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Birth order as a predictor of dental caries: A systematic review and meta-analysis of case-control and prevalence data from the last decade

Munirah Ibrahim Alsaeed[1], **Abdullah Omar Alabdulkarim**[2], **Ruba Saud Alkabani**[3]

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Authors' Affiliation:
[1]General Practitioner, Ministry of Health, KSA
[2]Medical intern, King Saud bin Abdulaziz University for Health Sciences (KSAU-HS), KSA
[3]Pediatric Resident at King Saud Medical City, KSA

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ABSTRACT

Aim: This systematic review aims to quantitatively assess the association between birth order and dental caries. *Methods:* In this systematic review, we identified the studies that were published in the last ten years in four electronic databases that are PubMed, Web of Science through Clarivate, MEDLINE through Clarivate, and EBSCO. We used the "Rayyan – Intelligent systematic reviews" website for duplicate removal and study screening. Review Manager 5.4 was used for quantitative data synthesis to estimate pooled odds ratios (OR). Higgin's I^2 test was used for detecting inter-study heterogeneity, and visual inspection of funnel plots was used to detect publication bias. *Results*: Our study included 83286 children from 7 studies. Our results indicated a considerable risk for being born second or younger (OR = 1.13 95% CI [1.09, 1.17], P < 0.001, I^2 = 96%), the third or younger (OR = 1.61 95% CI [1.53, 1.70], P < 0.001, I^2 = 95%), the fourth or younger (OR = 2.46 95% CI [2.25, 2.70], P < 0.001, I^2 = 94%), and being among each study's youngest group (OR = 2.41 95% CI [2.16, 2.69], P < 0.001, I^2 = 96%). *Conclusion:* The risk of caries was shown to be directly connected to a child's ordinal rank in the household. We discovered a significant risk that grows as the birth order rises. Because our data in all pooled studies were varied, caution should be exercised in interpreting the results.

Keywords: Dental caries; birth order; children; meta-analysis

1. BACKGROUND

Dental caries is one of the greatest mutual chronic disorders in people all over the world. It is a multifaceted illness that begins with microbial alterations inside the intricate biofilm (dental plaque). Dietary sugar consumption, salivary flow, fluoride exposure, and preventative behaviors all influence caries (Selwitz et al., 2007). Caries among the pediatric population in Western Europe has decreased in recent decades, according to epidemiological research (Downer et al., 2005; Marthaler, 2004; Hugoson et al., 2008).

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Meanwhile, by the end of the 1980s, however, there was a trend toward a plateau in caries decrease in pre-school children (Hugoson et al., 2005; Stecksén-Blicks et al., 2004). Additionally, the frequency of dental caries is on the rise in many affluent nations, particularly among young children (Haugejorden & Birkeland, 2002). As a consequence, caries remained common in children and teenagers (Nithila et al., 1998; Marthaler, 2004), affecting 46 percent of 4-year-olds and 80 percent of 15-year-olds (Stecksén-Blicks et al., 2004; Hugoson et al., 2008).

Furthermore, dental caries is a public health issue since it is a common ailment that is expensive to treat and affects the excellence of natural life of children of all ages (Low et al., 1999; Filstrup et al., 2003; Ismail, 2004). Preventing caries disease is therefore critical, but this will only be effective if exist scientific information about how to change the disease's etiological components is put to use. However, there are still a few issues and conditions associated with caries in kids and teenagers that are not completely understood, and it is critical to evaluate them in order to improve the basis for evidence-based prevention, such as approximal caries prevalence in permanent posterior teeth in adolescents, past caries experience in the primary teeth in relation to future caries development and treatment needs, and factors during early childhood whimsy.

There is currently insufficient data on birth order and its possible link to dental caries. Currently, the few studies that have investigated the relationship between birth order and dental caries have yielded conflicting results. Selwitz et al., (2007) attempted to find characteristics related to a greater caries risk, including higher birth order. Their findings identified the parents' educational level as a significant predictor concomitant with caries hazard, although birth order was determined to be not a significant determinant. Furthermore, when Tiberia et al., (2007) studied variations in caries experience based on birth order, birth order provided inconsistent findings for the sample. When the author used logistic regression, however, this effect was negated, and being the first-born became the greatest imperative hazard factor. There are gaps and contraindications in the present research on birth order and caries experience/risk. These constraints necessitated the launch of a comprehensive research study to look deeper into the perplexing relationship and seek to elucidate the probable association between birth order and dental caries.

Study question

Is having a late birth order a risk factor for dental caries among siblings in comparison with being the first or only child?

2. METHODOLOGY

Study design

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (PRISMA, 2020) were tracked in the current systematic review.

Study duration

We conducted this review during the period from 01 to 28 February 2022.

Study condition

This review investigated the relevant publications regarding dental caries/early childhood caries (ECC) in association with the birth order of the child.

Search strategy

We identified the included studies that were issued during the previous 10 years, where our search began on 31 January 2012 until 31 January 2022. We performed the search strategy on each of the following electronic databases: PubMed, Web of Science complete Clarivate, MEDLINE complete Clarivate, and EBSCO. The MeSH terms that were used for searching were "dental caries" and "birth order."

The search strategy used for each database was as follows:

Web of science through Clarivate: dental caries (Abstract) AND birth order (Abstract), MEDLINE complete Clarivate: dental caries (Abstract) AND birth order (Abstract), PubMed: ("Dental Caries" [Mesh]) AND "Birth Order"), and ("Dental Caries" [Mesh]) AND "Birth Order" [Mesh]), and EBSCO: (DE "DENTAL caries" OR DE "SECONDARY caries (Dentistry)") AND (DE "BIRTH order").

Study selection process

The following criteria were used during the screening process for study inclusion: Studies using valid methods or tools for identifying caries, Studies providing descriptive analysis and case-control data where cases are children with active caries or caries experience, and controls are children, who are caries-free, Studies providing data on birth order with children count on each category or subgroup. Studies were excluded if: Studies on the adult population, Studies not available in the English language.

Data extraction

We used Rayyan – Intelligent Systematic Review (Ouzzani et al., 2016) for managing the studies that were imported from the search by detecting and removing duplicates. Using keywords for inclusion and exclusion, we stayed talented to conduct a blind title and abstract screening, followed by a full-text assessment. We used a Microsoft Excel (Microsoft Corp., Redwood City, Calif., USA) sheet to extract data from included studies. We extracted information including study ID, title, author, year, design, population, gender, participant count for cases and controls, birth order, and occurrence of caries in each birth order category.

Strategy for data synthesis

Strictly following the study selection criteria yielded only studies that are valid to be enrolled for the quantitative data synthesis. To perform the meta-analysis on the quantitative data extracted from the included studies, we used Review Manager 5.4 software (RevMan 5.4, The Cochrane Collaboration, London, UK). We generated forest plots to visualize the estimated effect size along with the 95% confidence intervals (95% CI) of the individual studies, along with the pooled values. We used a fixed-effect model for the meta-analyses. Inter-study heterogeneity stayed judged by the I-square test using, where the threshold for significant heterogeneity was set at $P < 0.1$ or $I^2 > 50\%$. Funnel plots were used for visual inspection and assessment of publication bias.

3. RESULTS

Search results

We retrieved a total of 109 studies from searching the aforementioned electronic databases. Duplicates detection and removal resulted in the removal of 44 studies, with a total of 65 studies remaining for the enrollment for the title and abstract screening. Following the heading and abstract screening were performed, a total of 26 studies were excluded for irrelevant findings or wrong outcomes or population (table 1). Full-text assessment of 39 studies was conducted, and an entire 7 studies complied with the study selection criteria. Figure 1 summarizes the search and study selection process.

Table 1 Characteristics of included studies and caries prevalence among each birth order category

Study	Study design	Population type	Participant number	Age range	Males (n)	Males (%)	Country	Condition	First child (caries)	First child (total)	Second child (caries)	Second child (total)	Third child (caries)	Third child (total)	Fourth child (caries)	Fourth child (total)	Fifth child or younger (caries)	Fifther child or younger (total)
Borowska-Strugińska et al., 2015	Cross-sectional		1131	5 to 13	571	50%	Poland	Caries	81	255	85*	200*						
Dabawala et al., 2016	Case-control	Preschool children	422	.	197	47%	India	Early childhood caries (ECC)	117	217	59	123	9	15	3*	27*		
Folayan et al., 2015	Cross-sectional	Preschool children	497	6m to 71m	266	53.50 %	Nigeria	ECC	11	245	22*	247*						
Folayan et al., 2017	Cross-sectional	Household children	601	5 to 12	291	48.40 %	Nigeria	Caries	16	190	73*	406*						
Grieshaber et al., 2022		School children	6738	4 to 15	3466	51.40 %	Switzerland	Active caries	510	3089	681	3089	128	494	16 *	66*		
								Caries experience	1540	3089	1436	3089	231	494	32 *	66*		
Julihn et al., 2020	Retrospective registry-based cohort study	Children born in 2000-2003	65259	3 to 7	33423	51.20 %	Sweden	Caries increment	5800	30524	5168	23488	2393	8250	805	2063	449 *	934 *
Singh & Vijayakumar, 2020	Cross-sectional	School children	1900	13	.	.	India	Caries	644	856	493	920	75*	124 *				

* This category includes all younger siblings.
ECC = Early childhood caries

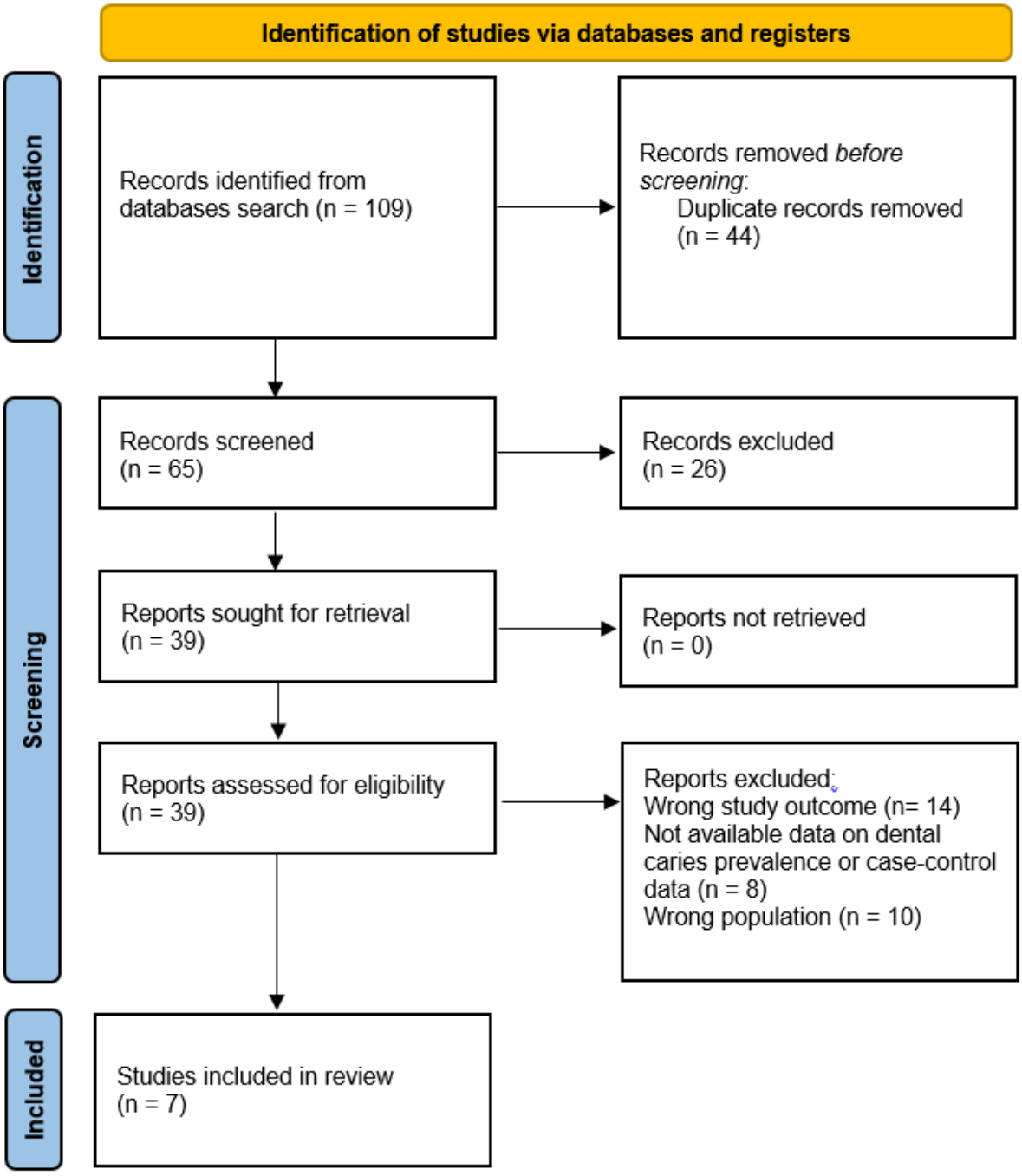

Figure 1 PRISMA flow diagram for the search process

Study characteristics

A total of 83286 children were included from 7 studies, two of which were conducted in Nigeria (Folayan et al., 2015; Folayan et al., 2017), two from India (Dabawala et al., 2016; Singh & Vijayakumar, 2020), one from Sweden (Julihn et al., 2020), one from Poland (Borowska-Strugińska et al., 2015), and one from Switzerland (Grieshaber et al., 2022). Wholly of the encompassed studies assessed caries prevalence among children. The earliest age cluster was that of the study of Folayan et al., 2015 as they included youngsters old 6 to 71 months, whereas the study of Grieshaber et al., 2022 included children aged 4 to 15 years. The proportion of males ranged from 47% in the work of Dabawala et al., 2016, to 53.5% in the work of Folayan et al., 2015.

Quantitative data synthesis

As shown in figure (2), at hand was a substantial risk for being the second child or young when compared to first or only child groups as a control (OR = 1.13 95% CI [1.09, 1.17], P < 0.001, I^2 = 96%). Our meta-analysis also shows that children born third or younger are at advanced hazard for dental caries in comparison with the first or only child control group (OR = 1.61 95% CI [1.53, 1.70], P < 0.001, I^2 = 95%). The fourth child or younger group was also equated by the 1st or only child group and stood established to be at advanced threat for developing dental caries, where the risk is higher than the two previous comparisons (OR = 2.46 95% CI [2.25, 2.70], P < 0.001, I^2 = 94%) (Figure 3). Finally, we compared the youngest group of every included study and compared it with the eldest (first or only child) as a control and found a significant risk for developing dental caries amongst the younger group (OR = 2.41 95% CI [2.16, 2.69], P < 0.001, I^2 = 96%) (Figure 4 and 5). However, as indicated by Higgin's I^2 test, pooled data were heterogeneous in all analyses performed. We used funnel plots inspection to visually assess for significant publication bias, and there is a symmetrical distribution of ORs change in the comparisons (figure 6).

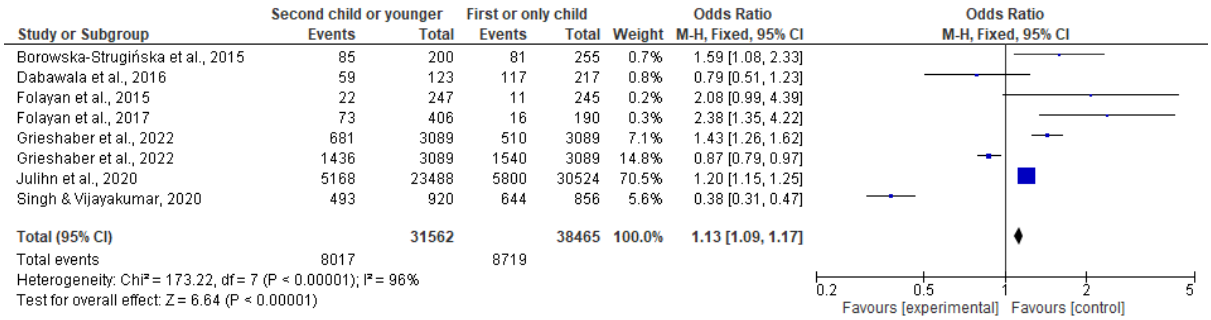

Figure 2 Forest plot of being the second child or younger in comparison to being the first or only child as a hazard influence meant for dental caries.

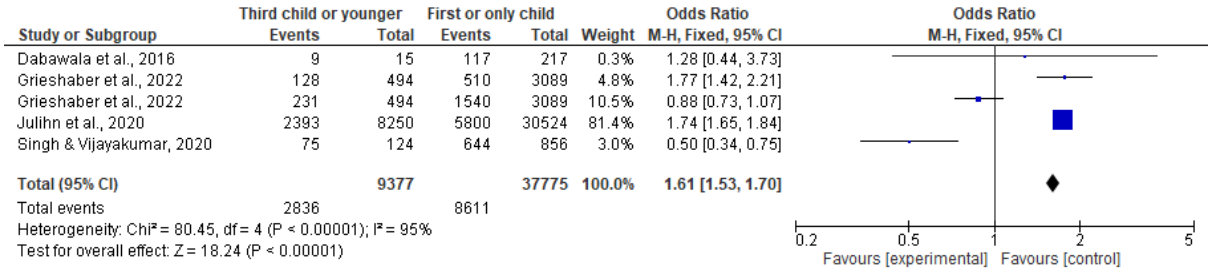

Figure 3 Forest plot of being the third child or younger in comparison to being the first or only child as a hazard influence meant for dental caries.

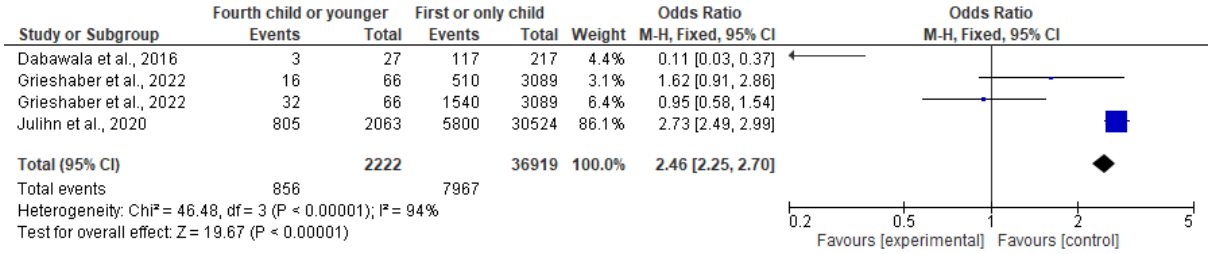

Figure 4 Forest plot of being the fourth child or younger in comparison to being the first or only child as hazard influence meant for dental caries.

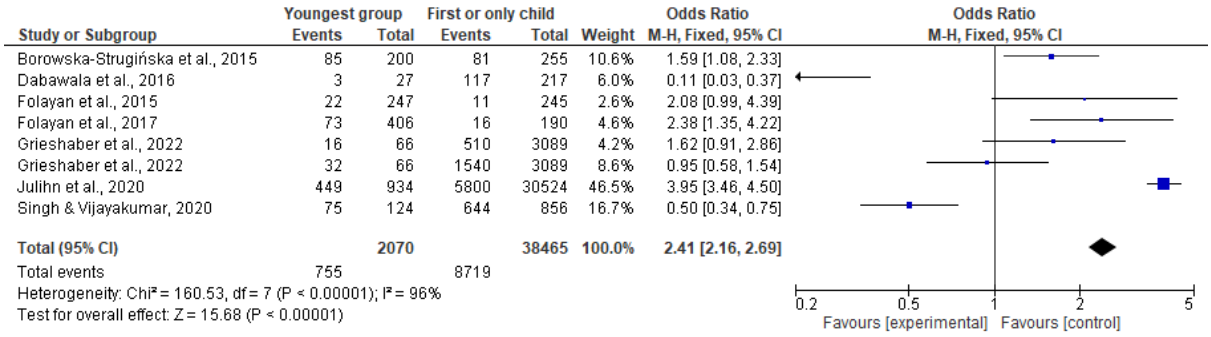

Figure 5 Forest plot of being among the youngest subgroup in comparison to being the first or only child as hazard influence meant for dental caries.

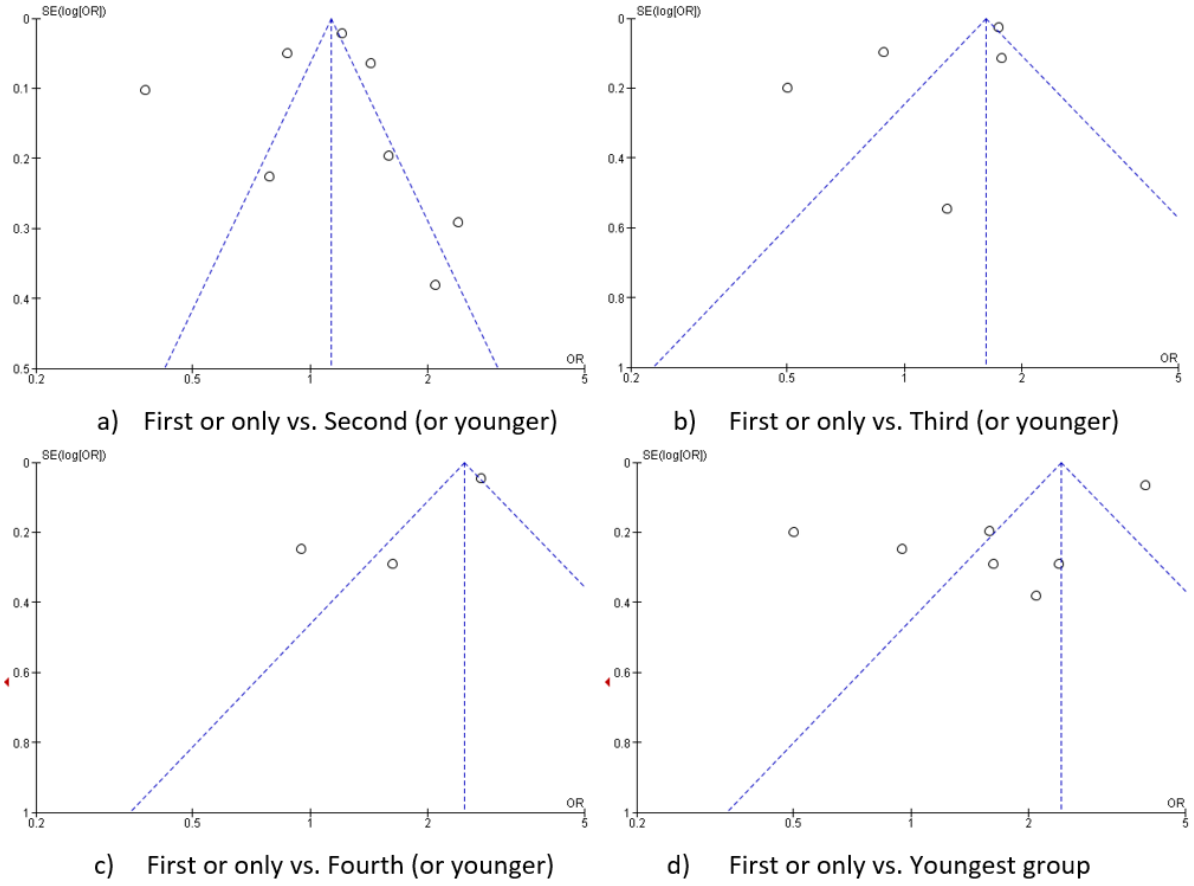

Figure 6 Funnel plots for assessing publication bias

4. DISCUSSION

Dental caries is a multifaceted and widespread dental disease that affects equally youngsters and grownups (Kassebaum et al., 2015). The occurrence of caries has decreased in several developed countries by implementing population-wide, individual preventative interventions, for instance, the use of fluoride dentifrices and toothpaste, the reduction of dietary sugars, or school-based intervention programs. Dental caries, while being entirely avoidable, is nevertheless a chief community health issue worldwide, with the incidence rising in low- and middle-income countries (Peres et al., 2019; Watt et al., 2019). Many risk factors and caries predictors have been identified, including some related to family structure (Wellappuli & Amarasena, 2012; Kinirons & McCabe, 1995).

This systematic review and meta-analysis aimed to assess the association between birth order and dental caries. We screened four major databases, namely PubMed, MEDLINE through Clarivate, Web of Science over Clarivate, and EBSCO. A total of 83286 youngsters stood encompassed in our meta-analysis from seven studies that were enrolled for the data synthesis. We found a significant association between birth order and dental caries as we compared different birth order groups with the control group that is being born first or being the only child and our analyses revealed significant risk for being born the second or younger (OR = 1.13 95% CI [1.09, 1.17], $P < 0.001$, $I^2 = 96\%$), the third or younger (OR = 1.61 95% CI [1.53, 1.70], $P < 0.001$, $I^2 = 95\%$), the fourth or younger (OR = 2.46 95% CI [2.25, 2.70], $P < 0.001$, $I^2 = 94\%$), and being among each study's youngest group (OR = 2.41 95% CI [2.16, 2.69], $P < 0.001$, $I^2 = 96\%$). Because randomization is impossible, observational studies are the only approach in the direction of defining the link between etiological variables and illness in the community.

Parental qualities have a strong influence on a child's overall health and oral health (Kumar et al., 2016; Mattila et al., 2005; Freire de Castilho et al., 2013). Pre-school children are said to have a bigger parental consequence on oral health than older children (Christensen et al., 2010). Our findings are consistent with those reported by Wellappuli and Amarasena (2012), who found that a birth rank of greater than one was substantially related to dental caries involvement in 3–5-year-old children when compared to children with a birth rank of one. Previous research on the effects of birth order and family size on dental caries has yielded conflicting results.

According to one study, children with either extreme of birth order (birth rank one and higher than three) were more prone to dental caries than infants with birth orders of 2 or 3 (Primosch, 1982). Caries-free pre-school children have similarly been conveyed to be more common in lower birth orders (Johnsen et al., 1980). In dissimilarity to the outcomes of this research, Wigen et al., (2011) found no link between the existence of old brothers and sisters in the household and caries occurrence in 5-year-old youngsters in Norway. The finding that a child's order situation in the household was unswervingly connected to the danger of caries is noteworthy, and it aligns with Chung et al., (1970) who discovered a positive association between increasing ordinal rank among the household and caries prevalence in 12- to 18-year-old children.

We hypothesize that when a family has a big digit of children, parents may provide less personalized care and attention to each child. Our assumption is based on Blake's (1989) resource dilution hypothesis, which was further developed by Downey (2001). According to the resource dilution hypothesis, sibling characteristics such as the digit of youngsters in a household as well as the delivery number situation of kids are connected to the traditional and factual incomes provided by parents to their offspring. The more children a family has, or the late their order of delivery, the further they must portion household incomes, with the poorer their performance (Marjoribanks, 2001).

In agreement with this hypothesis, a study suggested that the eldest siblings report receiving much more psychological support from their parents than the youngest (Terada, 2006). Other possibilities for the birth-order effect's processes include sibling effects and purposeful parental behavior (Zajonc, 1976; Hotz & Pantano, 2015). Differences in dental caries prevalence between developed and developing countries could be due to age group differences, but they could also be due to ethnic, cultural, regional, racial, and growing disparities, as well as access to dental treatments, which might all play a role, health-care behaviors, behavioral habits, nutritional habits and behaviors, and lifestyle differences (Dixit et al., 2013). The effects of parents' want of consciousness of their youngsters' tooth deterioration grade, along with negligence and consideration judgment, are well documented in Nag et al., (2012) study, in which it is suggested that caries proportions remained greater in daughters than boys in the generation of 6 to 18 an age because daughters are extra ignored by their parents.

Relatives and parents ought to be aware that dental treatment for children should begin during the mother's pregnancy since caries is more likely to occur in kids born to moms who have numerous dental caries later in life. Using a serve or a flask of milk, cariogenic germs are regularly transmitted from the mother's lips to the child's entrance for the 1st spell. Regular dental check-ups should begin as soon as the baby's main teeth emerge, especially when the 1st enduring tooth, 1st molar incisor, or sixth tooth emerges.

5. CONCLUSION

It can be concluded from our meta-analysis that a kid's ordinal situation in the family was right related to the danger of caries. We found a significant risk that increases with the increase of birth order. Our data in all pooled analyses were heterogeneous; therefore, maintenance is essential to be taken while interpreting these findings. We recommend future studies investigate the link between birth order and tooth decay while controlling for other sociodemographic confounders.

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Author Contributions

Authors contributed equally in search implementation as well as data extraction and manuscript writing.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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