to reduce child dental anxiety.

Keywords*: Self-esteem, Dental anxiety, Oral health-related quality of life, Child/adolescents*

Introduction

Research into child and adolescent quality of life has proposed that interventions promoting quality of life and self-esteem could potentially reduce social anxiety (Martinsen *et al.*, 2016; Sarı *et al.*, 2018; Stevanovic, 2013; Wu *et al.*, 2014; Pan *et al.*, 2018). Of importance was a cogent understanding of how child and adolescent quality of life, anxiety and self-esteem were inter-related. An appreciation of the complex nature of the interaction of quality of life with anxiety and self-esteem could inform successful intervention design to reduce anxiety in adolescents and children (Martinsen *et al.*, 2016).

Dental anxiety in children has been associated with emotional and social elements of oral health-related quality of life (OHRQoL) (Carrillo-Diaz *et al.*, 2013; Luoto *et al.*, 2009). Luoto et al (2009) questioned the complexity of the relationship of child oral health-related quality of life (COHRQoL) with treatment dental anxiety. They noted that the association was greater in children without experience of orthodontic treatment. Therefore, compared with adults (Carlsson *et al.*, 2015; McGrath and Bedi, 2004; Mehrstedt *et al.*, 2007; Ng and Leung, 2008), the interaction between dental anxiety and OHRQoL appeared to be more complex. Investigations of COHRQoL with self-esteem were limited to children receiving orthodontic treatment. This work showed negative associations between self-esteem and quality of life (Agou *et al.*, 2008; De Baets *et al.*, 2011). It also demonstrated that improved COHRQoL and self-esteem were directly related to positive treatment outcomes (Benson *et al.*, 2015). However, this did not illucidate the association for children and adolescents who had not received orthodontic treatment.

Previous research, therefore, has examined the complexities of child and adolescent quality of life, social anxiety and self-esteem and proposed that interventions that increase the quality of life and self-esteem could reduce social anxiety. It is possible that understanding the associations between child dental anxiety, COHRQoL and self-esteem could inform oral health interventions that promote COHRQoL and self-esteem and thereby reduce child dental anxiety.

As the first step in any intervention design, it is necessary, to examine the literature, using a systematic approach. Doing so, would allow the interaction between child dental anxiety, COHRQoL and self-esteem to be investigated and permit an examination of the direction and strength of their associations, that are vital in the process of intervention design. The aim of this study, therefore, was to identify the directions, strength and associations between dental anxiety, COHRQoL and self-esteem in children and adolescents.

Method

Following the PRISMA guidelines and registration of the protocol with PROSPERO (CRD42019140037), preliminary searches were conducted. The literature was scoped

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for associations between dental anxiety, COHRQoL and self-esteem in children and adolescents who were not receiving orthodontic treatment, orthognathic surgery, or general anaesthetic extractions for dental caries, to confirm the MeSH and search terms published in the protocol.

The search included the terms "OHRQoL", "dental anxiety ", "self-esteem" and "child" and was initiated in June 2019 and finished in April 2020 (Table 1). Eight databases, PubMed (MEDLINE), Cochrane Library, Scopus, Science Direct, CINAHL, Joanna Briggs Institute (JBI), Grey Literature Report, and the British Library EThOS service were searched electronically. Manual searches were conducted of the reference lists of all papers to identify other relevant articles. The search included articles written in English within the databases up to April 2020, filtered by age group (5 to 18 years OR child) and type of research (RCTs, meta-analyses, high powered cohort studies, cross-sectional and longitudinal studies).

Articles were screened in three phases. First, all records found through the database and hand searches were exported to Endnote and all duplicate records removed. The titles and abstracts were read by the first author (AA). Adult or child studies that did not include at least two of the child-related outcome measures were excluded in the first phase. Articles that met the eligibility criteria were included in the second phase (Table 2). This phase involved reading the title and abstracts of the included articles by the three authors independently. At this stage, studies with adolescents over 18 years, the use of inappropriate scales for children and/or adolescents to assess child dental anxiety, COHRQoL and self-esteem and, those articles which focused on physical or mental disability or investigated medically compromised children were excluded. The full texts of the included papers were retrieved and read by all three authors in the final phase.

Data were extracted from the included studies using a bespoke data collection form. The extracted data included the name of the first author, the year of publication, the population characteristics (number of children, gender percentage, age-range, mean age and standard deviation), the study setting, methodology (study design), child-related outcome measures, inventories used and the associations between child dental anxiety, COHRQoL and self-esteem. If outcome data required for the meta-analysis were missing or omitted, the authors of these articles were contacted and requests made for aggregated statistics.

The JBI critical appraisal tool (Moola *et al.*, 2020) was used to appraise the quality of all included reports. The tool has satisfactory validity and is easy to use in terms of application and time (Munn *et al.*, 2014). Study quality was independently assessed by the three authors. In the case of any disagreements arising from two of the reviewing authors, these were resolved by discussion, with the third to settle issues where necessary.

Quantitative data were extracted from each study and the effect size estimated with the assistance of the appropriate algorithms in the Comprehensive Meta-Analysis software (Borenstein, 2020). Suitable associations included Pearson's correlation coefficient, Spearman's correlation coefficient (a lower bound estimate of association), means and sample sizes of low/high-value groups, odds ratio and sample size, beta coefficient and raw regression coefficient with standard error. Random error overall effect size was calculated, including the heterogeneity statistic (I^2) to inspect the variability of effect sizes across studies. Reports that provided suitable correlation estimates between any two of the three child-related outcome measures, were transformed into effect sizes and inserted into the meta-analysis. If reports included in a meta-analysis were homogenous a fixed effects model was adopted. However, if the studies examined are found to be heterogeneous, a random effects model is recommended to allow for the wide variance of effect sizes. Funnel plots were inspected to assess publication bias.

Table 1. Search Strategy

Dental Anxiety OR (dent* AND (phob* OR fear)) AND "self-concept" OR "self-esteem" OR "self-image" / Self AND (concept OR esteem OR image)
"self-concept" OR "self-esteem" OR "self-image" / Self AND (concept OR esteem OR image) AND "quality of life" OR lifestyle OR OHRQoL OR "oral health-related quality of life"
Dental Anxiety OR (dent* AND (phob* OR fear)) AND "quality of life" OR lifestyle OR OHRQoL OR "oral health-related quality of life"

Results

Six hundred and sixty-nine records were identified. Forty-five articles met the initial eligibility criteria and 12 studies were finally included in the review (Figure 1). Of these 12, only 9 were included in the meta-analysis. A complete review of the 12 studies was conducted (Table 3).

Table 2. Inclusion and exclusion criteria

Inclusion criteria	Studies involving children and/or adolescents aged from 7 to 17 years;
	Studies assessing child oral health-related quality of life and/or;
	Studies assessing child dental anxiety and/or;
	Studies assessing self-esteem.
Exclusion criteria	Studies with those aged 18 years and over (adults)
	Studies using parental ratings of children's child dental anxiety, COHRQoL and self-esteem;
	Studies that involved children or adolescence with conditions that could modify the association between DA, SE and OHRQoL, such as; [i] Studies assessed OHRQoL and self-esteem in children and adolescents seeking or having orthodontic treatment
	[ii] Studies including children with any physical or mental disability or any known medical condition
	[iii] Studies including children having dental treatment under general anaesthesia

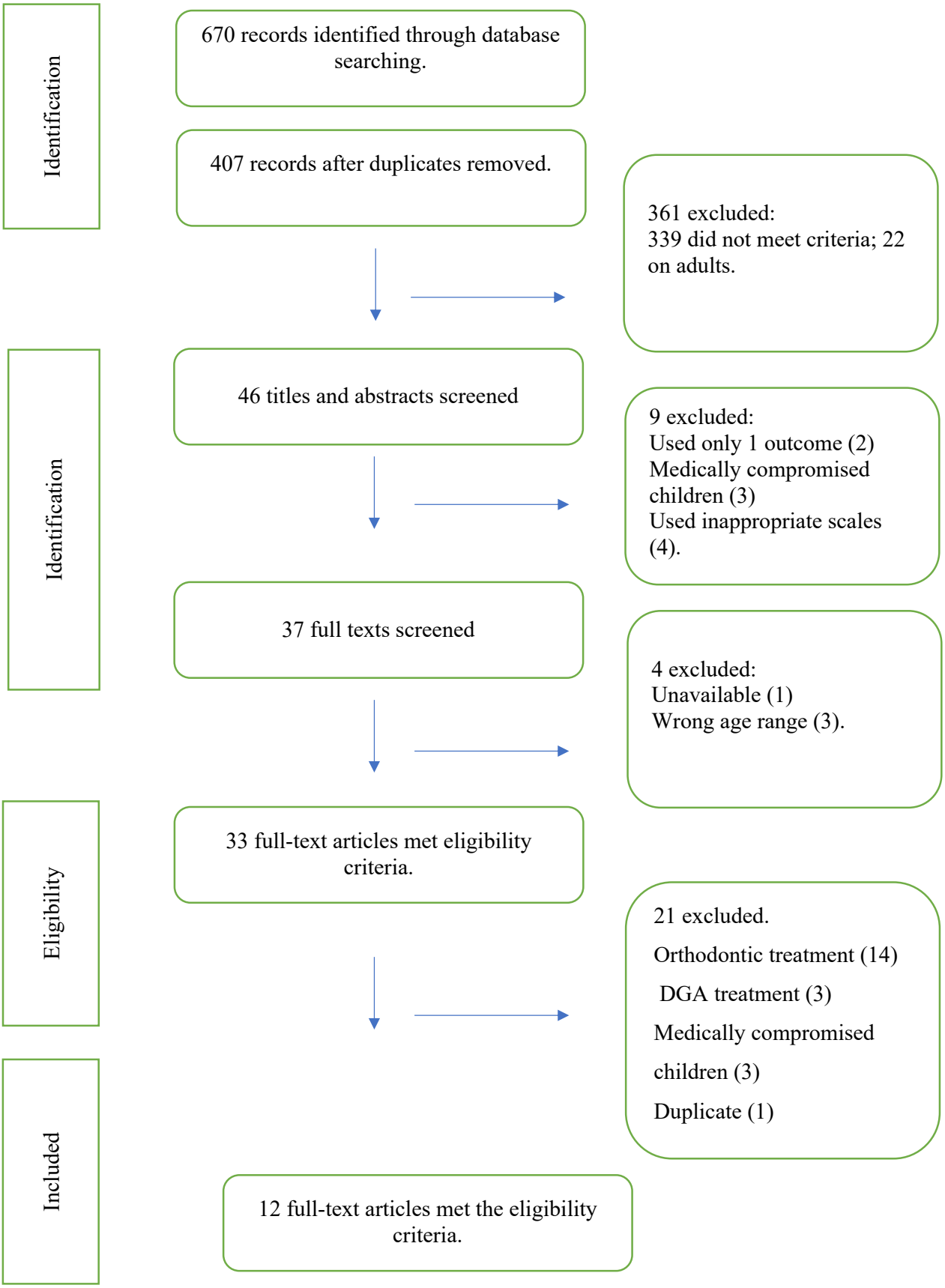

Figure 1. PRISMA flow chart

Seven studies were cross-sectional, three were longitudinal, one was a randomized control trial and one a mixed-method investigation. The selected reports dated from 2007 to 2019 and were from: India, Brazil, Iran, Saudi Arabia, Malaysia, New Zealand, Ireland and the UK. One study was conducted in Finland and Turkey.

Seven studies measured the relationship between dental anxiety and COHRQoL. Four assessed the association between COHRQoL and self-esteem. Only one examined the association between child dental anxiety and self-esteem. None reported associations between all three child-related outcome measures.

Table 3. Summary table of included articles

Authors	*Year*	*Country*	*n. (% female)*	*Age Range Mean (SD)*	*Design*	*Outcomes*	*Measures*	*Associations*
Cinar and Murtomaa	2007	Turkey, Finland	706	10-12 yrs. No mean or SD provided	Cross-Sectional	DA SE	Modified Dental Anxiety Scale (MDAS)* Pre-adolescent Health Behaviour Questionnaire [PHBQ]	Low self-esteem associated with dental anxiety
Baker et al	2010	Malaysia	439 (58.9%)	12-13 yrs. 12.04 No SD provided	Longitudinal	SE COHRQoL	Rosenberg's Self Esteem Scale (RSES)† Children perception questionnaire ($CPQ_{11–14}$)‡	Higher self-esteem at baseline correlated with COHRQOL at follow up: r_p =-0.14: P =0.003
Rodd et al	2011	United Kingdom	92 (65.2%)	10-11 yrs. 11.26 (0.30)	Longitudinal	SE COHRQoL	Self-perception Profile for Children (SPPC)§ Short form of Children perception questionnaire (ISF-16 $CPQ_{11–14}$)**	Physical self-esteem was a significant predictor of COHRQoL: r_p =-0.32: P<0.01
Foster-Page et al	2012	New Zealand	353 (48.4%)	12-13yrs. No mean or SD provided	Cross-Sectional	SE COHRQoL	Self-esteem subdomain of the CHQCF87 (SE)†† Children perception questionnaire ($CPQ_{11–14}$)	The lower oral health impacts; the higher self-esteem: r_p=-0.44: P =0.01
Goyal et al	2014	India	536	12 -15 yrs. No mean or SD provided	Cross-Sectional	DA COHRQoL	Children's fear survey schedule- dental subscale (CFSS-DS)‡‡ Children perception questionnaire ($CPQ_{11–14}$)	Significant association (p≤0.05) between all domains of $CPQ_{11–14}$ and CFSS-DS among school going and non-school going children.¥
Schuch et al	2015	Brazil	750 (54 %)	8-10 yrs. 9.15. No SD provided	Cross-Sectional	DA COHRQoL	Dental Anxiety Question (DAQ)§§ Child perception questionnaire ($CPQ_{8–10}$)	Anxious children who reported dental fear in the previous 6 months had higher CPQ_{8-10} scores (P <0.001) after adjustment.
Freeman et al	2016	Ireland	238 (52%)	7- 8 yrs. No mean or SD provided	RCT	SE COHRQoL	Coopersmith self-esteem inventory- school form (Coopersmith SEI-SF)*** Child perception questionnaire ($CPQ_{8–10}$)	There was a significant and positive association between COHRQoL and self-esteem: r_p =0.43: P ≤ 0.01
Pakpour et al	2018	Iran	1529 (55%)	No range provided. 15.05 (2.12)	Longitudinal	DA COHRQoL	Modified Dental Anxiety Scale (MDAS)††† Oral health-related quality of life (PedsQL Oral Health Scale)‡‡‡ General health related quality of life (PedsQL 4.0 generic core scale)§§§	'Dental anxiety had an indirect effect on COHRQoL mediated by periodontal health and/ or DMFT': β =0.008: SE=0.025: P >0.05¥
Merdad and El-Housseiny	2017	Saudi Arabia	1,312, (45%)	11-14 yrs. No mean age or SD provided	Cross-Sectional	DA COHRQoL	Children's fear survey schedule- dental subscale (CFSS-DS)**** Child perception questionnaire ($CPQ_{11–14}$)	Anxious children reported higher $CPQ_{11–14}$ scores than non-anxious children Anxiety predicted $CPQ_{11–14}$ scores: fearful children had scores 9.9 units higher than non-fearful children: P <0.001.
Frauches et al	2018	Brazil	80	8-10 yrs. No age means or SD provided	Mixed Methods	DA COHRQoL	Facial Image Scale (FIS)†††† Child perception questionnaire 8-10 ($CPQ_{8–10}$)	No significant association between COHRQoL and dental anxiety (p=0.94): r_s= 0.024, P=0.83, 95% CI: rho=-0.24, 0.19

Table 3 continued overleaf...

Table 3. Continued...

Chandak et al	2019	India	374 (46.8%)	11-14 yrs. Boys: mean age: 12.51: SD 1.49 Girls: mean age: 12.70: SD 1.30.	Cross-Sectional	DA COHRQoL	Dental Anxiety Scale‡‡‡‡ Oral Health Impact Profile-14 (OHIP-14)§§§§	Dental anxiety associated with oral health impacts and COHRQoL: r=1.30: SE=0.23: OR=2.50: P=0.02.
Coxon et al	2019	UK	4,950 (52%)	12-15 yrs.: mean age: 12.43: SD 4.9	Cross-Sectional	DA COHRQoL	Modified Dental Anxiety Scale (MDAS)***** Child Oral Impacts on Daily Performances (Child-OIDP)†††††	Dental anxiety significant predictor for COHRQoL: P=0.02

* MDAS higher scores indicate higher dental anxiety. † RSES higher scores indicate higher self-esteem. ‡ CPQ8-12 higher scores indicate poorer OHRQoL. § Higher total SPPC scores represent greater scholastic competence or greater global self-worth. ** ISF-16 CPQ11–14 Higher scores indicate more frequent impacts and thus worse OHRQoL. †† CHQCF87 Higher scores indicates better SE. ∞ Baker provided the bivariant raw correlation stated here which was used in the meta-analysis. ‡‡ CFSS-DS higher scores indicate higher dental anxiety. ¥ Goyal et al data not included in the meta-analysis as total CPQ11-14 scores were not provided. ¥ Pakpour et al data not included in the meta-analysis as the statistics provided were only for indirect effects. §§ DAQ higher scores indicate higher dental anxiety. *** SEI-SF higher scores indicate higher self-esteem. ††† MDAS higher scores indicate higher dental anxiety. ‡‡‡PedsQL higher score indicates better COHRQoL. §§§ PedsQL 4.0 generic core scale higher scores indicate better HRQOL. **** CFSS-DS higher scores indicate higher dental anxiety. †††† FIS higher scores indicate higher dental anxiety. ‡‡‡‡ higher DAS score indicate higher dental anxiety. §§§§ higher OHIP-14 scores indicate worse COHRQoL. ***** MDAS higher scores indicate higher dental anxiety. ††††† higher child -OIDP scores indicate worse COHRQoL.

Of the measures used to assess COHRQoL, seven studies used the Children Perception Questionnaire (CPQ), the remainder used the Short Form of Children Perception Questionnaire (ISF-16 CPQ_{11-14}), the PedsQL Oral Health Scale, the Oral Health Impact Profile (OHIP) and the Child Oral Impacts on Daily Performances (Child-OIDP). Child dental anxiety was assessed by the Modified Dental Anxiety Scale (MDAS), the Child Fear Survey Schedule- Dental Subscale (CFSS-DS), the Dental Anxiety Question (DAQ), the Facial Image Scale (FIS) and the Dental Anxiety Scale. Self-esteem was measured using the Rosenberg's Self Esteem Scale (RSES), the Self-Perception Profile for Children (SPPC), the Self-esteem Subdomain of the CHQCF87 (SE) and Coopersmith's Self-Esteem Inventory- School Form (Coopersmith SEI-SF).

The total sample size from all 12 studies was 10,862 young people whose ages ranged from 7 to 15 years (Table 3). All studies included both boys and girls. There were more boys in four studies. Three reports did not specify the male to female ratio.

The quality of the studies ranged from low to high (Table 4). Six studies had a low risk of bias, while five were at medium risk. One study had a high risk of bias. The most common factor reducing the quality of the study was the identification and management of confounders (Table 4).

Meta-analysis was conducted to estimate the association between child dental anxiety and COHRQoL and between COHRQoL and self-esteem. The association between child dental anxiety and COHRQoL was reported in five studies with a total sample of 7,466 (Figure 2). The heterogeneity test assessed the consistency of effects across studies was non-significant ($Q=4.2$, $I^2=5.5\%$, $p=0.37$), therefore a fixed factor solution was used (Figure 2). Dental anxiety was significantly related to COHRQoL, with an overall effect size = 0.06 [95%CI: 0.04, 0.08].

To examine the association between COHRQoL and self-esteem only four studies were included (total sample = 1,122) (Figure 3). Random factor model estimation was performed due to the significant heterogeneity across studies ($Q=26.63$, $I^2=88.7\%$). In meta-analysis, the summary estimate of effect was -0.35 [95%CI: -0.53, -0.17] (Figure 3). Funnel plots for each meta-analysis showed no evidence of publication bias according to conventional criteria.

As only one investigation examined the association between child dental anxiety and self-esteem it was not possible to conduct a meta-analysis.

Discussion

This systematic review aimed to identify the directions, strength and associations between dental anxiety, COHRQoL and self-esteem in children and adolescents. The 12 included studies were of varying quality. Meta-analysis found an overall small association between child dental anxiety and COHRQoL and a moderate association between COHRQoL and self-esteem. For this latter association there was a high level of heterogeneity, hence a firm conclusion on the strength of this association was difficult to state. The evidence of an association between child dental anxiety and self-esteem was even more limited, based upon a single study of low quality suggesting

Table 4. Risk of bias assessment of the studies

First author	Inclusion criteria	Description of study subject and setting	Validity and reliability of exposure measurement	Validity and reliability of Outcome measurement	Criteria used for measurement of the condition	Identification of cofounder	Deal with cofounding	Appropriate statistical analysis used	Overall risk of bias
Cinar	+	+	?	?	?	−	−	?	high
Baker	+	+	+	+	+	?	?	+	medium
Rodd	+	+	+	+	+	+	+	+	low
Foster-Page	+	+	+	?	+	+	+	+	low
Goyal	+	+	+	+	+	+	+	+	low
Schuch	+	+	?	?	+	+	+	+	medium
Freeman	+	+	+	+	+	?	?	+	medium
Pakpour	+	+	+	+	+	?	?	+	medium
Merdadl	+	+	+	+	+	+	?	+	low
Frauches	+	+	+	+	+	+	+	+	low
Chandak	+	+	+	+	+	−	−	+	medium
Coxon	+	+	+	+	+	+	+	+	low

+ Yes ? Unclear − No

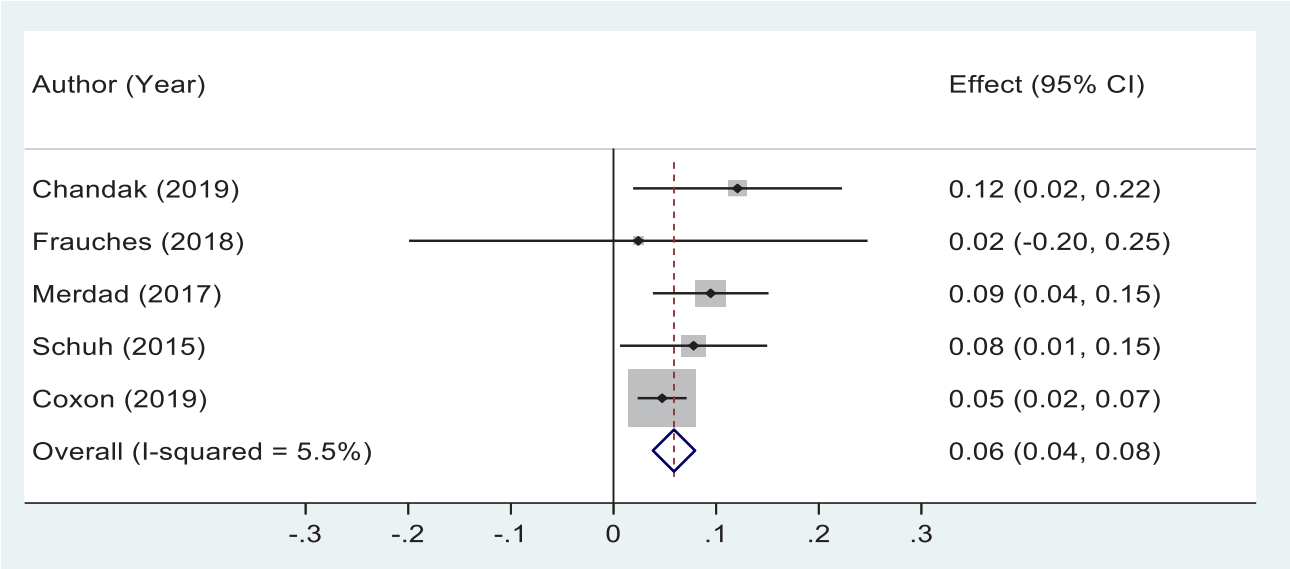

Figure 2. Association bewtween child dental anxiety and COHRQoL

a small negative association. No study investigated all three variables.

The spread of the gender and age of the participants was reasonably representative with children of every age group from 7 to 15 years included. Likewise, the measures of child dental anxiety, COHRQoL and self-esteem used were valid and reliable and the study designs were appropriate to answer the aim of this review.

There were some risks of bias in the included studies, which compromised the conclusions. Although, clear and specific criteria to identify relevant studies were applied, attempts to identify all relevant articles were challenging. Therefore, some studies may not have been retrieved, either because they were not published at the time of the search date or had revealed non-significant associations that may have suffered from non-reporting bias.

In addition, in this investigation of inter-relationships between psychological constructs associations between the three variables may be inflated as they share common methods variance. That is, the measurement of these constructs has been performed in nearly all studies by self-report questionnaires. For example, the relatively strong co-variation between self-esteem and quality of life may be attributable to the similarity of the self-report methods. This explanation, however, is not fully convincing as the other key relationships e.g. self-esteem and child dental anxiety did not show a relationship and despite using similar self-report data. Future work is necessary to address this issue of shared methods variance. The focus of a new investigation to examine the inter-relationships of these three psychological constructs should employ latent variable techniques such as confirmatory factor analysis.

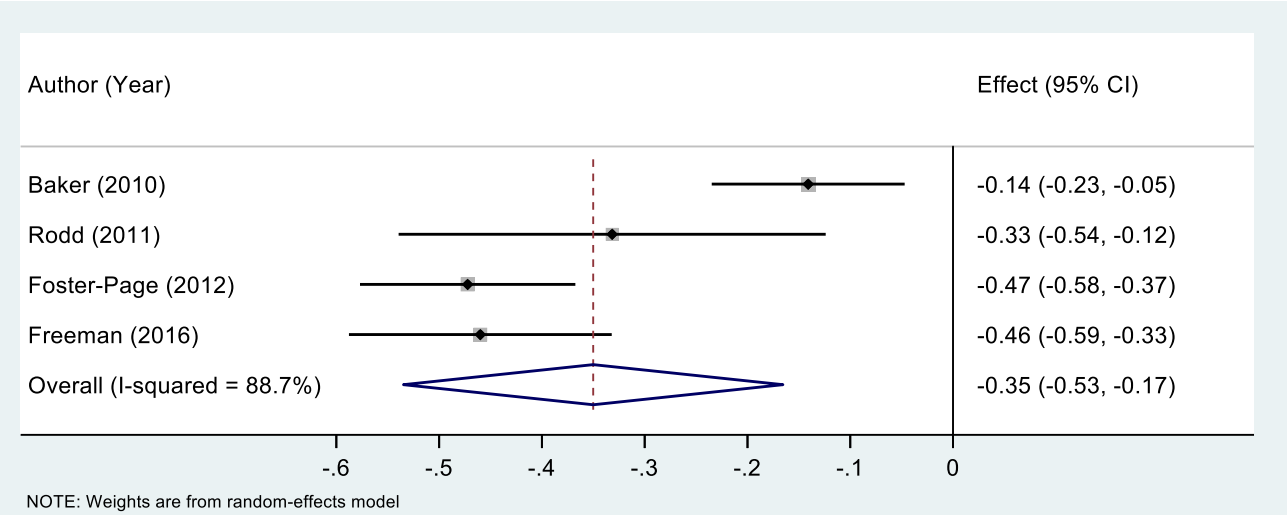

Figure 3. Association between COHRQoL and self-esteem

This detailed statistical approach enables close scrutiny of correlated residual errors of individual items and unique loadings to representative constructs (e.g., do the items in the COHRQOL relate solely to its latent variable or are there cross loadings to the self-esteem latent variable?).

Publication bias was assessed among those studies reporting the association between child dental anxiety and COHRQoL. The funnel plot demonstrated no apparent publication bias (see supplementary file https://discovery.dundee.ac.uk/en/publications/dental-anxiety-child-oral-health-related-quality-of-life-and-self). The other meta-analysis summarising the COHRQoL and self-esteem produced an inconclusive funnel plot. In addition, the low number of publications included undermined assessment using this approach. A general comment may be made that the original investigators were not concentrating on these relationships as in some respects this was incidental to the aim of their studies. Therefore, it is unlikely that they would alter their decision to publish based purely on these associations. More relevant to this review is the possibility that some child-related outcome measures were not reported, even though they might have been collected.

Despite these reservations and in view of meta-analysis it may be cautiously postulated that:

1. Higher child dental anxiety is related to poorer COHRQoL;
2. Poorer COHRQoL is associated with low self-esteem;
3. An association between child dental anxiety and self-esteem was proposed but not confirmed due to a lack of evidence.

There is some support for the above suggestions from the related literature, which has investigated various interventions. This work suggests that treatment interventions which do not raise children's general apprehension are associated with reduced child dental anxiety and COHRQoL (Luoto *et al.,* 2009), whereas those that increase nervousness may increase COHRQoL but have little effect on child dental anxiety (Klassen *et al.*, 2009). With regard to the relationship between COHRQoL and self-esteem, the available evidence suggests that health improvement interventions may have a direct effect on COHRQoL and an indirect influence on self-esteem (Freeman *et al.*, 2016). Therefore, it is advocated that the study of the relationships between the three psychological constructs this review examines, may assist researchers in developing sensitively designed interventions to improve health and social wellbeing.

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