

Comparison of Facial Morphology and Oral Health Status Among Tibetan Immigrants and Local Indian Population in Bylakuppe, Karnataka- An Original Research Study

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ABSTRACT

Background: In the early 1960s, after the failed uprising against Chinese rule in Tibet, Tibetans fled to India seeking asylum, who were given land for settlements by Government. One such settlement is at Bylakuppe, where they have businesses around the monastery catering to tourists. **Objectives:** Comparison of facial morphology and oral health status among Tibetan immigrants and local Indian population in Bylakuppe, Karnataka. **Methods:** The study consisted of 224 participants (109 Tibetan and 115 Indian) residing at Bylakuppe, Karnataka aged 18-44 years fulfilling inclusion and exclusion criteria. Facial and nasal characteristics were recorded by using Bannister's classification and nasal index respectively. Dental caries and fluorosis was recorded by using WHO oral assessment form for adults 2013. Data obtained was coded and fed into the SPSS version 27 for analysis. **Results:** Among Tibetan study subjects, hyperleptoprosopic facial type (98.2%) and mesorrhine (43.1%) and leptorrhine (35.8%) nasal type were predominant; while among Indian study subjects, hyperleptoprosopic facial type (82.6%) and platyrrhine (40%) and mesorrhine (30.4%) nasal type were predominant. Comparison of facial and nasal morphology among populations was found to be statistically significant ($p < 0.001$). Mean DMFT was 3.44 ± 3.76 and 4.26 ± 3.49 among Tibetan and local population respectively. Local population had no dental fluorosis, whereas Tibetans had very low (4.5%) prevalence of milder form of dental fluorosis. **Interpretation:** Craniofacial morphological differences primarily reflect genetic heritage, climatic conditions and ancestral evolution; while oral health disparities are likely to be influenced by socioeconomic, behavioural and cultural factors. **Conclusion:** Comparison of Facial and Nasal morphology between the study populations was found to be statistically significant, indicating racial differences not yet influenced by local environmental factors. But increase in DMFT among Tibetan immigrants compared to their counterparts, indicate the influence of local factors. Hence we need to plan sustainable targeted preventive programs taking into consideration all these factors.

Keywords: Facial morphology; Nasal morphology; Tibetan Immigrants; Indian population; Dental caries; DMFT; Dental fluorosis; Missing teeth; Filled teeth

How to cite this article: Roy A, Singla A, Yadav R, Tyagi U, Mishra S, Narang A. Comparison of Facial Morphology and Oral Health Status Among Tibetan Immigrants and Local Indian Population in Bylakuppe, Karnataka - An Original Research Study. Int J Drug Deliv Technol. 2026;16(51s): 1916-1928. DOI: 10.25258/ijddt.16.51s.155

INTRODUCTION

Facial morphology is the study of the shape, structure, and proportions of the human face, including both skeletal and soft tissue components such as the nose, eyes, cheekbones, and jawline. It is primarily influenced by genetic factors, along with environmental, cultural, and epigenetic influences. Variations in facial features are also associated with ethnicity, reflecting adaptations to climate and lifestyle. Additionally, factors like age, nutrition, and sexual dimorphism contribute to differences in facial growth and appearance. While individual variation exists, certain facial traits are more commonly observed within specific populations.¹

Fluorosis is an endemic condition caused by excessive fluoride intake. While optimal fluoride levels strengthen teeth and bones, overexposure can damage multiple body systems, including dental and skeletal structures, leading to dental and skeletal fluorosis. Fluoride is commonly ingested through drinking water, supplements, and toothpaste. In Tibetan populations, high consumption of brick tea—a type made from older leaves and stems with higher fluoride content—has been linked to increased fluoride intake. Due to environmental conditions and dietary habits, excessive intake of this tea may result in brick tea-type fluorosis (BTF).²

High altitude affects both diet and physiological functions, often leading to increased basal metabolic rate and reduced food intake in migrants. It also impacts systems such as oxygen transport, immunity, and organ function, while influencing dietary patterns and anatomical features across populations. Nasal morphology is shaped by climate and altitude. High-altitude populations like Tibetans typically have wider, shorter noses adapted for cold, dry air and efficient oxygen intake, whereas populations in warmer, humid regions like Karnataka tend to have narrower, longer noses suited for air conditioning and moisture retention.³

Dietary and oral hygiene habits, cultural customs and access to healthcare all affect oral health. Local Indians have a cuisine influenced by native spices, sweets and carbs; while Tibetan immigrants traditionally eat a diet high in tea and dairy. In both cultures, the prevalence of dental caries, periodontal disease and malocclusion may be impacted by these nutritional variations as well as different oral hygiene habits.⁴

Therefore, this study aims to systematically compare the facial and nasal morphological features of Tibetan Immigrants with those of Local Indian Population residing in Bylakuppe. By analysing these morphological variations, the research seeks to understand the influence of genetic background, environmental adaptation and possible evolutionary mechanisms. These findings may contribute to anthropological knowledge and forensic applications.

MATERIALS AND METHODS

Study design: The present study is a Clinical in vivo study.

Study period: Sep 2024 - Feb 2025

Sampling procedure: Convenience sampling

Sample Size: 200

Inclusion criteria:

Local Indian population who were residing in Bylakuppe, Karnataka for the past 10 years or more. Tibetan immigrant who were residing in Bylakuppe, Karnataka for the past 10 years or more. Individuals who were willing to participate in the study.

Exclusion criteria:

Individuals who had head and facial deformities. Individuals who were suffering from physical or developmental abnormalities. Individuals who had undergone previous nasal surgeries or had any deformities of the nose or nasal injuries.

Materials:

Mouth mirror, WHO probe, Divider, Ruler, Vernier Caliper

Ethical clearance:

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Ethical clearance was obtained from the Institutional Review Board of Coorg Institute of Dental sciences, Virajpet.

Study Procedure:

The study consists of two groups namely Tibetan immigrants and local Indian population in Bylakuppe, Karnataka. Permission was obtained from Lugsam Tibetan settlement, Dickey Larsoe settlement and Bylakuppe Gram Panchayat for the proposed study. The study subjects aged 18-44 years who were willing to participate in the study and fulfilling the inclusion and exclusion criteria were selected using a convenience sampling method. Before the start of the study, written consent was taken from all the study participants. The study included collection of demographic data, general information and clinical examination.

Clinical examination was done for anthropometric evaluation of facial characteristics and for recording the oral health status of study participants. For anthropometric evaluation, the subjects were classified using Bannister’s classification for Facial morphology. A Vernier calliper was used to measure the facial height and width. Facial width was measured as the straight distance between the most laterally placed zygion, when the head is oriented in eye ear lane and facial height which was defined as the straight distance between nasion to gnathion when the head is oriented in the eye

ear plane. Measurements was done using the outside jaws of the calliper.

For assessment of Nose type, the subjects were classified using Bannister’s classification. A vernier calliper was used to measure the nasal breadth and height. Nasal width was measured as the maximum distance between two ala and nasal height was measured from the nasion (between eyes) to subnasale.

Intra oral examination was conducted to record Dental Caries and Dental Fluorosis using WHO oral assessment form for adults 2013.

Dental Fluorosis was recorded using Dean’s Fluorosis index criteria.

RESULTS

A clinical in vivo study was conducted among 115 local Indian participants and 109 Tibetan participants residing at Bylakuppe, Karnataka.

The results of the study are as follows:

Table 1 shows the distribution of study subjects based on age groups. Among 115 participants in Indian group, 39 (33.9%) belong to 18–24 year group, 43 (37.4%) belong to 25–34 year group and 33 (28.7%) belong to 35–44 year group. Among 109 participants in Tibetan group, 24 (22%) belong to 18–24 year group, 35 (32.1%) belong to 25–34-year group and 50 (45.9%) belong to 35–44 year group. The mean (SD) age for the Indian Group was found to be 29.97±7.407 and the mean (SD) age for Tibetan Group was found to be 32.9±7.862.

Table 2 shows the distribution of study subjects based on gender. Among 115 participants in Indian group, 54 (46.95%) were male and 61 (53.05%) were female. Among 109 participants in Tibetan group, 89 (81.65%) were male and 20 (18.35%) were female.

Table 1: Distribution of study subjects based on Age Groups

	Age Groups			Total	Mean Age
	18-24 yrs	25-34 yrs	35-44 yrs		
Indian	39 (33.9%)	43 (37.4%)	33 (28.7%)	115 (100%)	29.97±7.407
Tibetan	24 (22%)	35 (32.1%)	50 (45.9%)	109 (100%)	32.9±7.862

Table 2: Distribution of study subjects based on Gender

	Male	Female	Total
Indian	54 (46.95%)	61 (53.05%)	115 (100%)
Tibetan	89	20	109

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	(81.65%)	(18.35%)	(100%)
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Table 3 shows the distribution of responses to the question - “How do you clean your teeth?”. Among 115 participants in Indian group, 2 (1.7%) participants responded ‘Finger’ and 113 (98.3%) participants responded ‘Toothbrush’. Among 109 participants in Tibetan group, all 109 (100%) participants responded ‘Toothbrush’.

Table 3: Distribution of Responses to the question - “How do you clean your teeth?”

	Finger	Toothbrush	Total
Indian	2 (1.7%)	113 (98.3%)	115 (100%)
Tibetan	0 (0%)	109 (100%)	109 (100%)

Table 4 shows the distribution of responses to the question - “Materials used to clean your teeth?”. Among 115 participants in Indian group, 109 (94.8%) participants responded ‘Toothpaste’ and 6 (5.2%) participants responded ‘Toothpowder’. Among 109 participants in Tibetan group, 108 (99.1%) participants responded ‘Toothpaste’ and 1 (0.9%) participant responded ‘Toothpowder.’

Table 4: Distribution of Responses to the question - “Materials used to clean your teeth?”

	Toothpaste	Toothpowder	Total
Indian	109 (94.8%)	6 (5.2%)	115 (100%)
Tibetan	108 (99.1)	1 (0.9%)	109 (100%)

Table 5 shows the distribution of response to the question - “Frequency of brushing?”. Among 115 participants in Indian group, 79 (68.7%) participants responded ‘once a day’ and 36 (31.3%)

participants responded ‘thrice a day’. Among 109 participants in Tibetan group, 64(58.7%) participants responded ‘once a day’; 2 (1.8%) participants responded ‘twice a day’ and 43 (39.4%) participants responded ‘thrice a day’.

Table 5: Distribution of Response to the question - “Frequency of brushing?”

	Once a day	Twice a day	Thrice a day	Total
Indian	79 (68.7%)	0 (0%)	36 (31.3%)	115 (100%)
Tibetan	64 (58.7%)	2 (1.8%)	43 (39.4%)	109 (100%)

Table 6 shows the assessment of Facial measurements among Tibetan immigrants based on Age. Among 18-24 year old study subjects, mean facial length was found to be 121.5±7.69; mean facial width was found to be 89.8±13.8; and mean morphological facial index was found to be 138.47±24.61. Among 25-34 year old study subjects, mean facial length was found to be 123.91±10.25; mean facial width was found to be 89.87±11.04; and mean morphological facial index was found to be 140.24±21.51. Among 35-44 year old study subjects, mean facial length was found to be 124.2±10.83; mean facial width was found to be 92.93±13.92; and mean morphological facial index was found to be 137.34±28.73.

Table 6: Assessment of Facial measurements among Tibetan immigrants based on Age groups

	Mean Facial Length (in mm)	Mean Facial width (in mm)	Mean Morphological Facial Index (in mm)
18-24 year	121.5±7.69	89.8±13.8	138.47±24.61

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25-34 years	123.91±10.25	89.87±11.04	140.24±21.51
35-44 years	124.2±10.83	92.93±13.92	137.34±28.73

Table 7 shows the assessment of Facial measurements among Tibetan immigrants based on Gender. Among males, mean facial length was found to be 124.88±9.68; mean facial width was found to be 91.68±12.85; and mean morphological facial index was found to be 138.95±22.02. Among females, mean facial length was found to be 117.41±9.3; mean facial width was found to be 89.39±13.89; and mean morphological facial index was found to be 136.59±38.07.

Table 7: Assessment of Facial measurements among Tibetan immigrants based on Gender

	Mean Facial Length (in mm)	Mean Facial Width (in mm)	Mean Morphological Facial Index (in mm)
Male	124.88±9.68	91.68±12.85	138.95±22.02
Female	117.41±9.3	89.39±13.89	136.59±38.07

Table 8 shows the assessment of Facial measurements among Local Indian population based on Age Groups. Among 18-24 year old study subjects, mean facial length was found to be 114.21±14.41; mean facial width was found to be 99.42±13.77; and mean morphological facial index was found to be 118.12±25.89. Among 25-34 year old study subjects, mean facial length was found to be 109.72±12.59; mean facial width was

found to be 97.8±16.03; and mean morphological facial index was found to be 116.32±29.58. Among 35-44-year-old study subjects, mean facial length was found to be 111.13±11.83; mean facial width was found to be 101.33±16.15; and mean morphological facial index was found to be 112.7±23.1.

Table 8: Assessment of Facial measurements among Local Indian population based on Age Groups

	Mean Facial Length (in mm)	Mean Facial width (in mm)	Mean Morphological Facial Index (in mm)
18-24 years	114.21±14.41	99.42±13.77	118.12±25.89
25-34 years	109.72±12.59	97.8±16.03	116.32±29.58
35-44 years	111.13±11.83	101.33±16.15	112.7±23.1

Table 9 shows the assessment of Facial measurements among Local Indian population based on Gender. Among males, mean facial length was found to be 112.28±13.42; mean facial width was found to be 97.85±15.33; and mean morphological facial index was found to be 118.79±27.76. Among females, mean facial length was found to be 111.08±12.82; mean facial width was found to be 100.71±15.21; and mean morphological facial index was found to be 113.32±25.21.

Table 9: Assessment of Facial measurements among Local Indian population based on Gender

	Mean	Mean	Mean
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	Facial Length (in mm)	Facial Width (in mm)	Morphological Facial Index (in mm)
Male	112.28±13.42	97.85±15.33	118.79±27.76
Female	111.08±12.82	100.71±15.21	113.32±25.21

Table 10 shows that comparative analysis of Facial morphology between Tibetan immigrants and local Indian population was found to be statistically significant (p<0.001).

Table 10: Comparison of Facial Morphology between Tibetan immigrants and local Indian population

Facial type	India n	Tibetan	Sig
Euryprosopic	3 (2.6%)	2 (1.8%)	$\chi^2 = 17.765$ p value = <0.001
Hypereuryprosopic	10 (8.7%)	0 (0%)	
Hyperleptoprosopic	95 (82.6%)	107 (98.2%)	
Leptoprosopic	3 (2.6%)	0 (0%)	
Mesoprosopic	9 (3.5%)	0 (0%)	
Total	115 (100%)	109 (100%)	

Table 11 shows the assessment of Nasal measurements among Tibetan immigrants based on age. Among 18-24 year old study subjects, mean nasal breadth was found to be 38.55±3.96; mean nasal length was found to be 53.67±5.69; and mean morphological nasal index was found to be 71.72±13.69. Among 25-34 year old study subjects, mean nasal breadth was found to

be 39.78±5.76; mean nasal length was found to be 55.16±10.22; and mean morphological nasal index was found to be 76.16±24.15. Among 35-44 year old study subjects, mean nasal breadth was found to be 40.17±4.95; mean nasal length was found to be 54.06±7.52; and mean morphological nasal index was found to be 76.09±17.56.

Table 11: Assessment of Nasal measurements among Tibetan immigrants based on Age groups

	Mean Nasal Breadth (in mm)	Mean Nasal Length (in mm)	Mean Morphological Nasal Index (in mm)
18-24 years	38.55±3.96	53.67±5.69	71.72±13.69
25-34 years	39.78±5.76	55.16±10.22	76.16±24.15
35-44 years	40.17±4.95	54.06±7.52	76.09±17.56

Table 12 shows the assessment of Nasal measurements among Tibetan immigrants based on gender. Among Males, mean nasal breadth was found to be 39.91±5.08; mean nasal length was found to be 55.6±7.82; and mean morphological nasal index was found to be 73.65±18.41. Among Females, mean nasal breadth was found to be 38.72±4.81; mean nasal length was found to be 48.67±7.06; and mean morphological nasal index was found to be 81.82±21.37.

Table 12: Assessment of Nasal measurements among Tibetan immigrants based on gender

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	Mean Nasal Breadth (in mm)	Mean Nasal Length (in mm)	Mean Morphological Nasal Index (in mm)
Male	39.91±5.08	55.6±7.82	73.65±18.41
Female	38.72±4.81	48.67±7.06	81.82±21.37

Table 13 shows the assessment of Nasal measurements among Local Indian population based on Age Groups. Among 18-24 year old study subjects, mean nasal breadth was found to be 51.02±14.24; mean nasal length was found to be 59.76±12.7; and mean morphological nasal index was found to be 86.23±19.23. Among 25-34 year old study subjects, mean nasal breadth was found to be 48.09±12.93; mean nasal length was found to be 55.17±11.27; and mean morphological nasal index was found to be 86.61±19.11. Among 35-44 year old study subjects, mean nasal breadth was found to be 55.38±18.16; mean nasal length was found to be 63.73±16.26; and mean morphological nasal index was found to be 86.61±18.09.

Table 13: Assessment of Nasal measurements among Local Indian population based on Age Groups

	Mean Nasal Length (in mm)	Mean Nasal width (in mm)	Mean Morphological Nasal Index (in mm)
18-24 years	51.02±14.24	59.76±12.7	86.23±19.23
25-34 years	48.09±12.93	55.17±11.27	86.61±19.11
35-44	55.38±18.16	63.73±16.26	86.61±18.09

years			

Table 14 shows the assessment of Nasal measurements among Local Indian population based on Gender. Among males, mean nasal breadth was found to be 50.82±14.72; mean nasal length was found to be 59.86±14.3; and mean morphological nasal index was found to be 86.17±20.97. Among females, mean nasal breadth was found to be 51.5±15.7; mean nasal length was found to be 58.58±13.18; and mean morphological nasal index was found to be 86.76±16.61.

Table 14: Assessment of Nasal measurements among Local Indian population based on Gender

	Mean Nasal Breadth (in mm)	Mean Nasal Length (in mm)	Mean Morphological Nasal Index (in mm)
Male	50.82±14.72	59.86±14.3	86.17±20.97
Female	51.5±15.7	58.58±13.18	86.76±16.61

Table 15 shows that comparative analysis of Nasal morphology between Tibetan immigrants and Local Indian population was found to be statistically significant (p<0.001)

Table 15: Comparison of Nasal Morphology between Tibetan immigrants and Local Indian population

Nasal index	Indian	Tibetan	Sig
Hyperleptorrhine	3 (2.6%)	5 (4.6%)	χ ² = 39.574 p value =
Hyperplatyrrhine	17 (14.8%)	7 (6.4%)	
Leptorrhine	14	39	

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	(12.2%)	(35.8%)	<0.001 (S)
Mesorrhine	35 (30.4%)	47 (43.1%)	
Platyrrhine	46 (40%)	11 (10.1%)	
Total	115 (100%)	109 (100%)	

Table 16 shows that comparative analysis of DMFT status between Tibetan immigrants and local Indian population was found to be statistically significant (p<0.001)

Table 16: Comparison of DMFT status between Tibetan immigrants and local Indian population

DMFT	Indian	Tibetan	Sig
0	16 (13.9%)	13 (11.9%)	$\chi^2 = 24.261$ p value= <0.001 (S)
1	9 (7.8%)	7 (6.4%)	
2	30 (26.1%)	7 (6.4%)	
3	15 (13%)	13 (11.9%)	
4	28 (24.3%)	19 (17.4%)	
5	5 (4.3%)	14 (12.8%)	
6	5 (4.3%)	9 (8.3%)	
7	1 (0.9%)	7 (6.4%)	
8	4 (3.5%)	6 (5.5%)	
9	0 (0%)	5 (4.6%)	
10	0 (0%)	1 (0.9%)	
11	0 (0%)	1 (0.9%)	
12	1 (0.9%)	3 (2.8%)	
13	0 (0%)	3 (2.8%)	
16	0 (0%)	1 (0.9%)	
21	1 (0.9%)	0 (0%)	
Total	115 (100%)	109 (100%)	

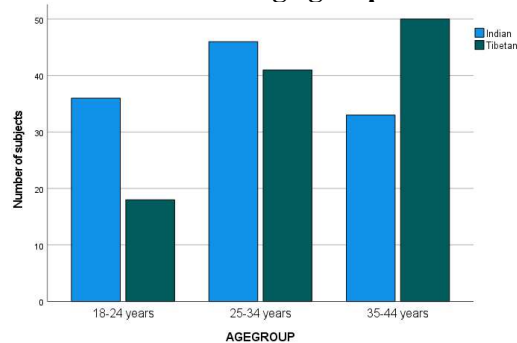
Table 17 shows that comparative analysis of Dental Fluorosis between Tibetan

immigrants and local Indian population was found to be statistically non-significant (p=0.12).

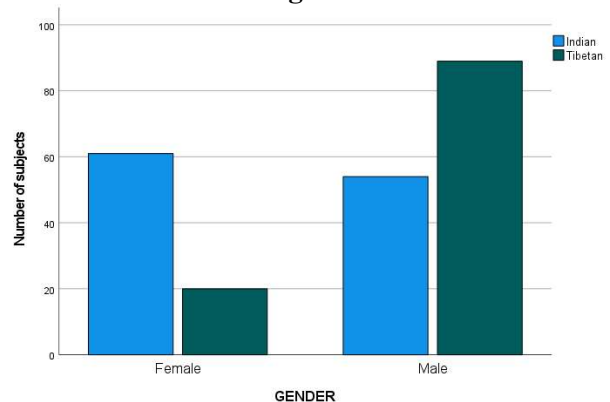
Table 17: Comparison of Dental Fluorosis between Tibetan immigrants and local Indian population

Dental fluorosis	Indian	Tibetan	Sig
Normal	115 (100%)	104 (95.4%)	$\chi^2 = 5.396$ p value= 0.12 (NS)
Very Mild	0 (0%)	1 (0.9%)	
Mild	0 (0%)	2 (1.8%)	
Moderate	0 (0%)	1 (0.9%)	
Severe	0 (0%)	1 (0.9%)	

Graph 1- Distribution of study subjects based on age groups

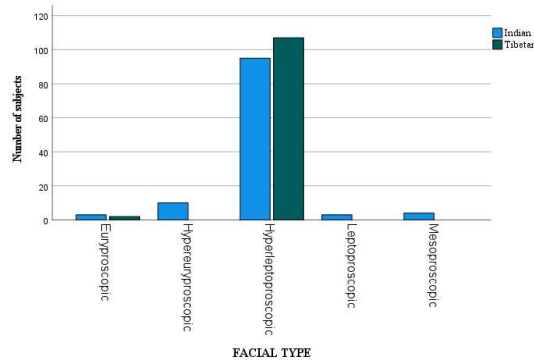


Graph 2 - Distribution of study subjects based on gender.

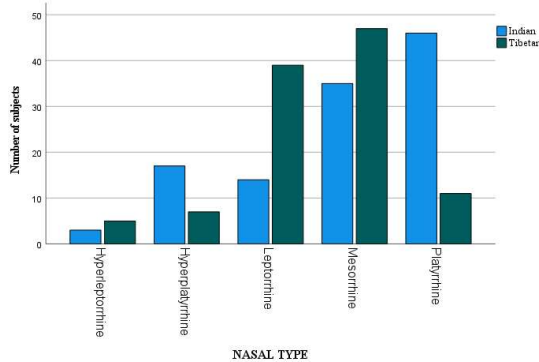


Graph 3 -Comparison of Facial type between Tibetan immigrants and local Indian population

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Graph 4 - Comparison of Nasal type between Tibetan Immigrants and Local Indian Population



Graph 5 -Comparison of DMFT between Tibetan Immigrants and Local Indian Population

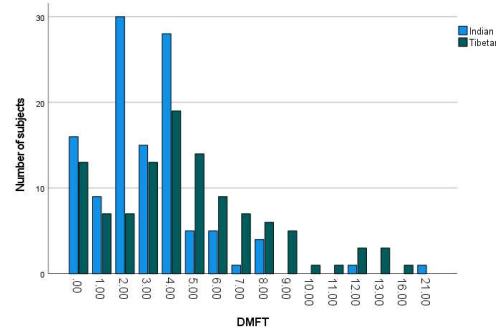
DISCUSSION

In the present study, 100% of Tibetan immigrants used toothbrush to clean their teeth in Bylakuppe. In a study done in Ngari, Tibet (Fan Yang et al 2025), 92% respondents used toothbrush.⁵

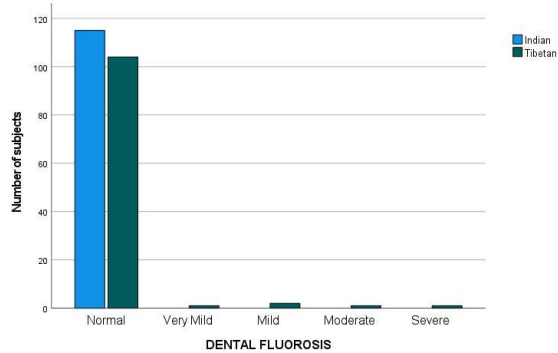
In the present study, 98.3% of local Indian population used toothbrush and rest of the local Indian population used finger to clean their teeth in Bylakuppe. According to National oral health survey done in the year 2002, 63.3% used toothbrush and 35.1% used finger to clean their teeth in Karnataka.⁶

In the present study, 99.1% of Tibetan immigrants used toothpaste to clean their teeth in Bylakuppe. In comparison, a 2014 study by Havaladar KS et al. in Kushalnagar found 96.3% of Tibetans used toothpaste.⁷

In the present study, 94.8% of the local Indian population used toothpaste to clean



Graph 6 - Comparison of Dental Fluorosis between Tibetan Immigrants and Local Indian population



their teeth, while the remaining used toothpowder, which is valued as a traditional practice in the community. A 2023 multi-country survey by Heba Mohamed Elkhodary et al. reported toothpaste use at 60.8% in the Eastern Mediterranean, 96.3% in Africa, 64.2% in the Western Pacific, 65.9% in Europe, 48.89% in South East Asia, and 69.8% in the Americas⁸ while a 2023 study by Maheshor Kaphle et al. in Nepal found 98.6% toothpaste use.⁹

In the present study, 58.7% of Tibetan immigrants clean their teeth once in a day, 1.8% clean their teeth twice a day and 39.4% clean their teeth thrice a day. A 2021 study by Dilip Prajapati et al. in Nepal reported 26.1% of Tibetans brushing once daily, 53.6% twice daily and 20.3% less than once daily.¹⁰

In the present study, 68.7% of local Indian population clean their teeth once in a day and

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rest (31.3%) of the population clean their teeth thrice a day in Bylakuppe. In a survey carried out in Gujarat by S. N. Goryawala et al. (2017), 86.8% of respondents brushed their teeth once per day, 12.4% did so twice daily, and just 0.8% maintained a three-times-per-day routine.¹¹

In the present study, among Tibetan immigrants, the mean facial length was found to be 121.5 ± 7.69 , 123.91 ± 10.25 and 124.2 ± 10.83 among 18-24, 25-34 and 35-44 year old respectively. The mean facial length was found to be 124.88 ± 9.68 and 117.41 ± 9.3 among Males and Females respectively. In a study conducted in North Western Rajasthan by Dr. Mukesh Fulwaria et al. (2017), the mean facial length among Male and Female Tibetan participants was recorded as 114.1 ± 0.83 and 111.6 ± 0.95 respectively.¹²

In the present study among Indian population, the mean facial length was found to be 114.21 ± 14.41 , 109.72 ± 12.59 and 111.13 ± 11 among 18-24, 25-34 and 35-44 year old respectively. Among Males and Females, the mean facial length was found to be 112.28 ± 13.42 and 111.08 ± 12.82 respectively. In a study conducted by Pooja R. Kulkarni et al. (2022) in Dharwad, the average facial length was observed to be 103.57 ± 0.54 mm in males and 96.61 ± 0.59 mm in females.¹³

In the present study among Tibetan immigrants, the mean facial width was found to be 89.98 ± 13.8 , 89.87 ± 11.04 and 92.93 ± 13.92 among 18-24, 25-34 and 35-44 years old year old respectively. The mean facial width was found to be 124.88 ± 9.68 and 89.39 ± 13.89 among Males and Females respectively. Similarly, findings from Tibet by Hua Zhong et al. (2022) noted male facial widths of 133.53 ± 7.31 mm and widths of 133.95 ± 8.1 mm among females.¹⁴

In the present study among Indian population, the mean facial width was found to be 99.42 ± 13.77 , 97.8 ± 16.03 and 101.33 ± 16.15 among 18-24, 25-34 and 35-44 year old respectively. The mean facial width was found to be 97.85 ± 15.33 and 100.71 ± 15.21 among Males and Females

respectively. Srikanth Maseedupalli et al. (2023), found an average facial width of 115.8 ± 8.3 mm among individuals aged 20–40 years; within this group, males averaged 118.9 ± 7.7 mm and females' 111.9 ± 7.4 mm.¹⁵ In the present study among Tibetan immigrants, the mean nasal length was found to be 53.67 ± 5.69 , 55.16 ± 10.22 and 54.06 ± 7.52 among 18-24, 25-34 and 35-44 year old respectively. The mean nasal length was found to be 55.6 ± 7.82 and 48.67 ± 7.06 among Males and Females respectively. In contrast, a study carried out in Tibet by Lauren N. Butaric et al. (2018) found a significantly lower mean nasal length of 35.65 ± 0.77 mm.¹⁶

In the present study among Indian population, the mean nasal length was found to be 51.02 ± 14.24 , 48.09 ± 12.93 and 55.38 ± 18 among 18-24, 25-34 and 35-44 year old respectively years; among Males, the mean nasal length was found to be 50.82 ± 14.72 and among Females, the mean nasal length was found to be 51.5 ± 15.7 . In a study conducted in Bhopal by Daisy Sahni et al. (2014), among males aged 18–20 years, the mean nasal length was 49.4 ± 0.28 mm, while females in the same age group had a slightly higher mean of 49.7 ± 0.28 mm; for individuals aged 21–30 years, the average nasal length was 50.7 ± 0.34 mm in males and 49.9 ± 0.28 mm in females; in the 31–40 year age group, male participants exhibited a mean nasal length of 52.2 ± 0.39 mm, whereas the female average was 49.7 ± 0.35 mm.¹⁷

In the present study among Tibetan immigrants, the mean nasal width was found to be 38.55 ± 3.96 , 39.78 ± 5.76 and 40.17 ± 4.95 among 18-24, 25-34 and 35-44 year old respectively; among Males, the mean nasal breadth of the male was found to be 39.91 ± 5.08 and among females, it was found to be 38.72 ± 4.81 . In research carried out in the United States, Jennifer Parker Porter et al. (2001) observed that the nasal breadth among African American females averaged 38 ± 0.28 mm, whereas North American Caucasian females had a narrower mean of 31.4 mm.¹⁸

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In the present study among Indian population, the mean nasal width was found to be 59.76 ± 12.7 , 55.17 ± 11.27 and 63.73 ± 16.26 among 18-24, 25-34 and 35-44 year old respectively; among Males, the mean nasal breadth was found to be 59.86 ± 14.3 and among Females, it was found to be 58.58 ± 13.18 . In Gujarat, M. M. Rohith et al. (2020) found the average nasal width to be 38.23 mm in males and 34.94 mm in females.¹⁹

The present study's findings indicate that Tibetan populations who have historically acclimated to high altitude, cold and low oxygen conditions have longer nasal structures and narrower nasal breadths, which are thought to aid in better airflow regulation and warming and humidification in thin, dry air. In contrast, the broader nasal breadth observed in the local Indian population may reflect adaptation to hot, humid, lowland climates, where wider nasal passages support efficient heat dissipation and air exchange.

In the present study, the mean DMFT in Tibetan immigrants was found to be 3.44 ± 3.76 . In a study done in Tibet (Lingxia Guan et al 2020), the mean DMFT was found to be 7.62 ± 4.84 in age group 35-44 years²⁰.

In the present study, the mean DMFT in Indian population was found to be 4.26 ± 3.49 . In a study done in Dakshinpuri, New Delhi conducted by Binod Kumar Patro et al (2007), the DMF was 5.7 ± 4.7 in the 35-44 years age-group.²¹

Caries prevalence in Tibetan population living in Bylakuppe seems to be quite high compared to Tibetans living in Tibet and living in others parts of India. Similarly, even caries prevalence in local Indian population living in Bylakuppe is higher compared to reports from other parts of India and National oral health survey. Sugar intake is common in diets in many parts of India (sweets, sugar-infused tea, packaged foods). Systematic review conducted by Cambridge University (2016) showed that most dietary patterns were vegetarian with a

predominance of fruit, vegetables and pulses, as well as cereals; dietary patterns based on high-fat and high sugar foods were also identified²². In a study done in Ladakh, India conducted by Bella Yanju Lin et al (2018), many Tibetan immigrants show dietary routines rich in carbohydrates, meat and coarse grains. Studies show that they consume more caloric and carbohydrates heavy diets but not particularly sweet focused²³. Reduced salivary IgA (secretory immunoglobulin A) has been linked to high altitude situations (such as Tibet), which impairs the body's natural oral defences. However, caries has historically been less in Tibet due to traditional diets and limited sugar consumption. As a result of migration and acculturation, exposure to new foods might have resulted in increase in caries experience.

In the present study, the prevalence of dental fluorosis among Tibetan immigrants was 4.5%. In the present study, the prevalence of dental fluorosis in Indian population was found to be 0%.

This low concentration of fluoride in water might be responsible for zero prevalence of dental fluorosis in local Indian population and a prevalence of 4.5% in Tibetan immigrants. In a study done in Tibet conducted by (Cai Wen 2022)²⁴ authors mentioned that the harsh environment of the plateau has led to limited food sources for the local Tibetan people who form the habit of drinking tea leaves as a satiation solution to digest greasy food and replenish vitamins and regular consumption of brick tea leads to excessive exposure of Tibetan residents to fluoride.²⁵ In Bylakuppe, the same traditional cuisine - regular consumption of brick tea is being followed, which exposes Tibetan immigrants to fluoride, which might be responsible for milder forms of fluorosis among them. Tibetan immigrants and the local Indian population residing in Bylakuppe distinctly differed in their face and nasal morphology. Being exposed to local environmental conditions after moving from Tibet to India 60 years ago, there aren't

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many obvious changes among Tibetan immigrants because evolutionary changes take time. Tibetans consumed more meat because of their harsh environmental circumstances, but increased intake of fresh, green leafy vegetables and fruits in their settlements in India would have altered their dietary pattern and might have an effect on their oral health too. Adding to this, their nomadic lifestyle also might have an effect on their oral health, resulting in more caries experience compared to their counterparts in Tibet. The results underscore the importance of dental health strategies by highlighting the impact of lifestyle factors, environmental adaptation and ethnic background on facial and nasal morphology and oral health outcomes.

ACKNOWLEDGEMENTS

The authors would like to thank Dr Paritosh, Dr Vishnu, Dr Chandan K.P., Dr Ravi Varma, Dr Shreyana, Dr Tanya, Dr Kavyashree, Dr Sushmitha and Dr Atharva for their help in completing this study.

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