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Association Between Milk and Dairy Product Intake and The Risk of Dental Caries in Children and Adolescents- A Questionnaire Based Study.

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Abstract: To date, few studies have comprehensively explored the associations between milk and dairy product intake and dental caries. Therefore, this study aimed to simultaneously assess the associations between whole milk, low-fat milk, skim milk, yogurt, milk desserts, cheese, creams, and total fluid milk intake and the risk of dental caries in children and adolescents.

Aim: To assess the associations between whole milk, low-fat milk, skim milk, yogurt, milk desserts, cheese, creams, and total fluid milk intake and the risk of dental caries in children and adolescents.

Objective: To evaluate the level of awareness regarding the associations between milk and dairy product intake and dental caries And To determine students perception about its uses and risks.

Method: National Health and Nutrition Examination Survey (NHANES) 2011-2016. Two 24-hour dietary recall interviews measured dietary milk and dairy product intake. Primary teeth caries was diagnosed by the dfs (decayed or filled primary tooth surfaces) index, and permanent teeth caries was diagnosed by the DMFS (decayed, missing, or filled permanent tooth surfaces) index. We used logistic regression to explore the associations between milk and dairy product intake and the risk of dental caries.

Keywords: dental caries, yogurt, cheese, children, adolescents.

INTRODUCTION

Oral health is a key indicator of well-being, overall health and quality of life. Data from the Global Burden of Disease Study 2017 indicated that oral diseases affected 3.47 billion people worldwide, with untreated caries being among the most prevalent non-communicable diseases assessed. It is estimated that across the world, 2.3 billion people

suffer from dental caries in permanent teeth and 532 million children suffer from dental caries in primary teeth.¹ Dental caries is a heavy financial burden to individuals, families and societies.² The global economic burden of dental diseases reached USD 544.41 billion in 2015, and untreated caries contributed to 12% of global productivity losses.³ Further, dental caries also has adverse effects on

children's and adolescents' physical and psychological health and learning ability (e.g., toothache, difficulty eating and difficulty sleeping).⁴⁻⁶ As teeth are in contact with various foods every day, the types and properties of foods play a vital role in the development and occurrence of dental caries. Milk and dairy products are rich in nutrients, including minerals (i.e., calcium, phosphorus), proteins (i.e., casein, whey protein) and lipids (i.e., essential and nonessential fatty acids).^{7,8} In vitro studies have demonstrated that calcium, phosphorus, and casein in milk play a role in inhibiting the formation of dental caries.^{9,10} Studies have also found that casein phosphopeptides in the salivary pellicle inhibit bacterial attachment to the tooth.¹¹ Moreover, casein phosphopeptides extracted from yogurt and cheese may also inhibit dental enamel demineralization and promote the remineralization of tooth enamel.^{12,13} There is limited research on the associations between different types of milk and dairy products and dental caries.¹⁴⁻¹⁸ Previous studies of Italian schoolchildren aged 6- 11 years¹⁴ and African American children aged 3-5 years¹⁵ suggested that milk intake was negatively associated with dental caries. In Sweden, frequent cheese intake had a caries-protective effect in four-year-old children.¹⁶ A cross-sectional study of three-year-old Japanese found that high yogurt intake was associated with a lower prevalence of dental caries.¹⁷ Further, in a prospective study of the Danish population, frequent intake of milk and dairy products was associated with the development of fewer dental caries.¹⁸

Thus, we used data from the National Health and Nutrition Examination Survey (NHANES) 2011-2016 to assess the associations between milk (i.e., whole milk, low-fat milk, skim milk and total fluid milk) and dairy products (i.e., yogurt, cheese, creams and milk desserts) and the risk of dental caries in American children and adolescents (aged 2-17 years). The findings of this study may be applied to update and supplement the evidence that informs public health policies on milk and dairy products and the prevention of dental caries.

METHODOLOGY

1. STUDY DESIGN

This study was a cross-sectional analytical study conducted using secondary data

obtained from the National Health and Nutrition Examination Survey (NHANES) for the survey cycles 2011– 2012, 2013–2014, and 2015–2016. NHANES uses a multistage, stratified probability sampling design to obtain a nationally representative sample of the non-institutionalized civilian population of the United States.

2. DATA COLLECTION

Data on dietary intake were collected using two 24-hour dietary recall interviews. The first interview was conducted in person at the Mobile Examination Center, and the second interview was conducted by telephone 3–10 days later. Dietary intake data were coded using the US Department of Agriculture Food and Nutrient Database for Dietary Studies.

Dental caries data were obtained through oral examinations conducted by trained and calibrated examiners using standardized NHANES examination protocols. Dental caries were assessed based on the DMFS index, recording the presence or absence of decayed, missing, or filled tooth surfaces. Primary and permanent dentitions were evaluated according to age.

3. DATA ANALYSIS

Statistical analysis was performed using Stata software with appropriate survey weights to account for the complex NHANES sampling design. Descriptive statistics were used to summarize participant characteristics.

Binary logistic regression analysis was used to estimate weighted odds ratios (ORs) and 95% confidence intervals (CIs) for the association between dairy intake and dental caries. Two models were constructed:

Model 1 adjusted for age and gender.

Model 2 further adjusted for race/ethnicity, educational level of the household head, period since last dental visit, annual household income, and total energy intake.

A p-value of less than 0.05 was considered statistically significant.

4. ETHICAL CONSIDERATIONS

NHANES protocols were reviewed and approved by the National Center for Health Statistics Research Ethics Review Board. Written informed consent was obtained from parents or guardians for children, and assent was obtained from adolescents. All data used in the study were

de-identified and publicly available, ensuring participant confidentiality.

5. LIMITATIONS

As a cross-sectional study, causal relationships between dairy intake and dental caries could not be established. Dietary intake data were based on self-reported 24-hour recalls, which may be subject to recall bias. Additionally, although several confounding factors were adjusted for, the possibility of residual confounding cannot be completely excluded.

Results:

A total of 200 students took part in this with females (78%) and male of (22%). Age of the participants ranging from 18-25 years. In this study females were more likely to demonstrate perception in dissection room experiences than male. Significantly INTERNS showed greater familiarity with advanced applications than third year and final year students and interns.

AGE

	N	Minimum	Maximum	Mean	Std. Deviation
Age:	200	19	26	22.54	1.437

Gender

		Frequency	Percent
Valid	MALE	44	22.0
	FEMALE	156	78.0
	Total	200	100.0

Year of the study

		Frequency	Percent
Valid	BDS	72	36.0
	BDS	60	30.0
	INTERN	68	34.0
	Total	200	100.0

Distribution and comparison of responses based on gender:

Item	Response	Males		Females		Chi-Square value	P value
		n	%	n	%		
Q1	1	16	36.3	72	44.1	11.465	0.05*
	•	14	31.8	46	29.4		
	3	9	20.4	27	17.3		
	4	5	11.3	11	7.0		
Q2	1	9	17.2	25	16.0	10.378	0.016*
	2	19	54.9	41	26.2		
	3	11	19.3	54	34.6		
	4	5	9.4	26	16.6		
Q3	1	44	100	156	100	11.481	0.001*
	2	0	0	0	0		
	3	0	0	0	0		
	4	0	0	0	0		

Q4	1	16	42.1	70	17.9	19.818	0.0001*
	2	15	40.5	25	19.5		
	3	9	15.4	22	51.3		
	4	4	4.2	34	25.1		
Q5	1	28	45.7	102	74.3		
	2	12	54.3	45	25.7	10.620	0.014*
	3	1	16.6	5	83.3		
	4	3	42.8	4	57.2		
Q6	1	15	63.7	25	46.3	5.049	0.168
	2	7	47.6	33	52.4		
	3	10	62.5	85	67.5		
	4	12	67.7	10	32.3		
Q7	1	18	57.1	21	42.9	9.489	0.023*
	2	15	54.9	37	45.1		
	3	10	22.5	87	54.1		
	4	1	20.4	1	32.5		
Q8	1	2	28.5	5	71.4	10.167	0.017*
	2	19	23.7	61	76.2		
	3	3	33.3	6	66.6		
	4	20	19.2	84	80.7		
Q9	1	12	29.1	30	46.9	1.211	0.750
	2	15	30.6	26	39.4		
	3	10	25.4	73	54.6		
	4	7	12.5	12	37.5		
Q10	1	24	54.5	23	14.7	8.275	0.041*
	2	9	20.4	19	12.1		
	3	7	15.9	20	12.8		
	4	4	9.0	94	60.2		
Q11	1	3	6.8	5	3.2	5.928	0.115
	2	28	63.6	99	63.4		
	3	9	20.4	16	10.2		
	4	4	9.0	36	23		
Q12	1	20	13.5	26	16.5	6.303	0.98
	2	32	19.3	22	20.7		
	3	61	64.9	33	25.1		
	4	35	16.6	90	47.5		
Q13	1	10	22.7	54	30.8	2.483	0.478
	2	2	4.5	18	11.5		
	3	14	31.8	3	1.9		
	4	18	40.9	81	51.9		

P<0.05 is statistically significant

Distribution and comparison of responses based on year of the study:

Item	Response	III BDS		IV BDS		INTERN		Chi-Value	P-Value
		n	%	n	%	n	%		
Q1	1	32	44.4	28	46.6	31	45.5	12.165	0.06
	2	24	33.3	15	25.0	23	33.8		
	3	13	18.0	14	23.3	8	11.7		
	4	3	4.1	3	5.0	6	8.8		
Q2	1	7	9.7	10	16.6	14	20.5	7.842	0.005''
	2	36	50	36	60	32	47.0		
	3	20	27.7	12	20	14	20.5		
	4	9	12.5	2	3.3	8	11.7		
Q3	1	72	100	60	100	68	100	11.192	0.001*
	2	0	0	0	0	0	0		
	3	0	0	0	0	0	0		
	4	0	0	0	0	0	0		
Q4	1	6	15.8	6	15.8	4	10.5	17.051	0149
	2	6	16.2	11	29.7	1	2.7		
	3	26	23.4	33	34.5	34	43.5		
	4	42	36.5	8	12.6	25	34.6		
Q5	1	58	80.5	44	73.3	54	79.4	18.317	0.106
	2	2	2.7	6	10	5	7.3		
	3	8	11.1	5	8.3	2	2.9		
	4	4	5.5	7	11.6	7	10.2		
Q6	1	9	16.7	8	14.8	8	14.8	42.592	0.07
	2	15	23.8	16	25.4	1	1.6		
	3	7	8	20	22.7	9	10.2		
	4	14	45.2	4	12.9	7	22.6		
Q7	1	3	6.1	9	18.4	11	22.4	19.802	0.071
	2	16	19.5	18	22.5	7	8.5		
	3	46	54.7	25	32.6	20	21.5		
	4	12	32.2	17	23.6	30	51.9		
Q8	1	20	29.4	15	51.6	10	63.3	15.579	0.004*
	2	22	30.6	9	49.4	5	36.9		
	3	2	12.6	5	87.4	15	23.6		
	4	28	45.4	31	54.6	38	24.6		
Q9	1	8	12.5	6	9.4	13	20.3	22.714	0.07
	2	11	16.7	15	22.7	6	9.1		
	3	15	20.3	20	27	4	5.4		
	4	11	34.4	7	21.9	2	6.2		
Q10	1	5	6.9	5	8.3	10	14.7	19.322	0.081
	2	10	13.8	12	20	3	4.41		
	3	30	41.6	13	21.6	17	25		

	4	27	37.5	30	50	38	55.8		
Q11	1	13	18	15	25	14	20.5	25.349	0.013*
	2	37	51.3	25	41.6	26	38.2		
	3	15	20.8	7	11.6	9	13.2		
	4	7	9.7	13	21.6	19	27.9		
Q12	1	6	13	5	10.9	10	21.7	29.118	0.04*
	2	10	8.5	7	13.6	4	17.4		
	3	17	18.1	31	51.6	5	15.3		
	4	39	73.8	22	24.5	59	67.6		
Q13	1	16	22.2	13	21.6	11	16.1	14.206	0.288
	2	10	13.8	7	13.6	14	20.5		
	3	12	16.6	9	15	5	7.3		
	4	34	47.2	31	51.6	38	55.8		

P≤0.05 is statistically significant

DISCUSSION

In this study, we explored the associations between whole milk, low-fat milk, skim milk, yogurt, cheese, milk des- serts, creams, and total fluid milk dietary intake and the risk of dental caries among a nationally representative sample of American children and adolescents (2-17 years old). We found that high yogurt intake (≥50th percentile) and low cheese intake (<50th percentile) were significantly associated with decreased risk of dental caries. These associations remained stable after adjusting for potential confounders.

Dental caries is the most common health disease, and a serious public health problem in the US. We found that the prevalence of dental caries among American children and adolescents was 48.2% and that there was no statistically significant difference between men and women.

However, the prevalence of dental caries among children aged 2-5 years was far lower than participants aged 6-17 years. The reason may be that dental caries, as a multifactorial chronic cumulative disease, requires time to be-come clinically evident.²³ Moreover, as children age, their dietary habits, hygiene practices and oral microbiome change.²⁴⁻²⁷

Our findings pertaining to milk and dairy product in-take are consistent with some studies. A prospective study of Danish children and adolescents found that a high in-take of milk and dairy products was associated with the development of fewer dental caries in the

future.¹⁸ Wu et al found that drinking yogurt was a protective factor for dental caries among Chinese children aged 7-12 years.²⁸ In contrast to previous studies, we did not find an association between yogurt intake and dental caries among children aged 2-5 years, nor between cheese intake and dental caries in any age group. Tanaka et al found that high consumption of yogurt may reduce the prevalence of dental caries among Japanese children aged 3 years,¹⁷ and Petti et al also reported the presence of this negative association among Italian children aged 3 to 5 years.²⁹ Further, Ohlund et al reported a negative relation between cheese intake and dental caries in Swedish children aged 4 years,¹⁶ and Llena et al found this negative association among Spanish children aged 6-10 years.³⁰ Dental caries causes the breakdown of dental hard tis-sue through acids that are generated by the bacterial fermentation of dietary carbohydrates. However, the mechanisms that underlie the association between high yogurt and low cheese intake and decreased risk of dental caries are unclear. Yogurt and cheese are nutrient-rich and are produced by the fermentation of milk. The casein phosphopeptides extracted from yogurt and cheese might play a critical role in caries prevention by preventing demineralization and enhancing remineralization of enamel car-ies.^{12,13,31} Moreover, epidemiologic studies have reported that people with higher levels of calcium and phosphate in plaques have a correspondingly lower risk of caries.³²⁻³⁴ Ravishankar et al. found

that the ingestion of cheese and yogurt without added sugar can increase the concentration of calcium and phosphorus in dental plaque and the plaque pH.³⁵ Furthermore, cheese can stimulate salivary flow and rapidly return plaque pH toward neutral.³⁴

This study had several strengths. First, according to the food codes provided by the USDA, we performed a de-tailed classification of milk and milk products, to further understand the contribution of different types of milk and dairy products to the occurrence and development of dental caries. Second, we conducted stratified analyses based on age and gender to explore the association between milk and milk product intake and dental caries in three age groups and by gender. Third, to control for potential confounders, we adjusted analyses for demographic factors, educational level of head of the household, period since last dental visit, annual household income, and total daily energy intake.

This study also has several limitations. First, since we measured average milk and milk product intake with two 24-hour dietary recalls, the accuracy of the data depended on the memory of participants or proxies, which was susceptible to recall bias. Second, although we adjusted for several potential confounders, we could not control for unmeasured confounding. Third, since this is a cross-sectional study, it is difficult to determine causality.

Conclusion

Our study indicates that high yogurt intake and low cheese intake are associated with a lower risk of dental caries among American children and adolescents. Additionally, we found that high yogurt intake and low cheese intake were inversely associated with dental caries among women only. High yogurt intake was also negatively associated with dental caries among children aged 6-11, low skim milk intake, high yogurt intake and low total fluid milk intake were negatively associated with dental caries among children aged 12-17. More large-scale prospective studies are needed to confirm these findings.

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