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REVIEW

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A systematic review of the impact of parental socio-economic status and home environment characteristics on children's oral health related quality of life

Santhosh Kumar*, Jeroen Kroon and Ratilal Laloo

Abstract

Childhood circumstances such as socio-economic status and family structure have been found to influence psychological, psychosocial attributes and Oral Health Related Quality of Life (OHRQoL) in children. Therefore, the aim of this study was to conduct a systematic review of the published literature to assess the influence of parental Socio-Economic Status (SES) and home environment on children's OHRQoL. A systematic search was conducted in August 2013 using PubMed, Medline via OVID, CINAHL Plus via EBSCO, and Cochrane databases. Studies that have analysed the effect of parental characteristics (SES, family environment, family structure, number of siblings, household crowding, parents' age, and parents' oral health literacy) on children's OHRQoL were included. Quality assessment of the articles was done by the Effective Public Health Practice Project's Quality Assessment Tool for Quantitative studies. Database search retrieved a total of 2,849 titles after removing the duplicates, 36 articles were found to be relevant. Most of the studies were conducted on Brazilian children and were published in recent two years. Early Childhood Oral Health Impact Scale and Children's Perception Questionnaire₁₁₋₁₄ were the instruments of choice in preschool and school aged children respectively. Findings from majority of the studies suggest that the children from families with high income, parental education and family economy had better OHRQoL. Mothers' age, family structure, household crowding and presence of siblings were significant predictors of children's OHRQoL. However, definitive conclusions from the studies reviewed are not possible due to the differences in the study population, parental characteristics considered, methods used and statistical tests performed.

Keywords: Oral health related quality of life, Children, Socio-economic status, Home environment

Introduction

The World Health Organisation (WHO) defines Quality of Life (QoL) as "an individual's perception of their position in life in the context of the cultural and value systems in which they live and in relation to their goals, expectations, standards and concerns" [1]. Currently, there is a growing interest and move towards the use of patient-focussed assessments to gain more meaningful information, although subjective, on the impact of oral disease on an individual [2]. This is because clinical indicators alone do not reveal the full impact of oral conditions on the psychosocial wellbeing of a patient [3]. Thus, it has been proposed that an evaluation of physical functioning and psychological

wellbeing should be complemented with a normative oral-health assessment [4].

Previously concerns were raised that children's reports of their health and QoL would not meet accepted psychometric standards of validity and reliability, because of limitations in their cognitive capacities and communication skills, [5-7] but currently several validated Oral Health Related Quality of Life (OHRQoL) instruments are aimed at school-aged children [6-9] and preschool children [10,11].

Studies show that children's oral-health status is often related to social dimensions, such as parental income and education [12]. Furthermore, childhood circumstances, as indicated by socio-economic status (SES), family structure and parenting quality, have been found to influence psychological and psychosocial attributes in children [13]. This is strengthened by findings from recent studies where

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parental socio-economic factors as well as home environment have been found to impact negatively on children's OHRQoL [14], with children residing in orphanages presenting with poorer OHRQoL than those living with their parents [15]. However, this is not always the case, with conflicting findings from a few studies where parental SES and home environment characteristics were found to be insignificant in predicting children's OHRQoL.

Determining the intervening variables that mediate the relationships between clinical variables and OHRQoL will facilitate the design of optimally effective clinical interventions [16]. While a systematic review has been conducted on the association of children's oral health status with their OHRQoL [17], there is currently no published evidence available on the influence of parental attributes on children's OHRQoL. Therefore, the aim of this study was to conduct a systematic review of the published literature to assess the influence of parental SES and home environment on children's OHRQoL.

Methods

Search criteria

The protocol for this systematic review was registered with the International Prospective Register of Systematic Reviews, and allocated with the registration number CRD42013005433. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for conducting a systematic review were used [18]. A search for eligible journal articles was undertaken in August 2013, using PubMed, Medline via OVID, CINAHL Plus via EBSCO, and Cochrane databases to answer if parental characteristics (SES, family environment, family structure, number of siblings, household crowding, parents' age, and parents' oral health literacy) influence children's OHRQoL. The search strategy that was used in PubMed is presented in Table 1. In order to prevent the loss of potential articles, a broad range of

Medical Subject Heading (MeSH) terms and combination of search strategies were used. As "Oral Health Related Quality of Life" is not a MeSH term, it was used as a keyword to search in all the fields. A truncation for the MeSH term "child" was used, as the search term "child" could have many variants. For parental characteristics, a wide-ranging list of subject headings and subheadings were used that were related to "socio-economic status" and "home environment". In PUBMED, there was no time limit set in the search criteria, while the lower limit for entry date in Medline via OVID and CINAHL Plus via EBSCO was set to 1946 and 1997 respectively. Titles from all languages were considered, since a few journals publish articles both in English and foreign languages.

Study selection and data extraction

All titles retrieved were exported to EndNote (version X6) software, and one of the authors (SK) selected titles that were relevant to OHRQoL in children. The selection criteria for inclusion after reviewing the full text of the articles were as follows:

- the article used validated OHRQoL instruments to assess OHRQoL in children; and
- the study evaluated the influence of SES, family income, family economy, parental occupation, parent's education level, parent's demographics, dental health literacy of the caregivers, household crowding, number of siblings, family structure and any other parent-related characteristics on children's OHRQoL.

Studies were excluded when individuals studied were older than 18 years of age, where full text was not available in English, and if the study did not consider the effect of relevant parental characteristics on OHRQoL of children.

Table 1 Search strategy used in PubMed

#1	Oral health related quality of life
#2	("Child*[MeSH] OR "Adolescent"[MeSH])
#3	"Oral health"[MeSH]
#4	"Quality of life"[MeSH]
#5	("Socioeconomic Factors"[MeSH] OR "Social Class"[MeSH] OR "Social Environment"[MeSH] OR "Poverty"[MeSH] OR "Illiteracy"[MeSH] OR "Literacy"[MeSH] OR "Educational Status"[MeSH] OR "Employment"[MeSH] OR "Family Characteristics"[MeSH] OR "Income"[MeSH] OR "Occupations and Professions"[MeSH] OR "Unemployment"[MeSH] OR "Social Change"[MeSH] OR "Family Characteristics"[MeSH] OR "Marital Status"[MeSH] OR "Parenthood"[MeSH] OR "Family Relations"[MeSH] OR "Nuclear Family"[MeSH] OR "Family Functioning"[MeSH] OR "Age Factors"[MeSH] OR "Birth Place"[MeSH] OR "Birth Intervals"[MeSH] OR "Birth Order"[MeSH] OR "Race Factors"[MeSH] OR "Special Populations"[MeSH])
#6	(#1 AND #2)
#7	(#1 AND #2 AND #5)
#8	(#2 AND #3 AND #4)
#9	(#2 AND #3 AND #4 AND #5)

Articles that assessed the association of children’s OHR-QoL with other variables that are not parent-related, such as ethnicity, geographic location of residence, urbanisation and dental care experienced, were also excluded, as were studies with subjects ranging from children to adults that have studied the association of subject’s SES with OHR-QoL but not of the parents. Piloted forms were used by one of the authors (SK) to extract information from each full-text article, which were then screened independently by the other two senior authors for accuracy. Consensus was reached through discussion between the authors where discrepancies occurred.

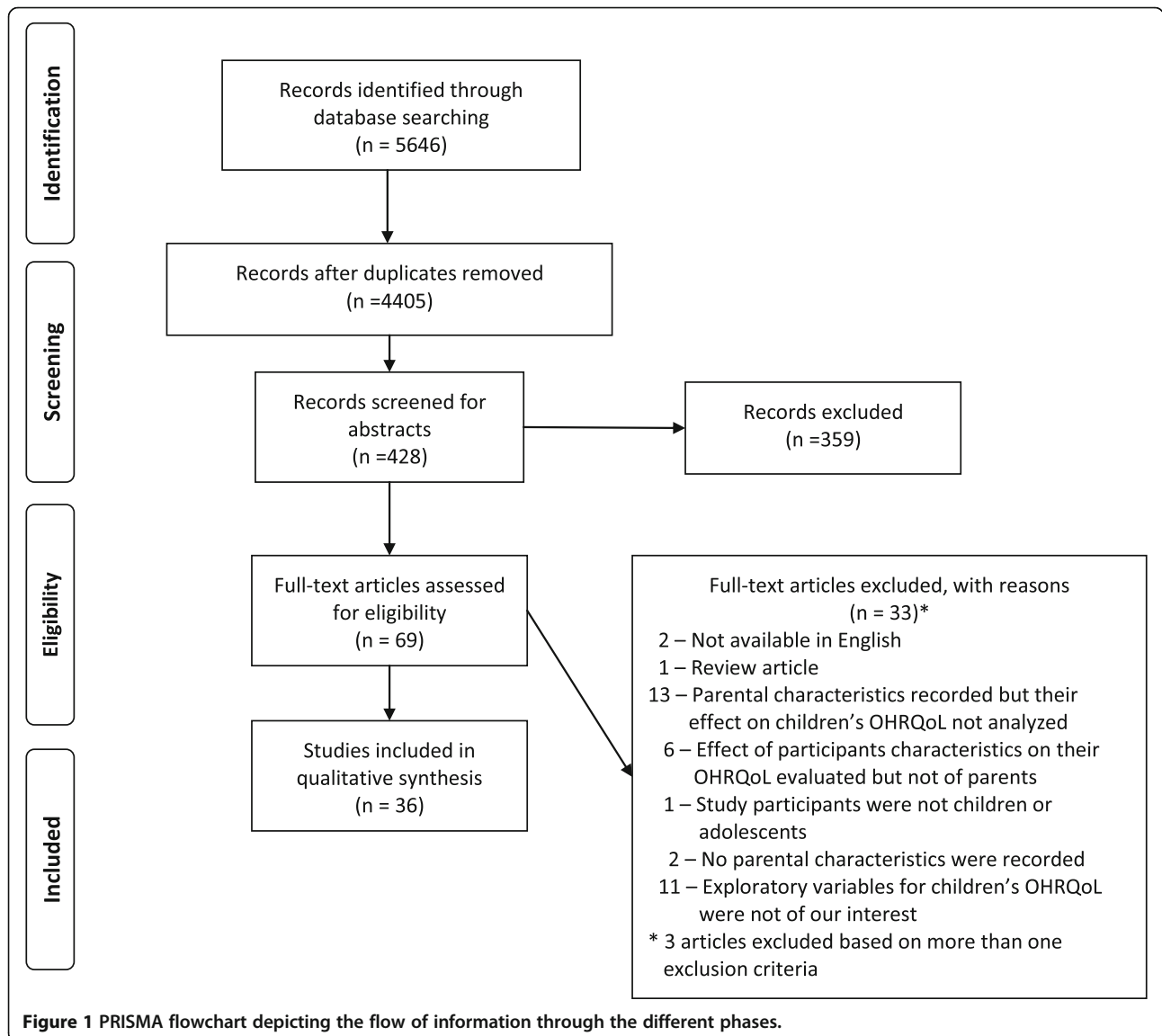
Quality assessment of selected articles

The Effective Public Health Practice Project’s (EPHPP) Quality Assessment Tool for Quantitative Studies was used to evaluate the quality of included articles [19]. The

EPHPP tool was created primarily for quality assessment of observational and clinical studies based on populations. EPHPP quality assessment involves rating each article on a three-point scale (strong, moderate and weak) in six components: selection bias, study design, confounders, blinding, data-collection methods, and withdrawals and drop-outs. Based on the rating of each methodological component, a global rating of strong, moderate or weak was allocated to each article [20].

Results

Figure 1 illustrates the details of both the selected and excluded studies. The database search retrieved a total of 5646 titles (2,627 from PubMed, 829 from Medline via OVID, 673 from CINAHL and 1,517 from the COCHRANE). After removing duplicates, 4405 titles remained, and 428 titles were considered for abstract



screening. After excluding a further 359 articles based on their abstract, 69 [4,9,14,15,21-85] articles were considered for full-text review of which 36 met the inclusion criteria. For the articles excluded, two were in Portuguese [84,85], one was a review [53] thirteen did not analyse the effect of recorded parental characteristics on children's OHRQoL [58,61,62,64-66,69,72,74,76-78,81], six evaluated the effect of socio-demographic characteristics of participants' on OHRQoL but not of their parents [67,68,73,75,80,82], one was not conducted on children or adolescents [70], two did not collect data on parental characteristics [60,71], eleven analysed the influence of exploratory variables on children's OHRQoL that were not directly related to parents [9,54-57,59,63,73,74, 78,79]. Three articles were excluded based on more than one exclusion criteria [73,74,78].

Overview of the included studies

Year of publication

Approximately one-third of the studies considered for inclusion [4,25,26,28,32,33,38,43,47,48,50] were published in 2013, while eight [14,21,27,29,31,34,35,83] and six papers [15,22,30,40,44,52] were published in 2012 and 2011 respectively. Aside from one paper published in 2005 [49], there were no papers that pre-dated 2007.

Study setting

Of the 36 articles which met the inclusion criteria nearly half ($n = 16$) were conducted in Brazil, followed by two each from Thailand [34,35], New Zealand [29,50] and Tanzania [39,41]. One study from Thailand [34] was conducted on both 12- and 15-year-old children, with a separate data set presented for both age groups; hence the data from this study appears in both Additional file 1: Table S1 and Table 2. There was one article each from the United States [27], Canada [36], France [49], Hong Kong [52], Malaysia [23], India [15], United Kingdom [32], Saudi Arabia [43], Syria [26], Greece [44], Norway [31], Chile [37], Sudan [42] and Argentina [83].

Age of the study population

Nine studies were conducted on pre-school children (Table 3), while 22 and 6 studies had a study population aged in the range of 10–15 (Additional file 1: Table S1) and 10–21 (Table 2) years respectively.

OHRQoL instruments used

The Early Childhood Oral Health Impact Scale (ECOHIS) was the OHRQoL instrument of choice in preschool children, except for one study [35]. Child Perceptions Questionnaire (CPQ₁₁₋₁₄) was the most widely used OHRQoL instrument in studies conducted on children and adolescents with fourteen papers reporting its use. Child-OIDP was used in six studies [25,34,39,41,42,49],

two of them being the validation studies [42,49]. Parental-Caregivers Perceptions Questionnaire (P-CPQ) and Family Impact Scale (FIS) components of COHQoL without CPQ₁₁₋₁₄ were used by two studies [21,43]. Three studies used OIDP with study populations aged 12 [45], 15 [34] and 15–16 years [24]. Oral Health Impact Profile (OHIP) was used in three studies, one with a study population aged 12–15 years [28], and the other two with adolescents in the age range of 15–18 [44] and 12–21 [37] years.

Quality of the study

Only three articles scored a global rating of “strong” based on EPHPP criteria. Most of the studies were either “moderate” (22 articles) or “weak” (11 articles).

Socio-economic status (SES)

A broad range of SES indicators were used in different studies; family income, parents' occupation, parents' education, family economic status, deprivation status and household wealth index. Seven studies reported of using a single composite scale for SES assessment [24,26,28,32, 42,45,83], of which two [42,83] observed poor OHRQoL in children belonging to high SES and one [26] reported of children belonging to low SES having poor OHRQoL. Area-based deprivation was used in three studies [29,48,50], of which one study on intermediate school children of Dunedin observed that those belonging to high deprivation had poorest OHRQoL compared to those in the low and medium categories of deprivation [29], but its effect was not observed in adjusted analysis.

Family income

Apart from four articles [15,27,35,44], family income or other indicators of family economy were recorded in all the included articles. Among the sixteen articles that evaluated the influence of total family income on children's OHRQoL, twelve papers found a significant association [4,14,21-23,36,43,46-48,51,52] with better family income predicting better OHRQoL in children. Although all the studies reported of children from families with high income having better OHRQoL, there were a few discrepancies between the studies; income was significant only in unadjusted analysis [23], effect of family income was limited to overall CPQ score and its two domains [46], family income had significant effect only on symptoms domain and family impact section of ECOHIS [52], family income was significant predictor of FIS of COHQoL but not P-CPQ [43], income significantly related to overall CPQ₁₁₋₁₄ and all its domains except for functional limitations [51]. A cohort study that estimated the association of oral health impacts in 12-year-old Brazilian adolescents with life course socio-economic variables considered family income at birth as one of the predictors, but its effect was not presented in the results [45].

Table 2 Background and study characteristics of studies conducted in adolescents as well as children aged 10-21 years old

Study design	Study sample characteristics	Age of the sample	Sample size (response rate)	OHRQOL instrument and method of administration	Parental characteristics studied	Significant parental characteristics in unadjusted analysis	Significant parental characteristics in adjusted analysis	Insignificant parental characteristics	Quality	Reference
CS	Public school children in grade 6 of Kilwa district, Tanzania	10-19	1780 (72.6%)	Child-OIDP (Kiswahili version) by interviewing subjects	Mother's education Father's education Family wealth index	Family wealth index on eating and leaning	Family wealth index on eating and speaking	Mother's education Father's education	Moderate	[39]
CS	Sub-sample of the sixth Thailand national oral health survey	15	811 (93.1%)	OIDP by interviewing children	Daily pocket money	None	None	Daily pocket money	Moderate	[34]
CS	Secondary school children, Sao Paulo, Brazil	15-16	1060 (48.1%)	OIDP attributed to malocclusion by interviewing the subjects	Socio-economic status (a composite measure recorded based on participation of the head of household in the production or distribution processes)	None	Not conducted	Socio-economic status	Weak	[24]
CS	School children of metropolitan/ non-metropolitan and urban/ rural areas of Greece	15-18	515	OHIP-14 questionnaire by children in face to face interviews	Parental education Parental Occupation	None	Not done	Parental education Parental Occupation	Weak	[44]
CS	High school children of the province of Santiago, Chile	12-21	9155 (99.9%)	Modified OHIP-Sp questionnaire by children	Household size Housing status Number of cars owned by the family Paternal income Level of mother's education	Household size Housing status Number of cars owned by the family Paternal income Mother's education	Household size Housing status Number of cars owned by the family Paternal income Mother's education	None	Moderate	[37]
CS	Secondary school students of Arusha, Northern Tanzania	12-21	2412 (80.7%)	Child-OIDP (Kiswahili version) questionnaire by subjects	Father's education Mother's education Family socio-economic status (perceived affluence of household) Household wealth index (based on durable household assets indicative of family wealth) Parents affording dental care	Mother's education Father's education Parents affording dental care Family SES	Family SES Parents affording dental care	Household wealth index	Moderate	[41]

CS - Cross-sectional; OIDP - Oral Impacts on Daily Performance; OHIP - Oral Health Impact Profile.

Table 3 Characteristics of the study population and principal results from OHRQoL studies in preschool children (studies involving children aged 6 have also been included)

Study design	Study sample	Age of the sample	Sample size n (response rate)	OHRQoL instrument and method of administration	Parental characteristics studied	Significant parental characteristics in unadjusted analysis	Significant parental characteristics in adjusted analysis	Insignificant parental characteristics	Quality	Reference
CS	Preschool children who sought dental care during the screening program at University of Sao Paulo, Brazil	2-5	260 (85.2%)	ECOHis questionnaire by one of the parent	Number of siblings Marital status of parents Household crowding House property Family income Mothers' age Father's age Mother's education Father's education Father's work activity away from home Mother's work activity away from home	Household crowding Mother's work activity Family income	Family income	Number of siblings Marital status of parents House property Mother's age Father's age Mother's education Father's education Father's work activity	Moderate	[22]
Prospective cohort	Interview data from Carolina oral health literacy project	3-5	203	ECOHis questionnaire by caregivers	Caregiver's oral health literacy Caregiver's age Caregiver's education	Caregiver's age (inversely related to ECOHis) Caregiver's education (inversely related to ECOHis) Caregiver's oral health literacy (weakly correlated with ECOHis)	Not conducted	None	Moderate	[27]
						(no p values provided for the relationship between any of the variables and children's OHRQoL)				

Table 3 Characteristics of the study population and principal results from OHRQoL studies in preschool children (studies involving children aged 6 have also been included) (Continued)

CS	Children and mothers of city of Pelotas, Brazil	2-5	608 (88.7%)	ECOHIS questionnaire by mothers	Maternal dental anxiety	Maternal dental anxiety for total ECOHIS score, child's function and parent distress domain	Maternal dental anxiety for parent distress domain	Family income	Moderate	[30]
					Family income	Mother's education	Mother's education for total ECOHIS score			
					Mother's education	Mother's use of dental services	Mother's use of dental service for child's function domain and total ECOHIS			
					Mother's use of dental services					
CS	Public preschool/nurseries children of Canoas, Brazil	2-5	1245 (90.2%)	ECOHIS questionnaire by caregivers	Mother's age	None	None	Mother's age	Moderate	[33]
					Family structure (nuclear/non-nuclear)			Family structure		
					Mother's education			Mother's education		
					Family income			Family income		
CS	Children of Diamantina, Brazil	2-5	638 (98.1%)	ECOHIS by interviewing any of the parent	Marital status of parents	None	Mother's age	Marital status of parents	Moderate	[38]
					Household crowding			Household crowding		
					Mother's age			Number of siblings		
					Number of siblings			Mother's education		
					Mother's education			Father's education		
					Father's education			Family income		
					Family income					
CS	Pre-school children of city of Belo Horizontem, Brazil.	5	1412 (96.3%)	ECOHIS questionnaire by caregivers	Child's position (single child/others)	Child's position	<i>For child impact section (CIS) of ECOHIS</i>	<i>For CIS of ECOHIS</i>	Moderate	[48]
					Caregiver's age	Caregiver's age	Child's position	Caregiver's education		
					Caregiver's education	Caregiver's education	Caregivers age	Caregiver's relationship to the child		

Table 3 Characteristics of the study population and principal results from OHRQoL studies in preschool children (studies involving children aged 6 have also been included) (Continued)

					Caregiver's relationship to the child (Mother/others)	Social vulnerability index	Household income	Social Vulnerability Index		
					Household income	Household income	<i>For Family impact section (FIS) of ECOHIS</i>	<i>For FIS of ECOHIS</i>		
					Social Vulnerability Index (a measure for socioeconomic status based on the residence)		Caregivers age	Child's position		
							Household income	Caregiver's education		
								Caregiver's relationship to the child		
								Social Vulnerability Index		
CS	Chinese preschool children in Hong Kong	3-5	1296 (96.5%)	ECOHIS questionnaire by parents or caregivers	Relationship of the primary caregiver to the child (Mother /other family member)	Caregiver's education for only symptom domain of ECOHIS	Household income on family impact section of ECOHIS	Relationship of caregiver to the child on overall ECOHIS, FIS and CIS.	Moderate	[52]
					Caregiver's education	Income level for only symptom domain of ECOHIS		Caregiver's education for other domains of the ECOHIS except symptoms, overall ECOHIS, FIS and CIS		
					Household income			Income level for other domains of the ECOHIS except symptoms, overall ECOHIS, FIS and CIS		
CS	Preschool children of Patumwan district, Bangkok, Thailand	5-6	503 (100%)	Modified Child-OIDP questionnaire by subjects	Family structure (Living with parents/Living with single parents or others)	Hometown of the parents	Occupation of the head of the household	Family structure	Moderate	[35]
					Hometown of parents (Both were from	Occupation of the head of the household				

Table 3 Characteristics of the study population and principal results from OHRQoL studies in preschool children (studies involving children aged 6 have also been included) (Continued)

					Bangkok/either was from Bangkok/both were from other places)						
					Occupation of the head of the household						
CS	Kindergarten children of Buenos Aires metropolitan area, Argentina	Not provided	95 (69.8%)	ECOHis questionnaire by parents	Family SES or poverty related factors based on parent's/ caregiver's education, family work conditions and oral health care coverage	SES or poverty related factors on family impact section of ECOHis	Not conducted	None	Poor	[83]	

CS - Cross-sectional; ECOHis - Early Childhood Oral Health Impact Scale.

Other family income indicators

More than half of the thirteen studies that analysed the effect of proxy family income indicators on children's OHRQoL found them to be significantly related to the outcome. The proxy measures of family income or wealth used in few of the articles were house ownership [40] (only associated with oral symptoms domain of CPQ₁₁₋₁₄); family wealth index based on durable household assets (related to impairment of few functions) [39]; and family health insurance (was not significantly related to children's OHRQoL) [49]. The perceived affluence of household, household wealth index based on durable household assets, and parent's affordability for dental care were proxy measures in a study, and found both household wealth index and parent's affordability to dental care to be significant predictors of children's OHRQoL [41]. A study on a representative sample of 12- and 15-year-old children in Thailand found that the prevalence of oral health impacts on QoL in 12-year-old children was greater in those children who receive daily pocket money of 0-20 baht compared to those who receive more than 20 baht per day [34]; this was significant only in unadjusted analysis.

Eight studies used family income along with other proxy measures such as self-perceived family economy [31], receipt of governmental income support and family dental insurance [36], financial government support [25], and social vulnerability index [48], which were found to have a significant effect on children's OHRQoL in unadjusted analysis. Conversely, house property [21] and house ownership [14] were not found to be significant, but one study on 12-year-old school children of Juiz de For, Brazil, reported that children whose parents owned a house had better OHRQoL than those who do not own a house [4] only in bivariate analysis. A study on Chilean adolescents found number of cars owned and monthly paternal income to be significantly associated with OHRQoL, while house ownership was insignificant [37].

Parent's occupation

Six studies [22,35,44-46,49] analysed the effect of a parent's occupation on children's OHRQoL. Of the four studies that observed a significant association, three found associations when the effect of confounders was not controlled in statistical analysis. Preschool children whose household heads were unskilled or economically inactive had a higher likelihood of having high-level oral impacts than those whose household heads had skilled occupations [35], while studies from France [49] and Greece [44] reported the parent's professional activity and parental occupation, respectively, to be insignificant. The influence of occupation of both the parents on their children's OHRQoL was studied in an article from Brazil, but the father's occupation was singularly significant in

unadjusted analysis, with children of unemployed fathers being at greater risk of poor OHRQoL than those who had employed fathers [46]. In a study that assessed the effect of parents' work activity found fathers' work activity away from home to be insignificant while mothers' work activity was significantly related to total ECOHIS scores which was not observed after statistical adjustment [22]. Occupational position of the head of the family [24] and occupation of both the parents [26] were used as components of composite SES scale in two studies. Maternal employment status at age 6 months was a significant predictor for children's OHRQoL at 12 years of age, with children of employed mothers reporting poorer OHRQoL than those who were not working [45].

Parent's education

Twenty-two studies [4,14,21-23,25,30,31,33,36-39,41,43-48,51,52] assessed the effect of educational level of parents on children's OHRQoL.

The education level of both parents was found not to be related to children's OHRQoL in three studies [22,38,39]. Parental education was recorded in two studies (with no clarity if the term 'parental' implied mother or father) that found no relationship between parental education and children's OHRQoL [23,44]. Two studies that evaluated the effect of mother's education on children's OHRQoL found it to be insignificant [33,47].

The remaining fifteen studies found mixed results, with few observing significant effects of both parents' or either of the parent's education on children's OHRQoL, and the remaining reporting parent's education to influence only a few domains of the OHRQoL. However, in all fifteen studies, a higher level of parental education was associated with better OHRQoL in children.

Three studies reported that higher educational level of the mother and father predicted better OHRQoL in children but only the mother's education was significantly related to OHRQoL after adjustment [4,14,46]. Father's education was significantly related to children's OHRQoL among cerebral palsy children in Brazil but it did not maintain its significance after statistical adjustment [21], while another study observed the father's years of schooling to be significantly related to children's perceptions of QoL after the effect of other confounders was adjusted in statistical analysis [25]. In a study that was conducted on adolescents in Tanzania, the education level of both the mother and father were significant predictors for better OHRQoL in children in unadjusted analysis alone [41].

Two studies [43,51] observed the mother's, but not the father's, education to be significantly related to OHRQoL scores. In four studies, the mother's and caregiver's [31,36] education had a significant association with OHRQoL scores in unadjusted analysis [48,52], but in three other studies, higher level of the mother's education significantly

predicted better QoL perceptions in children both in adjusted as well as unadjusted analysis [30,37,45].

Parental education was one of the components of SES scale in five studies [26,28,42,45,83] that evaluated SES's influence on children's OHRQoL. In two of these studies [28,45], only the education of the head of the household was integral of SES scale.

Parent's demographics

Age of the parents

Seven articles [22,25,27,33,38,43,48] considered the effect of parent's age on children's OHRQoL. Two articles [22,33] found no significant relationship between parent's age and children's OHRQoL. Four studies reported the mother's [25,38] or caregiver's [27,48] age to be inversely related to children's OHRQoL. In one study, only mother's age was significantly related to both P-CPQ and FIS components of COHRQoL, but the direction of the relationship was not reported in the results [43].

Location of origin of the parents

Two studies were identified that recorded information on the parents' place of origin in relation to the study location [35,49] and found this to be significantly related to children's OHRQoL. A study conducted on preschool children in Bangkok observed that children of parents whose hometown was not Bangkok were at a greater risk of having a high level of oral impacts than those children of whom either one or both parents were from Bangkok. However, this effect of the parents' hometown was not evident in an adjusted statistical analysis [35]. Similarly, a study from France observed higher Child-OIDP scores in children whose mothers were immigrants [49], while a father's place of birth was not significantly related to child-OIDP scores.

Marital status of the parents

Two studies [22,38] found no difference between the OHRQoL scores between the children with married and those with unmarried parents.

Home environment

Relationship of the caregiver to the child

Two studies [48,52] found no difference in OHRQoL scores between the preschool children who were taken care of by their mothers and those children whose caregivers were other family members. On the contrary, a study on children with AIDS [40] reported that children whose mother was not their caregiver scored lower on the social wellbeing subscale of CPQ₁₁₋₁₄ than those children who were cared for by their mothers.

Family structure

Seven studies [4,14,15,33,35,36,47] reported on the effect of family structure on children's OHRQoL which was found to be significant in five studies. The definition of family structure differed between the studies. Two studies [33,47] classified family structure as either "nuclear" and "non-nuclear", while three studies categorised family structure as "living with both the parents" and "living with single parents or others". Three studies reported better OHRQoL scores in those children living with their biological parents [4,14] and in nuclear families [47] than their comparative counterparts. A comparison of the perception of OHRQoL between children living with parents and those with no parents revealed better OHRQoL scores in the former [15]. Poor OHRQoL was found in children living in one-adult households than those children from multi-adult households [36].

Crowding

Eight studies [4,14,21,22,25,37,38,40] evaluated the effect of household crowding on perceptions of the impact of oral health on quality of life in children. All the studies recorded number of people per room as a measure of house crowding, except for one [37] that observed children in households, with more than three persons reporting poorer OHRQoL than those children with household size of 1-3 persons. Three studies [25,38,40] found household crowding to be an insignificant variable, while four studies [4,14,21,22] found it to be a significant predictor of children's OHRQoL only when statistical adjustment for confounders was not done.

Number of siblings

Eight articles [4,14,21,22,36,38,48,49] studied the relationship of number of siblings or children in the family with OHRQoL. Three studies [21,22,38] did not find any influence of the number of siblings on children's OHRQoL, while an equal number of studies [4,14,49] observed that the perception of OHRQoL deteriorated as the number of children in the family increased. Two studies [4,48] found that the impact of OHRQoL was poorer in children who had siblings than those who did not have any siblings.

Cigarette, alcohol and drug use

One study [14] analysed the effect of cigarette, alcohol and drug use in the family on children's OHRQoL, and reported poor OHRQoL in children of those families using these products.

Parental oral health literacy, behaviour and dental anxiety

A study [27] that aimed to find the relationship of caregiver's oral health literacy with preschool's OHRQoL found these variables to be weakly correlated. In another study, mothers with moderate or high dental anxiety

reported a higher total ECOHIS score but in adjusted analysis, maternal dental anxiety was only associated with the parent distress domain [30]. In the same study, mothers who visited a dentist more frequently reported higher ECOHIS scores [30].

Discussion

In evaluating oral health, interferences in physical, psychological and social functioning are important [86], as the traditional epidemiologic clinical indicators do not provide an insight into individual's abilities in performing their roles and activities [87]. Most of the currently available OHRQoL instruments have succeeded in measuring the impact of oral health on physical, functional, social and emotional wellbeing of an individual. Children like adults are also prone for various oral disorders, all of which can likely compromise functioning, well-being and QoL [17]. But the concept of OHRQoL in children has increased dramatically only in recent years. A systematic literature review reported that the number of articles published on child OHRQoL between 2000 and 2006 was three times higher than between 1995 and 1999 [17].

The Wilson and Cleary model of health-related QoL demonstrates that individual perceptions of QoL are influenced by several individual, environmental characteristics and also non-medical factors [16]. However, evaluating the determinants of OHRQoL in children seems to be a new concept as there were no studies older than 2005 in spite of certain OHRQoL instruments being introduced between 2002 and 2005. Admittedly, the OHRQoL instruments for preschool children, such as ECOHIS [10] and SOHO-5 [11], were developed in 2007 and 2012 respectively. The latter instrument is a self-reported OHRQoL measure for 5-year-old children. While the ECOHIS questionnaire was widely used in preschool children, there were no studies that have used SOHO-5 [11], which might be due to its recent development. The CPQ₁₁₋₁₄ was the most widely used self-reported OHRQoL instrument in studies that were conducted on children and adolescents, and it is found to be valid as well as reliable in many cultural settings [88]. Although the literature on the determinants of children's OHRQoL is abundant, it is unequally represented, with more than half of the studies conducted in Brazil.

This review indicates that the findings on the correlates of OHRQoL from studies are varied and non-uniform, with different measures being considered by different authors. Moreover, not all studies included in the review aimed to test the association between the parental attributes and children's OHRQoL. Findings from both the adjusted and unadjusted analysis were tabulated separately for each study. In a few studies, the significant effect of exposure on the outcome that was observed in unadjusted analysis was not observed in multivariate analyses after

adjusting for the effect of confounders. The importance of statistical adjustment becomes more pronounced in cross-sectional studies, and especially in those studies that aim to ascertain the influence of many interrelated exposures on an outcome.

Most of the studies were of moderate quality and only three were strong. This is because of the quality assessment criteria used, which rates only those whose study designs are experimental or longitudinal in nature as good. However, experimental or longitudinal study designs are rarely used in OHRQoL studies of our interest. Furthermore, a few studies that were of moderate quality were rated as weak in 'selection bias' component of EPHP as they did not report response rates in the articles. There were four prospective studies [23,27,28,45] one of which was conducted with an objective to evaluate the effect of orthodontic treatment on OHRQoL [28]. Due to the static nature of the exposure data (i.e., socio-economic and home environment characteristics), most of the studies were of cross-sectional design. However, it would be interesting to observe the dynamic effect of these exposure characteristics along the life course on children's OHRQoL, which was done in one of the studies [45] that assessed the influence of early life social conditions on children's OHRQoL.

The composite measure of SES or area-based deprivation failed to show its effect on children's OHRQoL in most of the studies. However, family income or family economy indicators and parental education levels were found to be significant predictors of children's OHRQoL. Nevertheless, their effect was not observed after adjusted analysis in a few of the studies. Further, the influence of family economy or parental education was associated with only few dimensions of children's OHRQoL. This discrepancy in results between the studies is due to the statistical methods adopted, i.e., a few studies analysed the effect of family income or parental education on overall OHRQoL score, while the others analysed the effect of these socio-economic variables on overall OHRQoL, as well as its dimensions. In addition, some studies performed statistical adjustment for the effect of confounders when analysing the influence of parental characteristics on children's OHRQoL and few have not made any attempt to do so. As anticipated, family economy and parental education were directly proportional to children's OHRQoL in all the studies that have found significant associations. Children of parents with high educational level and family income were more likely to have better OHRQoL. Low educational level may lead to reduced income [13] and lower income is related to material deprivation [46]. Children from poor families have limited access to health care and preventive interventions which might lead to a poor quality of life [14]. None of the studies observed parents' occupation to be significantly associated with children's OHRQoL. Based

on the findings from a few studies, it can be conceptually summarised that a mother's work activity is a significant predictor during the early childhood while father's occupation is significant during late childhood.

Mothers' or caregivers' age significantly predicted better OHRQoL in children, which might be due to younger mothers feeling less secure in caring for their child [38]. Moreover, children of parents who are not native to the study location were found to be more prone to poor OHRQoL than those children whose parents are native to the area. This might be due to the indirect influence of SES, as migrants tend to have a lower SES than others. The marital status of the parents failed to influence children's OHRQoL. Mother or other family members being the caregiver of the family did not influence children's OHRQoL, except in one study on children with AIDS [40]. It might be because of the additional care needed by these children than others as they are more prone to poor oral health. It is evident from the studies reviewed that children living with biological parents and those with nuclear families have better OHRQoL. More than half the studies that evaluated the relationship of crowding found it to be significantly associated with children's OHRQoL, but only in unadjusted analysis. Household crowding is a proxy indicator of SES [89], and thus its association with children's OHRQoL might have been masked by SES in adjusted analysis. Single children reported lesser impact of oral health on quality of life than those who have siblings, while the effect of the number of siblings a child has on their OHRQoL is inconclusive from the results of the reviewed studies. Other factors that significantly influence children's OHRQoL comprise familial use of deleterious substances, maternal dental anxiety and dental services usage.

This is first study that has systematically reviewed the literature on the effect of parental socio-economic and home environment characteristics on children's OHRQoL. A systematic review [53] has been published recently that evaluated the effect of socio-economic characteristics on OHRQoL, which also included studies on children. In order to avoid exclusion of potential articles that had keywords other than those we have used, a broader term "Oral Health Related Quality of Life" was used to search "all fields". We have not included other studies with the predictors "ethnicity", "urbanisation", "school type", "dental fear" and "dental visits" as these are not directly related to either socio-economic or home environment characteristics. One of the limitations of the present review is the lack of quantitative data presentation by meta-analysis. Meta-analysis was not possible due to extremely heterogeneous data from the studies included, with categorisation of both the outcomes and exploratory variables differing between the studies.

Conclusions

Accurate conclusions from the studies reviewed are not possible due to the difference in the study population, methods used and statistical tests performed. In general, children from families with high income, parental education and family economy had better OHRQoL. Mothers' age and home environment characteristics, such as family structure, household crowding and presence of siblings were significantly related to the outcome. Although the association of children's OHRQoL and variables like location of origin of parents in relation to study location, deleterious habits in the family, mother's dental anxiety and use of dental services were significant, the evidence is not strong enough as the data supporting their relationship with the outcome is only from one study. Lastly, the conclusions from the current review cannot be generalised to the whole population as the studies reviewed were not representative from the whole world, and nearly half of the articles were Brazil-based studies.

Additional file

Additional file 1: Table S1. Overview of the studies on children between the ages 10 – 15 years.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

SK, JK and RL participated in designing and developing the literature search protocol for the review. SK conducted the literature search, extracted and interpreted the data from relevant articles. JK and RL contributed in scrutinising the data extraction. All the authors contributed in drafting and approval of the final manuscript.

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