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Original Research Article

Influence of traditional dietary practices on dental caries: a study of Changal among the Hmar tribe

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ABSTRACT

Background: Among the Hmar tribes of northeast India, traditional dietary practices involving the consumption of Changal continue to be widely prevalent; however, their impact on dental caries has received little scientific attention. Therefore, the present study was undertaken to investigate the potential impact of traditional dietary practices and their associations with dental caries among the Hmar tribe of Cachar district of Assam.
Methods: A comparative cross-sectional study was conducted among 200 Hmar participants. The samples consisted of 100 consumers and 100 non-consumers, both male and female. Statistical analysis was performed using chi-square test to evaluate the association between Changal consumption and the prevalence of dental caries.
Results: In the present study, age was not significantly associated with dental caries ($p>0.05$). The prevalence of dental caries among non-consumers of Changal individuals was high (52% males and 62% females). However, lower prevalence of dental caries was observed among those who consumed Changal daily ($p<0.05$ among males and $p<0.001$ among females). The findings of the present study suggest that the prevalence of dental caries can be reduced by regular consumption of Changal.
Conclusions: The present study highlights that the daily consumption of Changal decreases the prevalence of dental caries among the Hmar of Cachar District, Assam. The high alkalinity of ash filtrates such as Changal may help to neutralize acids in the oral cavity if a significant amount contacts teeth during eating, thereby reducing caries risk. Further longitudinal studies are recommended to confirm these findings.

Keywords: Dental caries, Dietary patterns, Preventive dentistry

INTRODUCTION

Dental caries remains one of the most prevalent chronic oral diseases worldwide.[1] It is the most common non-communicable disease, affects individuals throughout life, and involves both permanent and deciduous dentition. Globally, 2 billion adults suffer from caries in permanent teeth and 510 million children are affected by dental caries in deciduous teeth.[2] In particular, among the Indian population a systematic review and meta-analysis of 70 studies conducted between 2009-2019 reported an overall prevalence of dental caries of approximately 54.16% in individuals aged 3-75 years.[3]

Dental caries is a multifactorial disease resulting from the interactions among dietary habits, oral hygiene practices and socio-economic determinants such as sex and family size.[4-12] Among these contributing factors, a dietary habits such as the frequency of sugar consumption play a key role in the initiation and progression of caries.[12-14] In contrast, a diet with alkaline properties help in neutralizing plaque acids and promotes remineralization of enamel, thereby promoting a healthier oral environment.[15]

Furthermore, emerging evidence suggests that dietary components rich in alkaline minerals such as calcium-

based materials and magnesium, contribute to oral buffering mechanisms and enamel remineralization.[16,17] These minerals play essential roles in maintaining mineral homeostasis within the oral cavity and may provide a protective effect against caries development. Therefore, dietary patterns incorporating alkaline substances may represent a potential adjunctive strategy for caries prevention

Given that the dynamic process of caries demineralization and remineralization depends on dietary habits such as the consumption of sugar and alkaline food, traditional dietary practices involving the consumption of alkaline substances such as Changal, warrant scientific investigation.

Changal, a traditional alkaline liquid ash filtrate prepared by filtering water through wood ash from firewood charcoal, is traditionally used by the Hmar community in Northeast India as a cooking ingredient to neutralize bitterness, soften tough vegetables and meats, and improve texture and digestibility similar to the methods of *Khar* in Assamese cuisine.[18,19] Wood ash contains minerals such as calcium oxides and magnesium oxides, which are alkaline in nature.[20,21] Owing to their alkaline composition, such minerals may play a significant role in modulating the oral pH and enhancing buffering within the oral cavity. Several studies have demonstrated that magnesium oxides and calcium oxides contribute to enamel remineralization and acid neutralization.[22-26] However, despite the high alkalinity of wood ash and the importance of its minerals for oral health, there is limited research specifically on the impact of traditional alkaline substances made out of wood ashes used by indigenous communities, including the Hmar population of Northeast India. Therefore, understanding the potential protective role of Changal is important in the context of culturally specific dietary practices and community-based preventive strategies. Thus, the present study aims to evaluate the impact of Changal consumption on the prevalence of dental caries among the consumers and non-consumers of the Hmar population. The null hypothesis of this study is that there is no significant difference in the prevalence and severity of dental caries between Changal consumers and non-consumers among the Hmar population.

METHODS

Area of study

Cachar district is located in the southernmost part of Assam, India. Cachar shares boundaries with two states, namely Manipur and Mizoram, and an international boundary that spreads across the Barak Valley region with Bangladesh.[27] According to the 2011 census, the geographical area of Cachar district is 3786 km^2. with a population of 2,024,771. Cachar has a sex ratio of 959 per 1000 males and the literacy rate is 79.34% of which 84.78% are males and 73.68% are females.[28] As per the Barak Valley Hill Tribes Development Council Data there are 36,684 Hmar in the Cachar district.[29]

The Hmar tribe is an indigenous tribe inhabiting the northeastern region of India, particularly in the states of Manipur, Assam, Mizoram, Meghalaya and Tripura. They belong to the Kuki-Chin-Mizo ethnolinguistic group and speak the Hmar language, which belongs to the Sino-Tibeto-Burma linguistic family of the Mongoloid race.[30] In Assam, a considerable Hmar population resides in the Cachar district of Barak Valley, where traditional fermented foods and traditional ingredient preparations such as changal remain an integral part of their dietary practices and cultural identity.

Data collection

A cross-sectional study was conducted among the Hmar population of Cachar district Assam. The fieldwork was carried out from the month of May 2024 to October 2024, during which the data were collected through interview schedules and visual observation. The interview schedules included demographic details such as age, sex, and relevant study variables. The observations were performed with the help of supplementary tools such as torch lights and dental mirrors. The samples consisted of 100 males (50 Changal consumers and 50 non-consumers) and 100 females (50 consumers and 50 non-consumers). This study included both male and female subjects aged 20 years and above from different socio-economic backgrounds. Samples who had chronic diseases such as cancer, diabetes, etc. were excluded from the present study. Each tooth was examined and checked for dental caries.

Informed consent

Written informed consent was obtained from all participants in local dialects and English prior to data collection. The confidentiality of the collected information was maintained throughout the study.

Statistical analysis

All the collected data were entered into Microsoft Excel and analysed via Janmovi software (version 2.7.12). Descriptive statistics such as frequencies, and percentages were calculated to summarize the data. To determine the associations between variables, a chi-square test was applied, while binary logistic regression analysis was performed to evaluate the protective effect of Changal consumption on dental caries after adjusting for factors such as sex, age, sugar consumption, education, occupation, and oral hygiene practices.

RESULTS

The background information on the demographic profile of the present study is shown in Table 1. The participants in the present study were mainly middle-aged individuals

(37%), with equal numbers of male (100%) and female (100%) individuals. Nearly half of the respondents (48.5%) had education up to matriculation or below, and only 13.5% of the study population had graduation and above, suggesting that a smaller proportion had advanced education. Table 1 shows that a large group of the population is engaged in farming and daily wage occupation (42%).

Table 2 shows the prevalence of dental caries according to age, sex, education and occupation of the study population. The highest prevalence of dental caries was observed among females (52.6%) who were 40-59 years of age. With respect to education, the highest prevalence of dental caries was observed at level-1 (matriculation and below) in both males (57.8%) and females (55.8%). With respect to occupation, dental caries was the most common among group-2 category (farmer and daily wager) in both males (57.7%) and females (87.5%). In the Group-3 (private sector and Government sector) category, the prevalence of dental caries was the lowest i.e., male (10%) and female (14.7%). The present findings reveal that education is inversely associated with the prevalence of caries. And only education and occupation were significantly associated with dental caries.

Table 1: Demographic characteristics of the study population (n=200).

Variables	Categories	Frequency	%
Age group (years)	20-39	62	31
	40-59	74	37
	60+	64	32
Sex	Male	100	50
	Female	100	50
Education level	Level-1 (matriculation and below)	97	48.5
	Level-2 (higher secondary)	76	38
	Level-3 (graduation and above)	27	13.5
Occupation	Group-1(homemakers, students, and unemployed)	52	26
	Group-2 (farmer and daily wager)	84	42
	Group-3 (private sector and government sector)	64	32

Table 2: Prevalence of dental caries in relation to demographic profile.

Variables	N	Categories	Caries (%)	Non caries (%)	P value (p>0.05)
Age (years)	Male				
	30	20-39	12 (40)	18 (60)	χ^2=0.22 p=0.898 (not significant)
	36	40-59	14 (38.9)	22 (61.1)	
	34	60+	15 (44.1)	19 (55.9)	
	Female				
	32	20-39	15 (46.8)	17 (53.1)	χ^2=1.07 p=0.585 (not significant)
	38	40-59	20 (52.6)	18 (47.3)	
	30	60+	12 (40)	18 (60)	
Education	Male				
	45	Level-1 (matriculation and below)	26 (57.8)	19 (42.2)	χ^2=16.63 p=0.00024 (significant at p<0.01)
	34	Level-2 (higher secondary)	14 (41.2)	20 (58.8)	
	21	Level-3 (graduation and above)	1 (4.8)	20 (95.2)	
	Female				
	52	Level-1 (matriculation and below)	29 (55.8)	23 (44.2)	χ^2=7.21 p=0.027 (significant at p<0.01)
	42	Level-2 (higher secondary)	18 (42.9)	24 (57.1)	
	6	Level-3 (graduation and above)	0 (00.00)	6 (100)	
Occupation	Male				
	18	Group-1 (homemakers, students, and unemployed)	8 (44.4)	10 (55.6)	χ^2=17.99 p=0.00012 (significant at p<0.01)
	52	Group-2 (farmer and daily wager)	30 (57.7)	22 (42.3)	
	30	Group-3 (private sector and government sector)	3 (10)	27 (90)	
	Female				
	34	Group-1 (homemakers, students, and unemployed)	14 (41.2)	20 (58.8)	χ^2=35.76 (significant at p<0.001)
	32	Group-2 (farmer and daily wager)	28 (87.5)	4 (12.5)	
	34	Group-3 (private sector and government sector)	5 (14.7)	29 (85.3)	

Table 3: Association of dental caries with frequency of Changal consumption, sugar consumption and brushing teeth.

Sex	Category	N	Caries (%)	Non caries (%)	P value
Changal consumption					
Male (n=100)	Daily	22	3 (13.6)	19 (86.4)	χ^2=12.58, p=0.0056 (significant at p<0.05)
	Weekly	17	5 (29.4)	12 (70.6)	
	Occasionally	11	7 (63.6)	4 (36.4)	
	Non-consumer	50	26 (52)	24 (48)	
Female (n=100)	Daily	24	1 (4.2)	23 (95.8)	χ^2=27.25, p=0.000005 (significant at p<0.001)
	Weekly	13	5 (38.5)	8 (61.5)	
	Occasionally	13	10 (76.9)	3 (23.1)	
	Non-consumer	50	31 (62)	19 (38)	
Sugar consumption					
Male	Daily	7	7 (100)	0 (00.00)	χ^2=18.46, p=0.00035 (significant at p<0.001)
	Weekly	26	15 (57.7)	11 (42.3)	
	Occasionally	25	9 (36.0)	16 (64.0)	
	Non-consumer	42	10 (23.8)	32 (76.2)	
Female	Daily	10	9 (90)	1 (10)	χ^2=24.06, p=0.00002 (significant at p<0.001
	Weekly	19	15 (78.9)	4 (21.1)	
	Occasionally	21	10 (47.6)	11 (52.4)	
	Non-consumer	50	13 (26)	37 (74)	
Brushing teeth					
Male	Daily	61	8 (13.1)	53 (86.9)	χ^2=52.93, p=0.00000000033 (significant at p<0.001)
	Weekly	23	17 (73.9)	6 (26.1)	
	Occasionally	16	16 (100)	0 (00.00)	
Female	Daily	55	11 (20.0)	44 (80)	χ^2=41.55, p=0.0000000098 (significant at p<0.001)
	Weekly	25	16 (64)	9 (36)	
	Occasionally	20	20 (100)	0 (00.00)	

Table 4: Association between Changal consumption and dental caries.

Sex	Changal consumption	N (%)	Caries (%)	Non caries (%)	P value	Crude odds ratio
Male (n=100)	Consumer	50 (50)	15 (30)	35 (70)	χ^2=5.00, p=0.025 (statistically significant)	0.339; 95% CI: 0.190-0.605 P<0.001
	Non-consumer	50 (50)	26 (52)	24 (48)		
Female (n=100)	Consumer	50 (50)	16 (32)	34 (68)	χ^2=9.03, p=0.003 (statistically significant)	
	Non-consumer	50 (50)	31 (62)	19 (38)		

Table 3 presents the associations of dental caries with the frequency of Changal consumption, sugar consumption and brushing habits among males and females. These findings indicate that the frequency of Changal consumption, sugar consumption, and frequency of brushing are significantly associated with dental caries. Daily consumption of Changal (13.6% in males and 4.2% in females), regular brushing (13.1% in males and 20% in females) and lower sugar intake (36.0% in males and 47.6% in females) were associated with a lower prevalence of dental caries, where as non-consumption of Changal (52% in males and 62% in females), occasional brushing (100% in males and 100% in females) and frequent sugar consumption (100% in males and 90% in females) were associated with higher prevalence of dental caries among both males and females, and the associations were statistically significant.

Table 4 shows the associations between Changal consumption and dental caries among males and females. The result revealed a statistically significant association between Changal consumption and dental caries in both the sex. A lower frequency of dental caries was observed among the Changal consumer (30% in males and 32% in female) than among the non-consumers (52% in males and 62% females). Logistic regression analysis revealed that Changal consumers had significantly lower odds of having dental caries than non-consumer did (COR=0.339, 95% CI: 0.190-0.605, p<0.001).

Table 5: Binomial logistic regression analysis showing for factors associated with dental caries.

Predictors	ß (estimate)	SE	Odds ratio (OR)	95% CI for OR	P value
Intercept	-1.0389	1.3963	0.3539	0.02292-5.462	0.457
Age	-0.0152	0.0164	0.9849	0.95364-1.017	0.354
Changal consumption					
Consumer versus non-consumer	-3.1858	0.6984	0.0413	0.01052-0.163	<0.001*
Sugar consumption					
Daily consumer versus non-consumer	2.8865	1.3164	17.9305	1.35866-236.633	0.028**
Weekly consumer versus non-consumer	1.4553	0.8247	4.2856	0.85113-21.579	0.078
Occasionally consumer versus non-consumer	1.1947	0.6951	3.3026	0.84557-12.899	0.086
Brushing habits					
Weekly versus daily	2.3727	0.6602	10.7262	2.94092-39.121	<0.001*
Occasionally versus daily	21.0680	1612.8775	1.41E+9	0.00000-INF	0.990
Education					
Level-2 vs level-1	-0.4670	0.6815	0.6269	0.16483-2.384	0.493
Level-3 vs level-1	-2.9350	1.4369	0.0531	0.00318-0.888	0.041**
Occupation					
Group-1 versus group-3	0.7313	0.8389	2.0779	0.40138-10.757	0.383
Group-2 versus group-3	1.9285	0.8152	6.8795	1.39207-33.998	0.018**

INF= infinity, * = significant at p<0.001, **= significant at p<0.05.

In Table 5 a binomial logistic regression analysis was conducted to identify factors associated with dental caries. The overall model was statistically significant (χ^2=178, df=11, p<0.001) with a McFadden R^2 of 0.649, indicating that the predictors explained a substantial proportion of the variability in dental caries. After adjusting for age, sugar consumption, brushing habits, education, and occupation, the analysis revealed that Changal consumption had a strong protective effect on dental caries, with consumers having significantly lower odds of dental caries than non-consumers did (OR=0.041, 95% CI: 0.01-0.16, p<0.001). Daily sugar consumption was significantly associated with increased odds of having dental caries (OR=17.93, 95% CI: 1.36-236.63, p=0.028). Infrequent brushing teeth also had significantly higher odds of dental caries compared to those who brushed daily (OR=10.73, 95% CI:2.94-39.12, p<0.001). Additionally, higher education was associated with lower odds of having dental caries (OR=0.053, 95%CI: 0.003-0.88, p=0.041). While certain individuals who are engaged in manual occupation had significantly higher odds of dental caries compared to group-3 (OR=6.88, 95% CI:1.39-33.99, p=0.018).

DISCUSSION

Dental caries is a multifactorial disease, and its prevalence varies across countries, regions and populations due to the interaction of dietary habits, oral hygiene practices and socioeconomic determinants. In this context, the present study assessed the impact of Changal consumption on dental caries among the Hmar populations in the Cachar district of Assam. In the present study, 44% of the study population was affected by dental caries. This prevalence is lower than the overall prevalence reported in the Indian population (54.16%), as reported in a systematic review and meta-analysis conducted by Pandey et al.[3] These findings suggest that the burden of dental caries among the Hmar population in the present study is comparatively lower than the national average. The observed difference in prevalence may be attributed to variations in dietary practices such as Changal consumption, oral hygiene habits, and socio-economic factors such as education occupation.

Apart from these factors, age is often considered as an important factor influencing the occurrence of dental caries. Several studies, such as systematic review conducted by Pandey et al meta-analysis by Janakiram et al, and a study among the urban population of Ghaziabad conducted by Kumar et al reported that the severity of dental caries tends to increase with advancing age.[3,31,32] However, contrary to these findings, age was not found to be significantly associated with the prevalence of dental caries in the present population after adjustment in the regression model. The present findings suggest that behavioural and lifestyle factors may have a greater influence on the development of dental caries than age alone.

Furthermore, sugar consumption and oral hygiene practices were strongly associated with dental caries in the present population. Participants who consumed sugar daily had significantly higher odds of developing dental caries compared with those who consumed sugar less frequently. On the other hand, regular tooth brushing was associated with a lower prevalence of dental caries. The findings of the present study align with those of previous

studies, such as that undertaken by Viswanath and Sabu, which also highlighted the role of sugar consumption and oral hygiene practices in the development of caries.[33] Similarly, the present study also demonstrated the influence of socio-economic factors on the prevalence of dental caries. Individuals with higher educational levels had lower odds of having dental caries. And individuals who are engaged in farming and daily wage occupations are more likely to have dental caries than those employed in the private and government sectors. The findings of the present study may reflect the associations of socio-economic disparities, differences in health awareness, hygiene and limited access to dental care services among certain population groups. Individuals with lower educational backgrounds and unstable occupations may have less exposure to oral health education and preventive dental practices, which can contribute to a higher risk of dental caries. Similar findings have also been reported in the systematic review by Cunha et al.[34]

In relation to the objective of the present study, the results indicated that the overall prevalence of dental caries varied according to the Changal consumption status. Changal consumers showed a lower prevalence of dental caries compared with non-consumers in both the males and females. Logistic regression analysis further confirmed that Changal consumption is significantly associated with lower odds of dental caries after adjusting for potential co-founding factors including age, education level, occupation, oral hygiene practices, and sugar consumption. Although limited studies are available that specifically examine the effects of Changal consumption on dental health, some studies on alkaline substances in the oral environment also suggest that alkaline substances lower the risk of dental caries and restore oral pH and support remineralization.[35,36]

However, these findings of the present study should be interpreted in light of certain limitations. First, the present study was a cross-sectional design, which does not permit the establishment of causal relationship between Changal consumption and dental caries. Second, the study included only the Hmar tribe of Cachar district, Assam, which may limit the generalizability of the findings to other tribal communities or population with different dietary, cultural practices and socioeconomic conditions. Third, dental caries was assessed through visual observation using dental caries and torchlight without additional clinical or radiographic investigation, which may have resulted in underestimation of carious lesions. Furthermore, the information on Changal consumption and other related relevant variables was collected through interviews and was therefore subject to recall bias. Although the analysis accounted for important factors such as age, sex, education, occupation, sugar consumption and oral hygiene practices, other factors, including fluoride exposure, access to dental care were not assessed. The alkaline content of Changal was not measured in the present study therefore the exact alkaline level and amount of Changal required to provide a protective effect against dental caries remain unknown.

CONCLUSION

In conclusion, the overall findings of the present study demonstrated that Changal consumption is associated with a lower prevalence of dental caries in the study population. These findings suggest that Changal consumption may have a protective influence on oral health, possibly because its alkaline properties may help neutralize the acid in the oral environment associated with caries development. Although dental caries is a multifactorial disease influenced by several behavioral and socio-economic factors, the results of this study highlight the potential role of traditional dietary practices such as Changal consumption in reducing the risk of dental caries. One of the important causes of dental caries in human teeth is the production of acids by micro-organisms such as *Lactobacillus acidophilus odontolyticus* in the mouth, which act on food debris lodging around the teeth. These acids largely dissolve the hard tissues of teeth which are alkaline in nature leading to dental caries. Therefore, alkaline compounds present in Changal may neutralize the acids produced by bacteria in the oral cavity, protecting the teeth from decay. To better understand of the biological mechanism and causal relationship between Changal consumption and dental caries, a longitudinal study is recommended.

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