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Research Article

Prevalence and Severity of Dental Carries in First Permanent Molars and it is Relation to Body Mass Index in Children Age 7-9 Years of Private Primary School in Babil Province of Iraq during 2024 – 2025

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KEY WORDS:
BMI
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Caries prevalence
First permanent molars

Abstract: Body mass index is an important indicator of overall body health and directly affected oral health. Since dental caries is worldwide, spread chronic disease so the object of this study is to evaluate the relation between body mass index and severity of dental carries. Study the association between body mass index categories and severity of dental caries, measuring the prevalence of caries in 7-9 years old children. This is a cross-sectional descriptive analytic study including 619 children 7-9 years old in private primary schools in Bible province of Iraq selection based on specific criteria (largest student population) used non-probability sampling technique (Purposive Sampling). Measuring length and weight for all participant and dental caries of four first permanent molar examined according to WHO recommendation by using dental mirror and explorer probe under natural light and DMFT and DMFS score are recording. The study included 619 participants with mean of age 7.9 ± 0.74. The largest age group is 8-year-olds, accounting for 44.7% of the participants. The majority of participants are male, making up 55.7% of the total. The highest proportion of individuals falls into the healthy weight category, at 63.5%. Females have higher DMFT values in all quadrants compared to males. The highest DMFT value was observed in the lower right quadrant among females. After body mass index measuring and DMFT and DMFS score recording the result is there is no significant association between body mass index and severity of dental caries, but there is a significant higher percent in female than male and in lower first permanent molars than upper first permanent molars.

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INTRODUCTION

Globally teeth decay is the most prevalent non-communicable disease. It is more prevalent than diseases such as diabetes, asthma, and heart disease, according to the WHO and research data: 40-70% of children aged 6-9 years suffer from cavities in their first permanent molars in most low income countries[1]. While rates of tooth decay in children are increasing, there is a clear increase in obesity and overweight rates globally, particularly in middle and high-income countries. In contrast, underweight and obesity remain significant problems in low-income countrie[2]. First permanent molars are most susceptible, and cavities often appear within a year or two of their eruption if preventive

measures such as fluoride and fissure sealants are not taken[3]. Teeth decay is a multifactorial condition and nutrition status and BMI of people are one of most important affecting factor to assess[4]. Many studies and researches have addressed the relationship between the severity and prevalence of tooth decay and body mass index in children[5]. One of them done in China by Rou Shi etal. on 105181 students 7-18 years old in Huizhou schools during 2020 and the result of the research was higher caries rate in underweight categories group and lower caries rate in over weight categories group[6]. In Saudi Arabia other research done by Meshal Aber Alonazi *et al*. on 380 children 6-14 years in deferent 5 regions duding 2024 found prevalence of carries was 66.6% and obese group have higher mean of dmft and DMFT than non-obese group and BMI have a negative impact on DMFT scores[7]. In Egypt Mohamed Ahmed Hammed *et al*. made a study on 1400 school 6-9 years in Cairo during 2024 and found a positive correlation between body mass index and dmf score and a week relation between BMI and DMF score[8].

Also deferent researches done in Iraq one of them in Kurdish school in Süleymaniye by Mohammed Khalid Mahmood *et al*. on 333 children age 6-12 during 2022 and the result of the research was children with normal body mass index and normal vitamin D level have lower caries index[9]. Other study in Mosul by Hadeel Abdullah Yaseen and Saher Sami Gasgoose on 300 student 7-10 years old during 2023 and the result was the sequence from highest to lowest caries score are over, under, normal weight[10]. In Babil also there was a research done by Jamal Saber Idan *et al*. on 422 student 6-13 years old during 2022 found significant association between BMI and dental caries[11].

MARTIAL AND METHODS

Study Design and Sample Selection: This is a cross-sectional study used non-probability sampling technique (Purposive Sampling) selection based on specific criteria (largest student population). At first, intentionally select specific location (center of city). Then, selected three private primary schools in the city center because they have the largest number of students. Then, examined all students aged 7-9 years within those schools.

Ethical Consideration

Participant Consent: Verbal consent of all children and their caregiver in study.

Institutional Approval: Written Approval from (ministry of health in Iraq, Training and development center in Babil).

Study Population: The target population was 7-9 years school age children in private primary school in Babil province of Iraq. The age range was selected as it is the most critical age of the first permanent molars to affect by caries. All children of any gender within these age groups in selected schools and classes were included. Children must have been attending school at the time of the examination to be included. Children with Child with genetic dental defect, Physical restricted child, Children with drugs abuse, Asthmatic child, chemotherapeutic child, Child with osteoporosis, Diabetic child, mental or psychological conditions who were unable to interpret the questionnaire and those whose parents failed to consent were excluded.

Data Collection and Variables: All selected children interviewed and do clinical examination of dental caries of four first permanent molar examined according to WHO recommendation by using dental mirror and explorer probe under natural light and DMFT and DMFS score are recording by using dental mirror and explorer probe and all these data recording according to DMFT and DMFS index. Measuring length and weight for all participant. Google form questioner made to fill by childcare givers include name (to connect child information with clinical examination sheet) with age, gender, medical status, previous dental history. Severity and prevalence of caries was evaluated according to the DMFS and DMFT.

Sample Size Calculation: This observational study with total 619 participants of children age 7-9 years old of three private primary school in city center of Babil province of Iraq (mal 345 and
female 274).

Statistical Analysis: Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 29. Descriptive statistics were applied to summarize participant characteristics, including age, sex, and BMI. Frequencies and percentages were calculated for categorical variables, while means, standard deviations (SD), medians, minimum, and maximum values were reported for continuous variables (e.g., DMFT and DMFS scores).

For inferential analysis, independent samples t-tests were employed to compare mean DMFT and DMFS scores between males and females, with statistical significance set at $p = 0.05$. One-way analysis of variance (ANOVA) was performed to evaluate differences in mean DMFT and DMFS scores across BMI categories (healthy, underweight, and overweight), though no significant differences were observed, and therefore post hoc analysis was not conducted. Pearson correlation analysis was applied to

examine the relationships between age, DMFT, and DMFS scores, with correlation coefficients interpreted according to strength and significance. In addition, 95% confidence intervals were calculated for mean estimates to reflect the precision of results. All statistical tests were two-tailed, and a p-value = 0.05 was considered the threshold for statistical significance.

RESULTS AND DISCUSSIONS

The study included 619 participants with mean of age 7.9 ± 0.74. The largest age group is 8 year olds, accounting for 44.7% of the participants. The majority of participants are male, making up 55.7% of the total. In terms of BMI, the highest proportion of individuals falls into the healthy weight category, at 63.5% as show in Table 1.

As show in figure 1, the prevalence of dental caries among participants was 38%.

As show in figure 2, the occlusal surface has the highest number of occurrences at 275 and the mesial surface has the fewest at 12.

For DMFT, the scores ranged from 0 to 4, with a mean of 0.8 and a median of 0.0, indicating that a significant portion of the sample had no teeth affected by caries. Similarly, for DMFS, the scores ranged from 0 to 20, with a mean of 1.0 and a median of 0.0, further suggesting a low over all burden of dental caries at the surface level for at least half of the individuals, despite a broader range of scores among some members of the sample as show in Table 2.

In Figure 3, the bar chart illustrates the distribution of the DMFT index (Decayed, Missing, and Filled Teeth) between males and females across the four oral quadrants. It is evident that females have higher DMFT values in all quadrants compared to males. The highest DMFT value was observed in the lower right quadrant among females (95), followed by the lower left quadrant (93).

The Figure 4 illustrates the DMFS (Decayed, Missing, and Filled Surfaces) scores across the four dental quadrants in both males and females. In all quadrants, females exhibited higher DMFS scores than males, with the most affected areas being the lower right (121 in females vs. 96 in males) ower left quadrants (119 in females vs. 106 in males).

In Table 3, one-way ANOVA conducted to assess for significant differences in the means across these BMI groups. The p-value for this ANOVA is 0.57, which is greater than the significance level of 0.05, indicating that there is no statistically significant difference in the mean scores of the measured variable among the healthy, underweight, and overweight BMI categories in this sample.

A one-way ANOVA conducted to test for differences in DMFS scores across these BMI categories, yielding a p-value of 0.65. Since this p-value is greater than the significance level of 0.05, it indicates that there is no statistically significant difference in the mean DMFS scores among the healthy, underweight, and overweight BMI categories in this sample as show in Table 4.

The results in Table 5 indicated a statistically significant difference in mean DMFT scores, with females (Mean = 1.0 ± 1.29) showing higher scores than males (Mean = 0.67 ± 1.12).

In Table 6, the analysis revealed a statistically significant difference between the two groups. Females (Mean = 1.29 ± 1.848) had a higher mean DMFS score compared to males (Mean = 0.92 ± 1.916).

The difference in both table 5 and 6 means was statistically significant with a p-value of = 0.05, indicating that females experienced a significantly greater number of affected tooth than males in this sample of 619 individuals.

Pearson correlation analysis was performed to examine the relationships between age, DMFT (Decayed, Missing, and Filled Teeth), and DMFS (Decayed, Missing, and Filled Surfaces) scores. The results showed weak positive correlations between age and both DMFT ($r = 0.077$, $p = 0.055$) and DMFS ($r = 0.075$, $p = 0.064$), though these were not statistically significant at the 0.05 level. A strong and statistically significant positive correlation was observed between DMFT and DMFS scores ($r = 0.867$, $p < 0.001$), indicating that individuals with a higher number of affected teeth also tend to have a greater number of affected tooth surfaces as show in the Table 7.

The prevalence of dental caries among overweight individuals is approximately 7% lower than in those with normal BMI. However, since the 95% confidence interval (0.80-1.07) includes 1.0, this difference is not statistically significant-meaning there's no clear evidence of an association between Overweight and dental caries in this comparison.

The prevalence of dental caries among underweight individuals is about 7% lower than in those with normal BMI.

However, since the 95% CI (0.72–1.21) includes 1.0, this difference is not statistically significant- indicating no clear association between being underweight and dental caries prevalence in this sample.

Caries can affect teeth from the moment they first appear. The first permanent molars, in particular, are highly susceptible during the early years following eruption due to incomplete enamel maturation and partial eruption, which make them more difficult to clean and expose them to cariogenic challenges[12]. In the present study, conducted among children aged 7-9 years in Babil Province, Iraq, the overall prevalence of dental

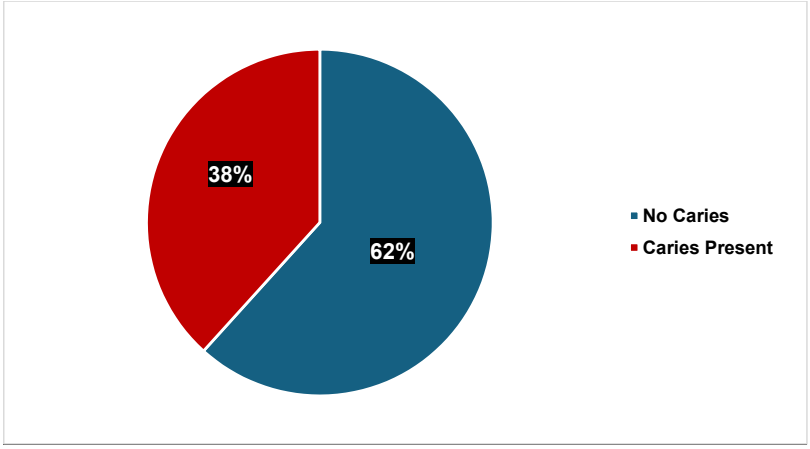

Fig. 1: The prevalence of dental caries among participants (N=619)

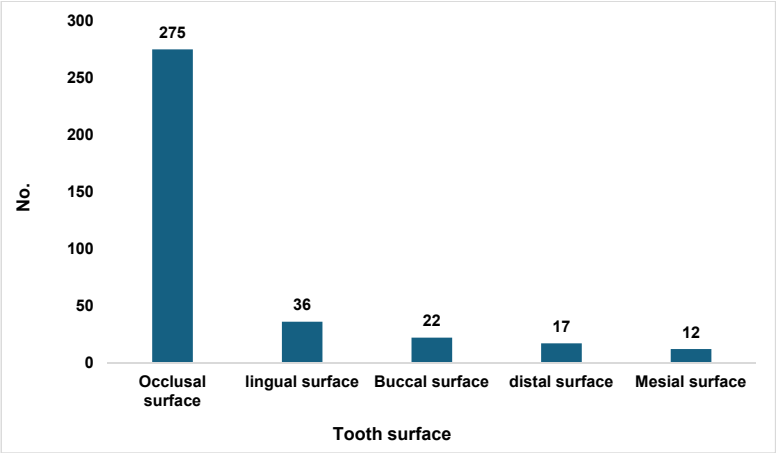

Fig. 2: Distribution of caries in the studied sample according to tooth surfaces

caries was 38%, with occlusal surfaces being the most affected. Females exhibited higher caries prevalence and severity compared with males, while the lower right molar in females and the lower left molar in males were the most commonly affected sites. Although weak positive correlations were observed between age and both DMFT and DMFS scores, these did not reach statistically significance. A strong positive correlation was observed between DMFT and DMFS, indicating that children with more affected teeth also had a greater number of affected tooth surfaces. Importantly, analysis by BMI category revealed no significant association between caries and BMI (ANOVA p = 0.57). The absence of a statistically significant association in the present study may be partly attributed to the narrow age range (7-9 years) and limited variation in BMI categories, which could have reduced statistical power. Additionally, early mixed dentition may mask the true relationship due to simultaneous exfoliation and eruption processes.

The lack of a significant correlation between BMI and dental caries aligns with findings from several regional and international studies. For instance, a cross-sectional study in Sulaymaniyah, Kurdistan Region of Iraq, involving 333 children aged 6-12 years, reported no significant association between BMI on DMFT (p = 0.55), although children with normal BMI exhibited slightly lower DMFT scores[9]. Similarly, a large-scale Germany study on 1,290 elementary schoolchildren (6-2 years) found high caries prevalence but no clear association with BMI[13]. Systematic reviews by Hooley et al.[14] and Paisi *et al.*[15] further emphasized inconsistencies and methodological variability across studies, suggesting that BMI alone may not serve as a reliable predictor of caries risk. These reviews underscore that factors such as diet, oral hygiene, fluoride exposure, socioeconomic status, and access to dental care, may exert a greater influence on caries experience[14,15].

Conversely, several studies have demonstrated significant associations between BMI and dental caries. A study in Riyadh, Saudi Arabia (2017-2018) involving 400 children aged 6-12 years reported a positive correlation between BMI and caries indices (dmft and DMFT), influenced further by parental education and socioeconomic status[16]. Similarly, a

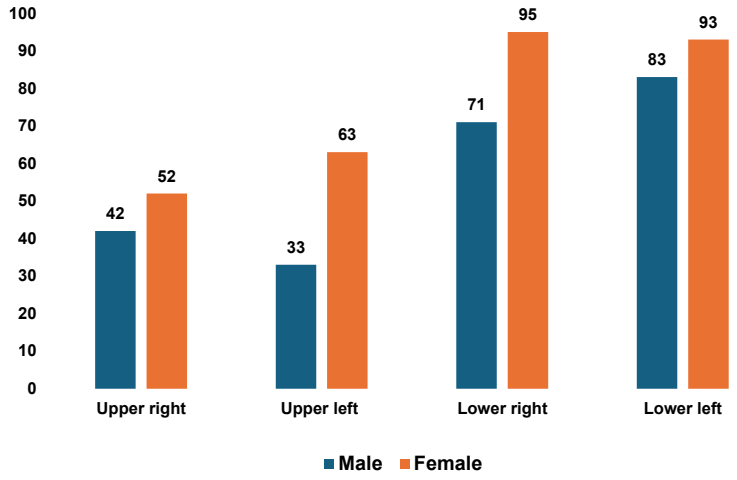

Fig. 3: DMFT Scores by Jaw Quadrants between Males and Females (N=237)

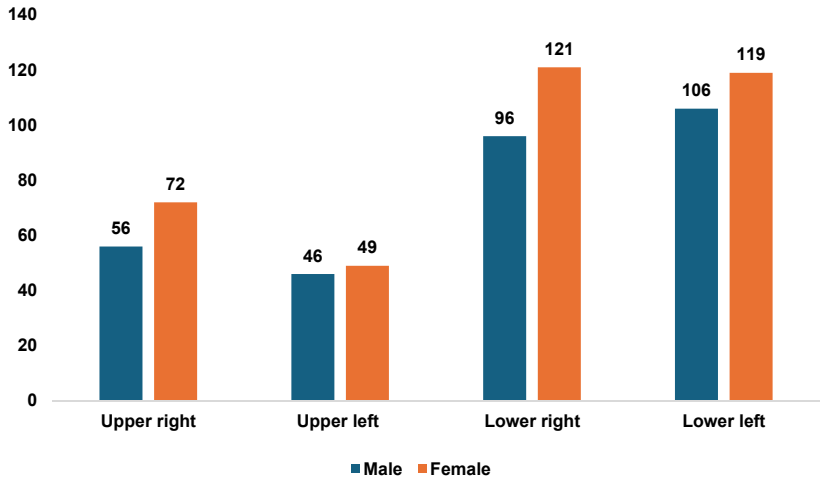

Fig. 4: DMFS Scores by Jaw Quadrants between Males and Females (N=237)

2023 study in Hail, Saudi Arabia, including 524 public school children aged 9-12 years, found very high caries prevalence (86%), with overweight children exhibiting significantly higher DMFT scores than their normal-weight and underweight counter part ($p < 0.001$)[17]. An Indian study in Faridabad, Haryana (2023), likewise, observed significantly higher DMFT scores among both underweight and overweight children compared with normal-weight peers[18]. Recent scoping reviews have reported comparable inconsistence some identifying higher caries prevalence among underweight children (e.g., Reddy *et al*., Kotha *et al*., Bhayat *et al*.)[19-21] while others found greater risk among overweight or obese groups (e.g., Vasconcelos *et al*., Alsweed *et al*., Bulut *et al*., Barbosa *et al*., Yen *et al*.). A recent systemic review found no clear association.

A recent systematic review (2024), which screened 577 articles and included 26 studies, further highlighted the heterogeneity of findings. Some studies reported the highest caries prevalence among underweight children, while others found overweight or obese children at greater risk. Several investigators, however, failed to identify any significant relationship[22].

These inconsistencies underscore the multi factorial nature of dental caries. It is plausible that BMI interact with multiple confounding variables-including diet, oral hygiene behaviors, fluoride exposure, socioeconomic status, and access to dental services to modulate caries risk[23]. Therefore, while BMI a useful general indicator of health, it should not be interpreted in isolation as a determinant of dental caries[24].

Several possible explanations may accounted for the observed caries patterns among Iraqi children. The increased availability and afford ability of sugary foods and beverages contributed to frequent sugar intake[25]. Poor oral hygiene practices and limited access to preventive dental services further exacerbated the problem[26]. Economic constraints, such as poverty and

Table 1: Distribution of participants by Age, Sex and BMI (N= 619)

Variable	Class	No.	Percentage
Age	7	182	29.4
	8	277	44.7
	9	160	25.8
Sex	Male	345	55.7
	Female	274	44.3
BMI	Healthy	393	63.5
	Underweight	44	7.1
	Overweight	182	29.4

Table 2: Severity of DMFT and DMFS Across the Entire Sample

Variable	N	Minimum	Maximum	Mean	SD	Median	Range
DMFT	619	0	4	0.8	1,21	0.0	(0-4)
DMFS	619	0	20	1.0	1,89	0.0	(0-20)

Table 3: One-Way ANOVA of DMFT Scores Across BMI Categories (N=619)

BMI	N	Mean	SD	SE	95% Confidence Interval		Min	Max	P-value
					Lower Bound	Upper Bound			
Healthy	393	0.78	1.197	0.06	0.66	0.90	0	4	0.57*
Underweight	44	0.93	1.336	0.20	0.53	1.34	0	4	
Overweight	182	0.87	1.214	0.09	0.69	1.05	0	4	
Total	619	0.82	1.211	0.04	0.72	0.91	0	4	

*A one-way ANOVA testing for differences at P-value = 0.05.

Table 4: One-Way ANOVA of DMFS Scores Across BMI Categories (N=619)

BMI	N	Mean	SD	SE	95% Confidence Interval		Min	Max	P-value
					Lower Bound	Upper Bound			
Healthy	393	1.1	1.916	0.097	0.86	1.24	0	20	0.65*
Underweight	44	1.3	2.122	0.320	0.67	1.96	0	8	
Overweight	182	1.1	1.792	0.133	0.84	1.37	0	12	
Total	619	1.1	1.894	0.076	0.93	1.23	0	20	

*A one-way ANOVA testing for differences at P-value = 0.05

Table 5: Comparison of Mean DMFT Scores Between Males and Females (N=619)

	Sex	No.	Mean	SD	SE	P-value
DMFT	Male	345	0.67	1.124	0.061	0.001*
	Female	274	1.0	1.291	0.078	

*Significant difference between means using independent sample T-test at p-value = 0.05

Table 6: Comparison of Mean DMFS Scores Between Males and Females (N=619)

	Sex	No.	Mean	SD	SE	P-value
DMFT	Male	345	0.92	1.916	0.103	0.014*
	Female	274	1?29	1.848	0.112	

*Significant difference between means using independent sample T-test at p-value = 0.05.

Table 7: Pearson Correlation Coefficients between Age, DMFT, and DMFS Scores

Correlations		age	DMFT	DMFS
age	Pearson Correlation	1	0.077	0.075
	Sig. (2-tailed)		0.055	0.064
	N	619	619	619
DMFT	Pearson Correlation	0.077	1	0.867**
	Sig. (2-tailed)	0.055		0.001
	N	619	619	619
DMFS	Pearson Correlation	0.075	0.867**	1
	Sig. (2-tailed)	0.064	0.001	
	N	619	619619	

**Correlation is significant at the 0.01 level (2-tailed)

Table 8: Prevalence ratio (PR) of dental caries between underweight and normal BMI groups

BMI	Dental caries		Total	Prevalence ratio	P-value	95% Confidence Interval	
	Yes	No				Lower	Upper
Normal	249	144	393	1	0.33	0.83	1.71
Overweight	107	75	182				
Total	356	219	575				

low household income, limit access to oral hygiene products and routine dental care[27]. In addition, insufficient parental awareness regarding the importance of oral health, especially the undervaluation of primary teeth, may result in untreated caries, predisposing the permanent dentition to subsequent decay[28]. Low fluoride concentrations in drinking water often resulting from reliance on multiple water sources other than municipal supplies, represent another critical risk factor[29]. Broader lifestyle transitions, including shift from traditional diets to processed, cariogenic foods,

Table 9: Prevalence ratio (PR) of dental caries between undererweight and normal BMI groups

BMI	Dental caries		Total	Prevalence ratio	P-value	95% Confidence Interval	
	Yes	No				Lower	Upper
Normal	249	144	393	0.9	0.93	0.63	2.25
Underweight	26	18	44				
Total	275	162	437				

and the lack of effective school-based preventive programs, also contributing to the increasing burden of dental caries among Iraqi children[30].

The findings of this study provide valuable insights into the oral health status of Iraqi children at a critical developmental stage when first permanent molars erupt. The results emphasize the need to integrate the oral health promotion with general health monitoring, including nutritional assessments. By linking BMI with caries experience, this study highlighted the potential of school-based programs to address both obesity and dental disease simultaneously through dietary counseling, preventive interventions such as fluoride applications and sealants placement, early intervention, and oral health education campaigns[31]. Moreover, these data may also serve as a baseline for future epidemiological studies and public health planning aimed at reducing the burden of dental caries among children in Iraq.

This study has several limitations. First, the sample was restricted to children from three private schools in the city center, which may limit generalizability to the broader Iraqi child population, especially those from rural or lower socioeconomic backgrounds[32]. Second, the cross-sectional design allows assessment of associations but not causality. Third, key confounders such as dietary habits, frequency of sugar consumption, and oral hygiene practices were not evaluate[33]. Fourth, caries diagnosis relied solely on clinical examination without radiographic confirmation, potentially underestimating true prevalence[34]. Despite these limitations, the study provide essential baseline data on the association between BMI and caries among Iraqi children.

Based on these findings, several recommendations are preposed. School-based preventive programs should be reinforced through regular fluoride applications and sealant placement for newly erupted permanent molars. Oral health education initiative targeting children, parents, and teachers should emphasize proper dietary habits and oral hygiene practices. Routine dental check-ups need to be promoted as an integral part of school health services. Moreover, oral health promotion should be incorporated into broader public health policies, linking dental care with nutritional monitoring and BMI screening. Address fluoride deficiency by assessing fluoride levels in drinking water and considering water fluoridation or alternative fluoride delivery methods where appropriate[35]. Expanding future research to include larger and more diverse populations, especially from rural areas, and incorporating longitudinal study designs to elucidate causal pathway would provide a deeper understanding of the causal pathways linking BMI and caries. Future research should also explore the role of dietary sugar frequency and saliva biomarkers as mediators between BMI and caries risk, using longitudinal or mixed-model approaches. Future longitudinal and multicenter studies are recommended to elucidate causal pathways and control for confounding variables, enabling a clearer understanding of the complex interplay between BMI and caries in children[36].

CONCLUSION

This study demonstrates a non-significant association between BMI and dental caries among children in Babil province, highlighting the high prevalence of caries. These findings underscore the need for comprehensive preventive strategies that integrate oral health promotion with general health initiatives, ultimately aiming to improve the well-being of children at both local and national levels.

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