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DENTAL CARIES AMONG DOWN'S SYNDROME POPULATION IN SAUDI ARABIA: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstract:

Down's syndrome (DS) is the most common cause of hereditary intellectual impairment in humans. DS is also associated with characteristic facial features that are believed to have oral health effects. This systematic review and meta-analysis aimed to evaluate the prevalence of dental caries among the DS population in Saudi Arabia.

A systematic search was conducted on PubMed, Web of Science, and Medline through Clarivate and EBSCO to identify potentially eligible publications. Rayyan QCRI analysis tool was used for duplicate detection, and study screening, whereas Review Manager (RevMan Computer program Version 5.4) the Cochrane Collaboration, 2020. was used to conduct a random-effects meta-analysis on prevalence data and DMFT scores. Data was synthesized, both, qualitatively and quantitatively (presented as forest plots).

The search resulted in 267 studies, of which seven studies were included with a total population of 565. The pooled DMFT score among the DS population in Saudi Arabia is 4.88 (95% CI: 3.66 – 6.09), and the pooled prevalence of dental caries was 73% (95% CI: 52% - 93%). High levels of heterogeneity were observed in both analyses (I^2 = 91%, and 96%, respectively).

Our study reports a relatively high dental caries prevalence among the DS population in Saudi Arabia. Pooled DMFT score for permanent teeth among our study sample was higher than those reported by other meta-analyses conducted on the disease-unrestricted populations in Saudi Arabia.

Keywords: *Down's syndrome; dental caries; Saudi Arabia, DMFT, tooth decay, meta-analysis.*

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INTRODUCTION:

Down syndrome (DS) is a genetic condition in which a person's chromosomal count is increased to 47 instead of the normal 46. Because three copies of chromosome 21 are found in the majority of instances, this condition is also known as "trisomy 21." The most prevalent cause of hereditary intellectual impairment in humans has been identified as Down syndrome.[1] In the United States, DS affects around one in every 800 live births, resulting in 350,000 people. [1] This condition affects men somewhat more than women, and Hispanics are at a greater risk than the general population.[2] Having a kid with Down syndrome becomes more likely as the mother's age rises. The danger ratio is 1:1000 at 30 years old, and by age 40 it has risen to 9:1000. [3]

Although the severity and presentation of Down syndrome vary, the majority of DS individuals have a number of symptoms. Eighty percent of people with Down syndrome have an IQ of 25 to 50. Their birth height and weight are usually below normal, with a growth delay. [3,4] These people have weakened immune systems, which makes them more vulnerable to infections of the gastrointestinal, respiratory, and urinary tracts. [5] They're also more likely to have leukemia, hypothyroidism, and congenital cardiac problems.[4] Furthermore, many people with DS have a low height, a simian crease, and an abnormal facial appearance (eyes with a laterally directed upward slope, narrow palpebral fissures, small ears, and a short, broad nose). [3]

Increased drooling, angular cheilitis, dry mouth, and an increased incidence and severity of fissured tongue and lower lips may be linked to the skeletal and soft tissue characteristics of DS patients. [6,7] Some DS patients exhibit bruxism (tooth grinding), a behavioral manifestation that may lead to changes in tooth morphology and mineralization. [8,9]

Macroglossia, delayed eruption, microdontia, hypodontia, bruxism, generalized spacing among teeth, conoid teeth, fusion/gemination, enamel hypocalcification, mouth breathing resulting in dry mouth, fissured tongue and lips, high incidence of oral candidiasis, mucosal ulcers, acute necrotizing ulcerative gingivitis, and imbalanced occlusion are just a few of many reported oral problems associated with DS. [3,4,10,11]

Previous research has shown that children with Down Syndrome had lower rates of dental caries than children without the condition. [10] Some of the aforementioned oral symptoms, such as widespread diastemas and delayed eruption, provide some protection against dental caries. Recent research has shown that DS patients display three dental cavities in the same way as their healthy counterparts. [3,10,11]

Due to the research's inconclusive findings, and lack of large-scale studies in Saudi Arabia, this study aims to systematically review the dental caries burden among the DS population in Saudi Arabia.

METHODOLOGY:

Study design and duration:

This is a systematic review and meta-analysis. The study was conducted during July 2021.

Study condition:

This study investigates the published literature reporting the prevalence of dental caries and/or DMFT scores among the Down's syndrome population in Saudi Arabia.

Search strategy:

An electronic systematic literature search of three major databases, PubMed, Web of Science, and Medline through Clarivate and EBSCO, was conducted to include relevant and eligible study articles. The search was limited to the English language and each database as needed. Boolean operators such as "OR" and "AND" were used in combination with the appropriate keywords. The search keywords for each database were as follows:

Pubmed
"Down Syndrome" AND Caries AND "Saudi Arabia, Trisomy 21 AND Caries AND Saudi Arabia, Down syndrome AND Dental AND Saudi Arabia, Down syndrome AND Oral AND Saudi Arabia, and Trisomy AND Dental AND Saudi Arabia, Trisomy AND Oral AND Saudi Arabia.
Clarivate (Web of science & MedLine)
Down
syndrome (Topic) and Caries (Topic) and Saudi Arabia (Topic).

EBSCO
Down syndrome AND Dental AND Saudi Arabia, AB (Down syndrome or trisomy 21 or down's syndrome or down's or trisomy) AND AB caries AND AB Saudi Arabia, Down syndrome AND Oral AND Saudi Arabia, Trisomy AND Oral AND Saudi Arabia, and Trisomy AND Dental AND Saudi Arabia.

Selection criteria:

This review included the studies with the following criteria:

Analytical studies reporting the prevalence of dental caries and/or DMFT scores among DS population in Saudi Arabia.

No age or sex restrictions were set.
Exclusion criteria comprised the following:
Studies not conducted in the English language.
Studies with no free access.

Data extraction:
Rayyan (QCRI)[13] data analysis tool was used to identify the duplicate records of the search strategy results. The reviewers screened titles and abstracts for convenience by investigating the pooled search results utilizing a set of inclusion/ exclusion criteria. The researchers evaluated the full text of the study articles that met the inclusion criteria. They overcame any disagreements or conflicts through debate and discussion. To comprise the eligible articles, a data extraction sheet was created. The reviewers extracted data of the study titles, authors, study year, study design, study population, participants' age, and gender, total number of participants, prevalence of dental caries, and DMFT score.

Strategy for data synthesis:
To produce a qualitative overview of the included research characteristics and result data, summary tables containing the collected details from the eligible studies were presented. After the data processing was evaluated, the extent of the proposed pooled analyses was investigated. Following the conclusion of data extraction in this meta-analysis, decisions were made on how to improve the use of prevalence data, as well as the numerical data of the DMFT scores. A qualitative synthesis of the determined data was performed regardless of the feasibility of the pooled meta-analyses.

To conduct quantitative data synthesis for the effect size of interest, the authors utilized Review Manager 5.4 (Review Manager, 2020). A random-effects generic inverse variance meta-analysis was used to pool the prevalence of dental caries, as well as to pool the DMFT scores obtained from the included studies. An I-square statistic was used to measure heterogeneity as part of the pooled meta-analysis. To evaluate publication bias, the funnel-plot and funnel-plot symmetry measures were performed.

RESULTS:

Search results:
The initial systematic search yielded a total of 267 studies. Rayyan (QCRI) identified and removed 116 duplicates from these studies. After the title and abstract screening, 90 studies were excluded due to irrelevant findings, inappropriate research type or design, and 61 studies were enrolled for the full-text screening, which resulted in the exclusion of 54 studies due to irrelevant analysis or wrong outcome. This screening process eventually resulted in a total of 7 eligible studies for quantitative and qualitative data synthesis. The selection process and identification are summarized in **Figure (1).**

Characters of the included studies:
The study included 7 studies ([14,15,16,17,18,19,20])two of which were conducted in Riyadh city [15,17] , two in Makkah [14,19], and three in Aseer, Al-Qassim, and AlKharj [16,17,20]Total number of participants in the included studies is 565. Participants were of both sexes with age ranges from 0 to 24 years.

Dental caries among DS population in Saudi Arabia:
A random-effects generic inverse variance meta-analysis was conducted, and the pooled prevalence of the dental caries among the DS population in Saudi Arabia from three studies was 73% (95% CI: 52% - 93%), P=0.000, there was significant heterogeneity (I^2 = 91%, P=0.000) (Figure 2).

The mean DMFT scores in 10 sets of groups from six studies was 4.88 (95% CI: 3.66 – 6.09), P=0.000, with significant heterogeneity (I^2 = 96%, P=0.000) (Figure 3).

Sandeepa et al., 2021[16] reported DMFT scores among four age groups (0-6, 7-12, 13-18, and 19-24 years), where DMFT scores reported were increasing with older groups (7.57 ± 5.1, 9.42 ± 3.9, 12.56 ± 6.6, 13.21 ± 7.7, respectively).

Similarly, Al-Khadra[17] reported DMFT scores among two age groups (7-14, and 15-22 years), where DMFT scores were 3.93 ± 1.64, and 4.11 ± 1.77, respectively.

Publication bias and inter-study heterogeneity:
Visual inspection of the funnel plots reveals an asymmetrical distribution of the DMFT scores (figure 4a), and dental caries prevalence (figure 4b). We used Higgin's I2 test to assess inter-study heterogeneity. There was significant heterogeneity in both analyses performed (dental caries prevalence: I^2 = 91%, P=0.000; and for DMFT scores: I^2 = 96%, P=0.000).

DISCUSSION:

This systematic review and meta-analysis included 7 articles with a total population of 565. The pooled DMFT score among DS population in Saudi Arabia is 4.88 (95% CI: 3.66 – 6.09), and the pooled

prevalence of dental caries was 73% (95% CI: 52% - 93%). High levels of heterogeneity were observed in the aforementioned analyses (I^2 = 91%, and 96%, respectively).

Our DMFT score pooled from Saudi studies (4.88 (95% CI: 3.66 – 6.09)) was higher than that reported in the study of Al Habashneh et al.[21] as the mean (± SD) DMFT score of a sample of DS individuals from Jordan was 3.32 ± 3.77.

Another study conducted in Hebrew University Hadassah School of Dental Medicine comparing 70 children with DS with 32 healthy controls reported a lower mean DMFT score (± SD) among the DS group (3.37 ± 0.56) than the Saudi studies pooled in our meta-analysis. [22]

The systematic review and meta-analysis of Robertson et al.[23] included DMFT data of 685 DS individuals from 11 studies found that the pooled DMFT score (mean ± SD) to be 1.87 ± 1.08, which is lower than our pooled DMFT score.

Though little evidence is present, a limited number of studies and high heterogeneity is evident in our analyses; these aforementioned findings suggest a higher DMFT score among the DS population in Saudi Arabia than the countries pooled in the Robertson et al. study. [23]

DMFT scores included in our study ranged markedly (1.5 ± 1.7 – 12.56 ± 6.6), scores from older populations seem to be higher. DMFT scores were assessed in the study of Sandeepa et al., 2021[16] in four age groups (0-6, 7-12, 13-18, and 19-24 years), finding that DMFT scores increased with age (7.57 5.1, 9.42 3.9, 12.56 6.6, and 13.21 7.7). Similarly, the DMFT scores of two age groups were reported by Al-Khadra, 2011[17] (7-14 and 15-22 years), with DMFT scores of 3.93 ± 1.64 and 4.11 ± 1.77, respectively.

The systematic review and meta-analysis of Deps et al., [24] was conducted to assess the possible association between DS and dental caries, where they compared 943 individuals with DS (case) with 936 individuals without DS (controls). Authors reported that subjects with DS have lower dental caries prevalence than controls, OR = 0.36; (95% CI: 0.22–0.57).

Our current study did not compare the DS population with healthy controls; however, a meta-analysis pooled the DMFT scores of permanent teeth from seven studies, including the Saudi pediatric population revealed a pooled DMFT score of 3.4 (95% CI: 1.9-4.8), which is lower than the pooled score in our analysis.

Another meta-analysis reporting lower pooled DMFT score than ours is the study of Alayyan et al., [25] which pooled DMFT scores from the Gulf Cooperation Council States, including 8 (out of 15) data sets from Saudi Arabia found that the pooled DMFT score was 2.6 (95% CI: 2.5 – 2.6).

Limitations:

Since data from all areas of Saudi Arabian was not obtained, our study may have lacked national representativeness. Furthermore, this study pooled only the DMFT scores of DS groups, whereas studies comparing DS groups to controls were lacking. As a result, additional research is needed to determine the risk of developing dental caries in the Saudi DS community. Furthermore, significant inter-study heterogeneity may limit the confidence in the accuracy of our findings; thus caution should be taken when interpreting the data.

CONCLUSION:

Our study reports a relatively high dental caries prevalence among the DS population in Saudi Arabia. Pooled DMFT score for permanent teeth among our study sample was higher than those reported by other meta-analysis conducted on the disease-unrestricted populations in Saudi Arabia.

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Figure (1): PRISMA chart summarizing the systematic search process.

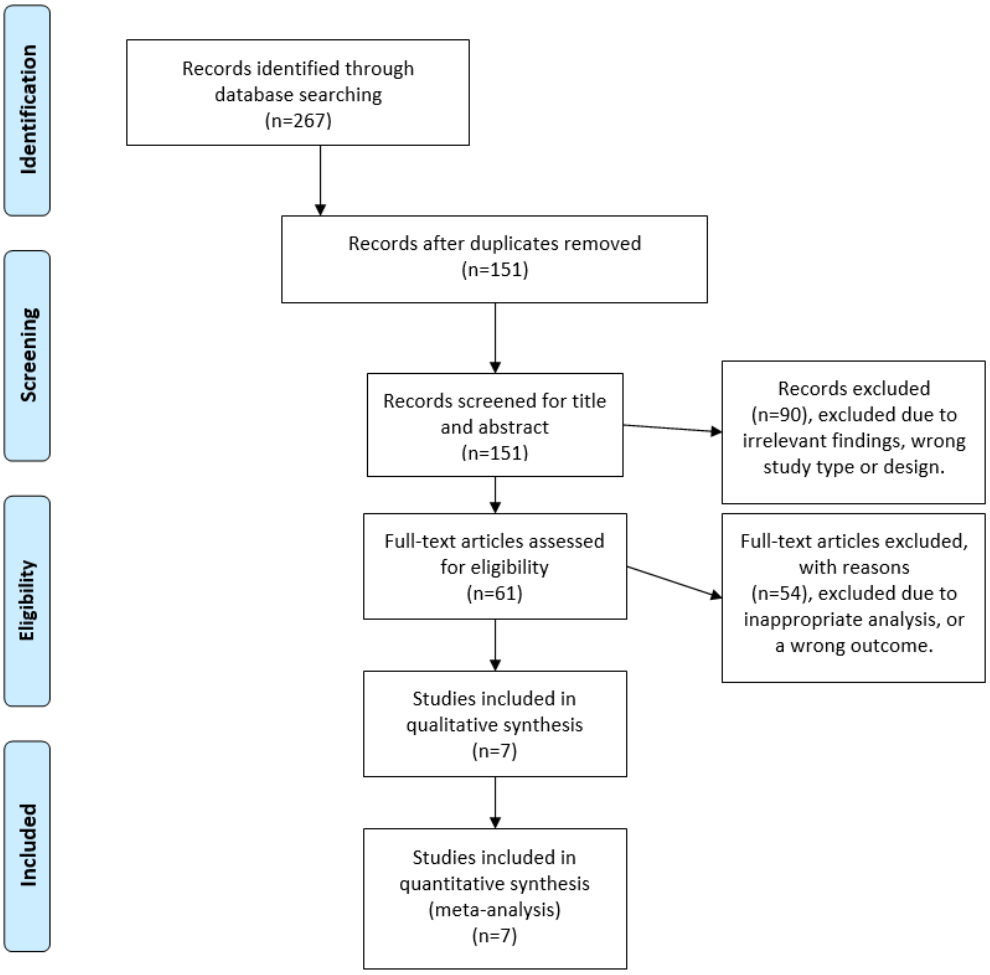


Table (1): Characteristics of the included studies (n=7)

Study	Study design	Population type	Participants number	Age range	Age (Mean)	Males, n (%)	Country	City	Condition
Ashour et al., 2018	Cross-sectional	Down syndrome	52	6 to 17			Saudi Arabia	Makkah	Dental caries
AlSarheed, 2015	Cross-sectional	Down syndrome	93		10.75	59 (63.4%)	Saudi Arabia	Riyadh	Dental caries
Sandeepa et al., 2021	Cross-sectional	Down syndrome	56	0 to 24		11 (19.6%)	Saudi Arabia	Aseer	Dental caries
Al-Khadra, 2011	Cross-sectional	Down syndrome	224	3 to 22		131 (58.5%)	Saudi Arabia	Riyadh	Dental caries
Al-Otaibi et al., 2016	Case-Control study	Down syndrome	36	6 to 12			Saudi Arabia	Al-Qassim	Dental caries
Alzughaibi et al., 2017	Case-Control study	Down syndrome	100	4 to 15			Saudi Arabia	Makkah	DMFT
Shah et al., 2014	Cross-sectional	Down syndrome	4				Saudi Arabia	AlKharj	DMFT

Figure (2): Forest plot of prevalence of dental caries among Down syndrome population in Saudi Arabia.

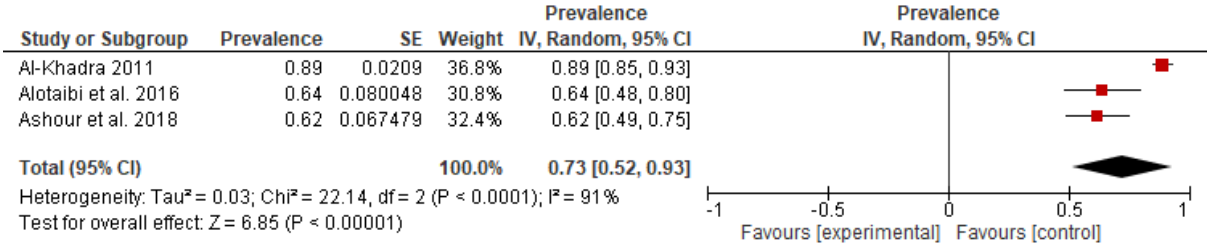


Figure (3): Forest plot of pooled DMFT scores among Down syndrome population in Saudi Arabia.

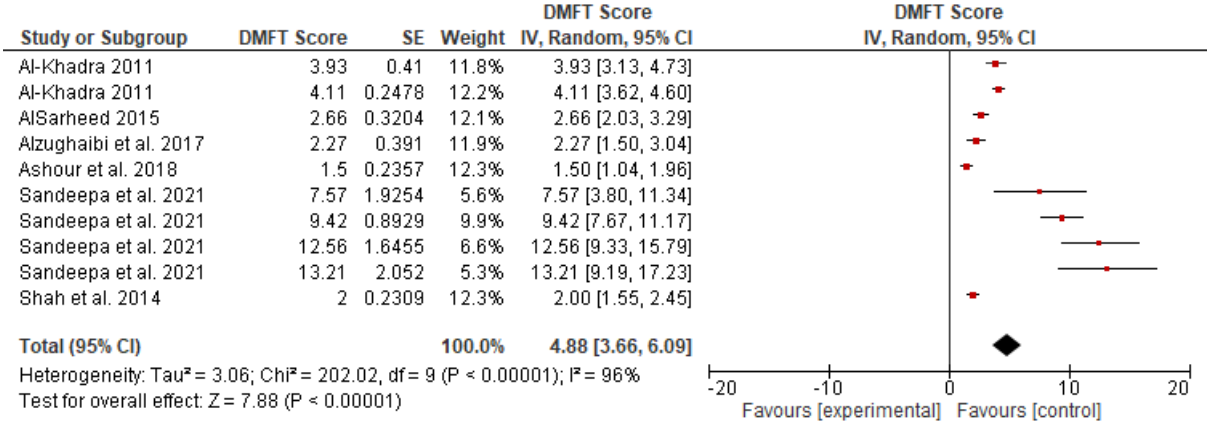
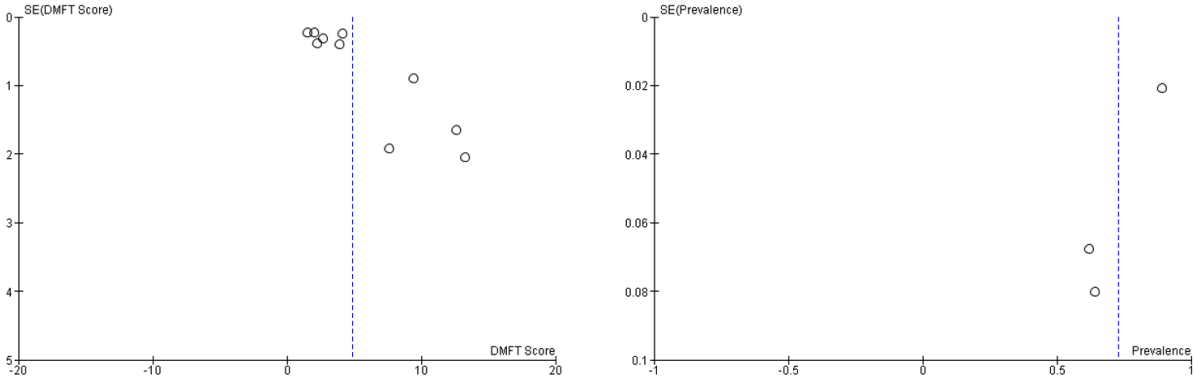


Figure (4): Funnel plots for visual detection of publication bias



a) DMFT Scores b) Caries prevalence