A Tooth Size Allocation Investigation into the Bodo Origins: Revisited
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Introduction
The Bodo are an ethnic group located north of the Brahmaputra Valley in the State of Northeast India. A previous tooth size allocation analysis by Fisher and Hemphill (2022) yielded inconclusive results. The current study examines another group located north of the Brahmaputra River, the Nyishis, who reside east of the Bodo in Arunachal Pradesh.

Methods
- Diastemal dental casts were collected from school children between 14-19 years of age.
- Mesiodistal (MD) and buccolingual (BL) measurements were obtained for all permanent, except third molars.
- EM Estimation was used to estimate up to four missing values by individual. Those with more than four missing values were removed from further consideration.
- Univariate analyses (Levene’s test, paired samples t-tests, one way ANOVA, Welch’s test, Q-Q plots) were used to ensure homogeneity of variance and adherence to normality necessary for parametric analyses.
- Three multidimensional statistical analyses were used to test the inter-relatedness of the target and comparative groups: Canonical Variates Analysis (CVA), Multidimensional Scaling (MDS), and Neighbor-Joining Cluster Analysis.

Hypotheses
- Given the paucity of archaeological evidence (Dikshit & Hazarika, 2011-12; Jamir, 2012), hypotheses concerning the origins of ethnic groups of northeastern India are based on linguistic affinities. All linguists agree that the Tibeto-Burman languages spoken in northeastern India are intrusive into the subcontinent, probably within the last three millennia (Blench & Post, 2014; Burling, 2003; Gadgil et al., 1997). Three alternative hypotheses may be tested:
  1. The introduction of Tibeto-Burman languages did not involve substantial population movement. Hence, ethnic groups of northeast India are indigenous inhabitants of this region distinct from other South Asians due to long-standing genetic drift (Jeong et al., 2017; Majumder, 1998; Sharma et al., 2012).
  2. The introduction of Tibeto-Burman languages occurred due to movement of populations from southern China along two vectors, one north of the Brahmaputra Valley, the other to the south via Manipur and Nagaland (Gaha & Tay, 1990; Su et al., 2000; Wang et al., 2018).
  3. Tibeto-Burman languages were introduced from the north via the Tibetan Plateau (Blackburn, 2004; Gnecchi-Ruscone et al., 2017; Liu et al., 2022; Zhang et al., 2019) resulting in a genetic cline from north to south.

Results
- With their group centroids plotted in the upper right of the array, Bodos and Nyishis stand apart from all other groups.
- Occupying the upper-left and lower-left, respectively, Khowars and Gurungs also represent distinct outliers to other South Asians.
- The Naga samples aggregate together in the center-left, but the two Kuki samples are widely dispersed, with Koms showing close affinities to Nagas, but Hmurs are marked by distant affinities to Himalayan groups.
- Peninsular Indian groups occupy the center of the array but lack regionality.

Graph 1: Canonical Variates Analysis

Graph 2: Multidimensional Scaling (Kruskal)

Discussion
- Our results offer some support for the first hypothesis, as northeast Indians do stand apart from South Asians of other regions; however, there is no clear patterning among the northeast groups. It would thus stand to reason that genetic drift has affected northeast groups.
- Regarding the second hypothesis, a separation exists between northern and southern groups from the northeast, but both CVA and MDS show exceptions. The Bodo and Nyishis were not associated with groups residing north of the Brahmaputra valley.
- The third hypothesis, that Tibeto-Burman-speaking ethnic groups from northeast India are related to groups of the Tibetan Plateau and this relation would be strongest in the North and weakest in the South, is not supported by our results. The Bodo and Nyishis have no affinities to the Sherpas or Gurungs, and the Tangkhul Nagas, located in the south, have the strongest affinities to these groups.
- The Bodos and Nyishis shared no affinities to the samples presented, and their origins may be sought elsewhere, such as Myanmar or Thailand.

Acknowledgements and References
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Table 1: Ethnic Group Samples

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<th>Ethnic Group</th>
<th>N. Pakistan</th>
<th>N. India</th>
<th>N. Assam</th>
<th>N. Bangladesh</th>
<th>N. Myanmar</th>
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<tbody>
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<td>Bodo</td>
<td>186</td>
<td>503</td>
<td>462</td>
<td>215</td>
<td>125</td>
</tr>
<tr>
<td>Nyishi</td>
<td>186</td>
<td>503</td>
<td>462</td>
<td>215</td>
<td>125</td>
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</tbody>
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Table 2: Original CVA Classification Matrix

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Table 3: Jackknifed CVA Classification Matrix

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