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Sexual Dimorphism in Permanent Mandibular Canine

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ABSTRACT

Introduction

Sexual dimorphism in mandibular canines, which are stable and decay-resistant, aids sex determination. Studies have extensively documented odontometric traits and sexual dimorphism in various ethnic groups. This study sought to assess sexual dimorphism in the mesiodistal diameters of mandibular canines.

Methods

A cross-sectional study was conducted at People's Dental College and Hospital, involving 120 participants (60 males, 60 females); equal numbers of Brahmin, Chhetri, and Newa, aged 18 years and above. Mesiodistal widths of healthy mandibular canines, free of pathology, spacing, or rotation, were measured using a digital Vernier caliper. Data were analyzed with SPSS version 16 after entry into Microsoft Excel.

Results

Males exhibited significantly larger mesiodistal widths (right: 7.42±0.32 mm, left: 7.24±0.36 mm) than females (right: 6.78±0.23 mm, left: 6.62±0.29 mm) ($p < 0.001$). There was notable sexual dimorphism in the mesiodistal diameters of mandibular canines between the sexes, with the right canine showing a greater degree of dimorphism (9.45%) than the left (9.36%). Among three ethnic groups, there was the highest dimorphism rate of 10.38% on the right and 10.22% on the left among Brahmins, followed by Newa at 9.29% on the right and 8.24% on the left, and Chhetri at 8.34% on the right and 9.80% on the left.

Conclusion

Mandibular canine mesiodistal width demonstrates significant sexual dimorphism in Newa, Brahmin, and Chhetri populations, with Brahmins showing the greatest difference. These findings support its forensic utility for sex estimation in Nepal, though integration with additional markers is advised due to measurement overlaps. Ethnic-specific databases are needed to enhance forensic applications.

Keywords
Canine; dental; ethnic; forensic; sexual dimorphism

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INTRODUCTION

Sex determination through skeletal analysis is extremely accurate, particularly using the pelvic and skull bones, but DNA testing remains the most reliable method. However, DNA testing in developing and middle-income countries like Nepal is generally not feasible, considering its costliness and lack of facility. Therefore, odontometric analysis of teeth, and more specifically mandibular canines, has been a useful and convenient forensic method.[1,2] Mandibular canines are most appropriate for identification since they are strong, less susceptible to disease, and even trauma. South Asian research, including that in India's Uttar Pradesh and Rajasthan, has indicated significant sexual dimorphism of mandibular canines, at 7.95% for the right canines and 8.89% for the left canines.[3-5] For Nepal, limited research[6-9], such as that from Dhulikhel and Dharan, reports 8.29% and 6.12% dimorphism rates for the right and left mandibular canines, respectively, with canines showing consistent univariate dimorphism. Nepal's ethnic mosaic, e.g., Brahmin, Chhetri, and Newa, and its unique geographic position, highlight the need for population-specific odontometric data. While regional studies suggest sexual dimorphism in Nepalese populations, detailed data on specific ethnic groups are few. The study aims at Newa, Brahmin, and Chhetri population mandibular canine mesiodistal widths for the purpose of furthering forensic identification. By using the intense sexual dimorphism of these dental measurements and merging findings with ethnic-specific databases, the study aims to create more precise and standardized sex determination protocols for the forensic practice of Nepal.

METHODS

A cross-sectional study was conducted in People's Dental College and Hospital, Kathmandu from 1st February 2025 to 30th April 2025 after the Ethical approval was obtained from the Institutional Review Committee of People's Dental College and Hospital [Reference number 1. CH No.12 2081/2082]. The study population consisted of patients visiting the dental outpatient department (OPD) aged 18 years or older, and data collection was conducted after obtaining informed consent from the patients.

Selection Criteria for participants

Individuals with healthy mandibular canines free of any pathology, absence of spacing and rotation in the anterior region of the lower jaw were included. The individuals with missing canine teeth on either side; prosthesis, if any, is used on the concerned teeth and with the history of any trauma/ surgical treatment on the concerned teeth were excluded.

A convenient sampling technique was used. The sample size calculation was done by using the following formula;

$n= 2(Z_{\alpha}+Z_{\beta})^2 s^2/d^2$

Z_{α}: 1.96 at 95% confidence level

Z_{β}: 1.28 at 90% power

- S: standard deviation of mesio-distal width 0.532[9] (larger among males and females).
- d: mean difference of mesiodistal width (7.03-6.64=0.39)
- $n= 2 (1.96+1.28)^2 0.53^2/0.39^2$
- n=39.8 ~40

Total: 40

Male: 20

Female: 20

Since the sample size formula is the minimum sample size for each group to detect whether the stated difference exists between the two means, we included 20 males and 20 females for the Brahmin, Chettri, and Newa ethnicities.[10] A total of 60 male and 60 female participants were included for the present study.

After obtaining consent, demographic information for each participant, including age, sex, and ethnicity (Brahmin, Chhetri, and Newa), was recorded using a structured questionnaire. Self-reported ethnicity was the primary method, cross-checked by common surnames associated with these groups in Nepal. Care was taken to ensure that individuals identifying with these groups had primary ancestry within them to maintain the integrity of the population categories for comparative purposes. This information was crucial for stratifying the sample and for subsequent inter-population analysis.

The mesial and distal surfaces of the concerned teeth were identified and the distance between the crest of the curvature on the mesial surface and the crest of the curvature on the distal surface was recorded by a Digital Vernier caliper.[11] For each tooth of right and left, three measurements were taken by the same person in a clean and well-illuminated room under aseptic precautions. The average of the three values was obtained to minimize the intra-observer error and reliability.[6] The data were entered into Microsoft Excel and analyzed using SPSS Statistics version 16. Independent t-test is performed to test the statistical difference between the sexes and ANOVA for statistical difference between 3 ethnicities.

From the above-obtained odontometric measurements, sexual dimorphism for the right and left sides was calculated using the following formula by Garn et al.[12]

Sexual Dimorphism= $[(X_m \div X_f) -1] \times 100\%$

Where X_m= mean mesio-distal diameter in males: X_f= mean mesio-distal diameter in females.

RESULTS

A total of 120 participants were included in the study, with 60 males and 60 females. The mean mesiodistal diameters of the mandibular canines in males were measured as 7.42±0.32 mm and 7.24±0.36 mm for the right and left sides, respectively. For females mean mesiodistal diameters were measured as 6.78±0.23 mm and 6.62±0.29 mm for the right and left sides respectively (Table 1).

Table 1. *Mandibular canine width in male and female (n=120)*

Mesiodistal width	Sex	n	Mean	p value*
Right Canine	Male	60	7.42±0.32	<0.001
	Female	60	6.78±0.23	
Left Canine	Male	60	7.24±0.36	<0.001
	Female	60	6.62±0.29	

**p value from independent t-test*

Statistically significant difference was found with the mesiodistal diameter of mandibular right and left canines between males and females. Among the mandibular canines, the right canine (9.45%) showed more dimorphism than the left one (9.36%). (Fig. 1)

The mean diameters of the mandibular right and left canines in males and females of Newa, Brahmin, and Chettri ethnicities, with their statistical analysis, are depicted in Table 2. The mean width of right and left mandibular canines showed statistically significant differences between males and females in all three ethnicities.

Among the three ethnicities, Brahmins showed the maximum amount of sexual dimorphism, with the right having 10.38% and the left having 10.22%.

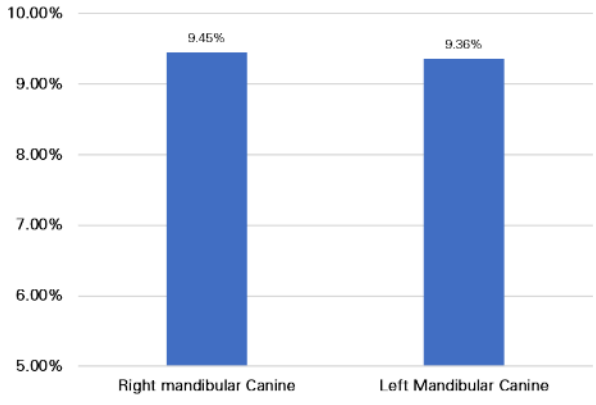

Figure 1. *Percentage of sexual dimorphism in males and females*

Table 2. *Mandibular canine width in Male and Female in Newa, Brahmin, and Chhetri ethnicities*

Ethnicity	Canine Side	Mesiodistal width (Mean ± SD)		p value*
		Male (n=20)	Female (n=20)	
Newa	Right	7.41±0.31	6.78±0.32	<0.001
	Left	7.22±0.34	6.67±0.34	<0.001
Brahmin	Right	7.44±0.28	6.74±0.16	<0.001
	Left	7.33±0.34	6.65±0.23	<0.001
Chhetri	Right	7.40±0.38	6.83±0.20	<0.001
	Left	7.17±0.41	6.53±0.27	<0.001

**p value from independent t-test.*

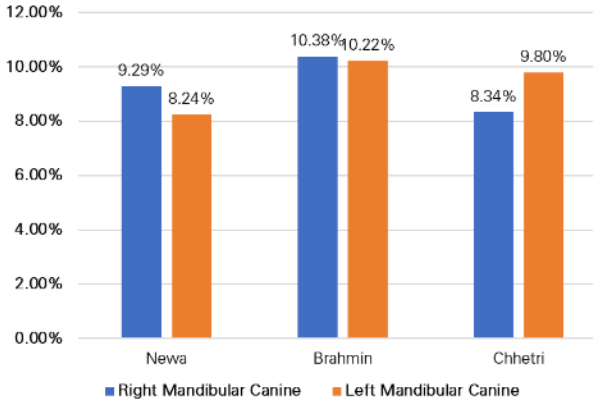

Figure 2. *Percentage of sexual dimorphism in right and left mandibular canines in Newa, Brahmin, and Chhetri ethnicities*

Sexual dimorphism in Newa was calculated as 9.29% for right and 8.24% for left. For the Chhetri ethnic group, 8.34% for the right and 9.08% for the left canines were calculated (Fig 2).

DISCUSSION

The present study investigated sexual dimorphism in the mesiodistal width of mandibular canines among three distinct Nepalese populations: Newa, Brahmin, and Chhetri. The findings confirm the presence of significant sexual dimorphism in these groups and provide valuable population-specific odontometric data. The results consistently demonstrate that males in all three studied Nepalese populations possess significantly larger mandibular canines (mesiodistal width) than females. This aligns with the general pattern of dental sexual dimorphism observed in human populations worldwide.[13] In the study conducted by Shrestha B in Nepal mean mesiodistal width was found to be 7.19 mm in males and 6.7 mm in females for the right side, whereas 7.03mm in

males and 6.64 mm in females for the left side, with a statistically significant difference between the genders, supporting our current study.[9]

Within three ethnicities, the differences in mean mesiodistal canine widths between sexes were statistically significant ($p < 0.001$) for both right and left sides. The magnitude of sexual dimorphism, as quantified by the Garn et al formula[12], ranged from approximately 10.38% to 8.24%. For instance, the Brahmin population exhibited slightly higher values 10.38% for right mandibular canine 10.22 % for left mandibular canine compared to the Newa 9.29% for right mandibular canine 8.24 % for left mandibular canine and Chhetri 8.34% for right mandibular canine, 9.80% for left mandibular canine groups, although these inter-group sexual dimorphism differences were modest. The consistent finding of larger male canines across these genetically and culturally distinct groups suggests a common underlying biological basis for this dimorphism, likely related to hormonal influences during development and genetic factors linked to the Y chromosome.[13]

In the study performed by Kaushal et al[14] in North Indian populations in 60 subjects shows the mean values for mesiodistal width on the right side were 7.22 in males and 6.69 in females; on the left side, 7.29mm in males and 6.69mm in females. The values were found statistically highly significant when compared between males and females. The left canine showed the maximum percentage of sexual dimorphism of 8.89%. In our present study maximum percentage of sexual dimorphism was observed on the right side as 9.45%.

The observed levels of sexual dimorphism in these Nepalese populations are comparable to those reported in other South Asian groups. For example, studies in various Indian populations have documented sexual dimorphism values for mandibular canines typically ranging from 4% to 9%.[3] A study on a Lebanese population reported significant dimorphism with males having canine widths greater than 7.188 mm[15], a threshold that aligns broadly with the male mean values found in our Nepalese samples (e.g., ranging from 7.44 mm to 7.17 mm). The slight variations in the degree of dimorphism among the Brahmin, Chhetri, and Newa, and when compared to other global populations, may reflect subtle differences in genetic heritage, nutritional status during development, or other environmental modulators that can influence overall body size and, consequently, tooth size.[13]

The Brahmin and Chhetri populations, both belonging to the Indo-Aryan linguistic family, share a degree of common ancestry stemming from migrations into Nepal. In contrast, the Newa are predominantly of Tibeto-Burman stock, with a long history in the Kathmandu Valley.[16] These differing genetic backgrounds may contribute to subtle variations in dental traits, such as tooth size and shape, as seen in other studies comparing Indo-Aryan and Tibeto-Burman groups. Furthermore, traditional dietary habits, socio-economic conditions, and localized environmental factors experienced over generations might also play a role in shaping morphometric traits, including tooth size.[17] The study confirms that mandibular canine width exhibits significant sexual dimorphism, aligning with global findings. This supports its use in forensic sex estimation when skeletal remains are fragmentary.[18]

The data generated from this study have important implications for forensic science and dental anthropology within the Nepalese context. The confirmation of significant sexual dimorphism in mandibular canine width suggests its potential as a supplementary tool for sex determination from dental remains.[19, 20]

There are some limitations in the present study, which offer important implications. The sample for each population group is sufficient to allow for the estimation, but small enough, since a higher sample size would increase the statistical power of the study and make the generalizability of the sample larger. The study was limited to three ethnicities from a geographic area in Nepal and may not apply to all Nepalese populations. Future research should aim to include a wider array of Nepalese ethnic groups and geographical regions. The development of population-specific discriminant functions based on a larger dataset is also a recommended next step for forensic applications.

CONCLUSION

The present study confirms statistically significant sexual dimorphism in mandibular canine mesiodistal width among Nepal's Newa, Brahmin, and Chhetri populations, with males showing larger canines. In conformity with the worldwide and South Asian finds, the results make canine mesiodistal width a legitimate forensic tool for sex determination in Nepal, enhancing the accuracy of identifications of fragmented remains. Despite limited sample size and ethnic scope, this research enriches population-specific databases and provides the foundation for broader studies and standardized forensic protocols.

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CONFLICT OF INTEREST

The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

1. Negi BK, Prasad RG, Nagpal P, et al. Comparative analysis for sexual dimorphism of mandibular canine in two ethnic diverse population with clinical and experimental method. J Oral Res Rev. 2025;17:15-20. https://doi.org/10.4103/jorr.jorr_43_24
2. Sharma A, Chauhan S, —. A study of sexual dimorphism in permanent mandibular canines and its implication in forensic dentistry. J Anat Soc India. 2017;66:S27-S28. https://doi.org/10.1016/j.jasi.2017.08.090
3. Sharma M, Gupta S, Sharma A, et al. Dental sexual dimorphism. Dent J Adv Stud. 2015;3:135-139. https://doi.org/10.1055/s-0038-1672028
4. Srivastava P. Correlation of odontometric measures in sex determination. J Indian Acad Forensic Med. 2010;32:56-61.
5. Gupta S, Chandra A, Gupta OP, et al. Establishment of sexual dimorphism in North Indian population by odontometric study of permanent maxillary canine. J Forensic Res. 2014;5:1000224. https://doi.org/10.4103/2231-0754.143521
6. Shrestha S, Shakya R, Mehta D, et al. Estimation of sex using mandibular canine index in a young Nepalese population. Anat (Ankara). 2019;13:163-167. https://doi.org/10.33314/jnhrc.v17i4.2187
7. Atreya A, Shrestha R, Tuladhar LR, et al. Sex predictability by using mandibular canine index. 2019. https://doi.org/10.2399/ana.19.086
8. Acharya AB, Mainali S. Univariate sex dimorphism in the Nepalese dentition and the use of discriminant functions in gender assessment. Forensic Sci Int. 2007;173:47-56. https://doi.org/10.1016/j.forsciint.2007.01.024
9. Shrestha B. Sexual dimorphism in permanent maxillary and mandibular canine of medical students in Gandaki Medical College, Nepal. Birat J Health Sci. 2019;4:654-659. https://doi.org/10.3126/bjhs.v4i1.23941
10. Ministry of Health and Population (Nepal), New ERA, ICF. Nepal Demographic and Health Survey 2022. Kathmandu: MoHP; 2023.
11. Moorrees CT, Jensen E, Yen PKJ. Mesiodistal crown diameters of the deciduous and permanent teeth in individuals. J Dent Res. 1957;36:39-47. https://doi.org/10.1177/00220345570360011501
12. Garn SM, Lewis AB, Kerewsky RS. The relationship between sexual dimorphism in tooth size and body size as studied within families. Arch Oral Biol. 1967;12:299-301. https://doi.org/10.1016/0003-9969(67)90050-7
13. Frayer DW, Wolpoff MH. Sexual dimorphism. Annu Rev Anthropol. 1985;14:429-473. https://doi.org/10.1146/annurev.an.14.100185.002241
14. Kaushal S, Patnaik VV, Sood V, et al. Sex determination in North Indians using mandibular canine index. J Indian Acad Forensic Med. 2004;26:45-49. https://doi.org/10.1177/0971097320040203
15. Ayoub F, Shamseddine L, Rifai M, et al. Mandibular canine dimorphism in establishing sex identity in the Lebanese population. Int J Dent. 2014;2014:235204. https://doi.org/10.1155/2014/235204
16. Pokharel R. Politics and problematics of the definition and categorization of ethnicity in Nepal. Bodhi. 2011;5:1-15. https://doi.org/10.3126/bodhi.v5i1.8042
17. Lukacs JR. Dental paleopathology and agricultural intensification in South Asia: new evidence from Bronze Age Harappa. Am J Phys Anthropol. 1992;87:133-150. https://doi.org/10.1002/ajpa.1330870202
18. Acharya AB, Mainali S. Sex discrimination potential of buccolingual and mesiodistal tooth dimensions. J Forensic Sci. 2008;53:790-792. https://doi.org/10.1111/j.1556-4029.2008.00778
19. Agrawal A, Manjunatha BS, Dholia B, et al. Comparison of sexual dimorphism of permanent mandibular canine with mandibular first molar by odontometrics. J Forensic Dent Sci. 2015;7:238-243. https://doi.org/10.4103/0975-1475.172449
20. Dutta A, Saini V. A pilot study on ethnic variations and reverse sexual dimorphism in permanent teeth dimensions of sub-adult Santhal population of India. Bull Int Assoc Paleodontol. 2024;18:87-97. https://ojs.srce.hr/index.php/paleodontology/article/view/32935