Comparing soft versus bony upper airway dimensions between populations of different climates

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Introduction

Differences in airway passages lead to a multitude of different impacts on the way humans breathe. Mainly, longer, narrower, and taller pathways lead to more air turbulence compared to their smaller counterparts[1].

This results in humidification and heating of air prior to its arrival in the lungs. Differences in these airways may have changed as humans migrated across the globe to different climates.

To further test this hypothesis, our research looked at how the bony versus soft-tissue airway passages differ between African and European populations.

Methods

- The current sample included 41 CT images (African American 7F / 2M ; European American 13F / 15M ; 1F / 3M unknown race)[2]
- Working with 3DSlicer 5.2.2, I oriented 3D models of the subjects' skulls into Frankfort Horizontal position and interpolated them with 2D CT images of the soft tissues. I then plotted 12 midline landmarks including bony and soft tissue portions of the nasal cavity, nasopharynx, and oropharynx to obtain linear distances (See **Figure 1**).
- We took those measurements and ran linear regressions of several nasal dimensions against the functional soft tissue nasal length (external nasal tip to posterior nasopharynx).

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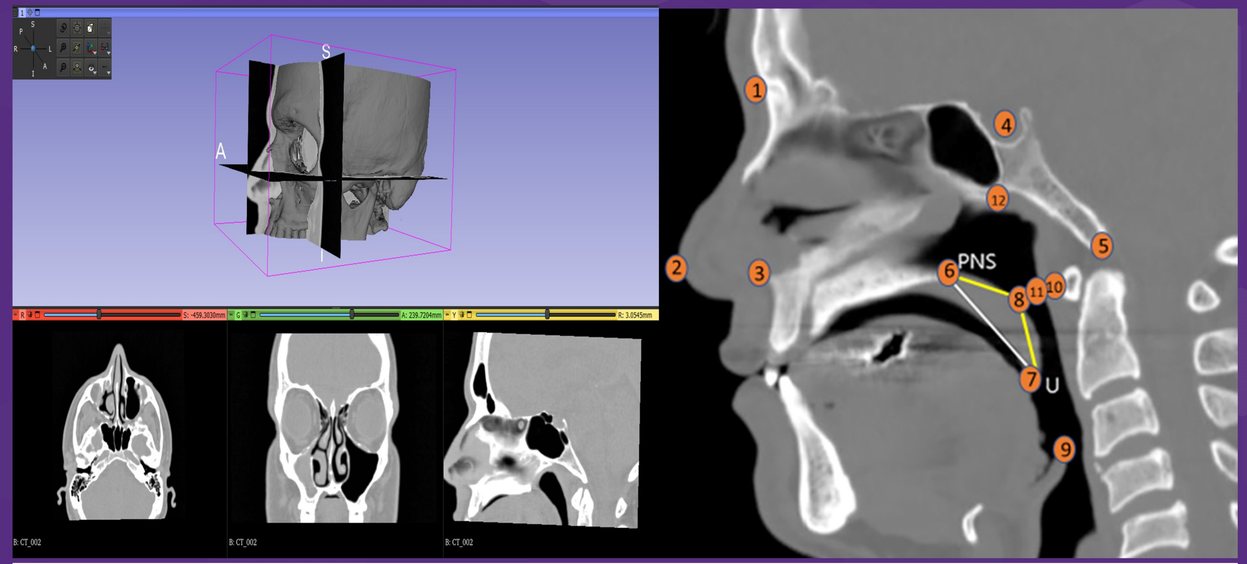

Fig 1. Screen shots from 3D slicer showing alignment of 3D skull models with CT slices (left) and placement of landmarks (right)

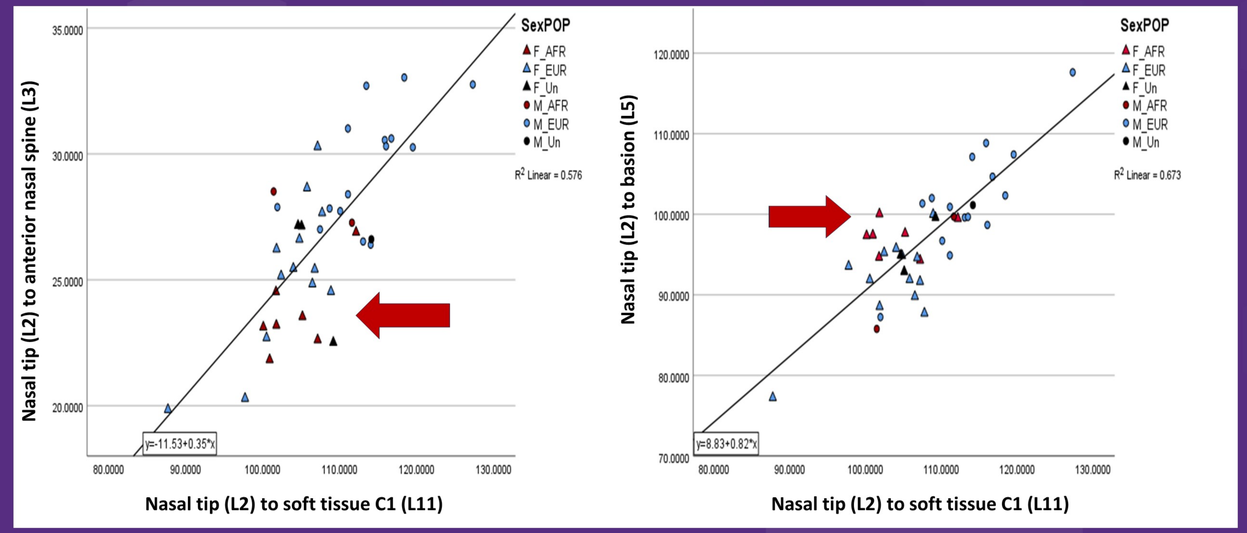

Fig 2. Regression plots for nasal dimensions (see Figure 1 for landmarks). Red arrows indicate placement of African females below line (left graph) and above regression line (right graph).

Results

- Females had smaller airways compared to males in both African and European populations. This is expected given their smaller builds on average.
- Interestingly, a trend was noted between European female and African females. African females tended to have longer nasal cavities and soft tissue nasal length. (see **Figure 2**) nasopharynx lengths (anterior nasal spine to C1). African females also had shorter soft-tissue nasal lengths (nasal tip to anterior nasal spine) relative to their functional length.

Conclusions

- Given the small sample size, more research into the topic will need to be preformed. Our research does suggest that there is significant difference in soft vs bony airway passage anatomy of different groups based on the climates from which they hailed. These differences support previous studies and suggest a natural selection process occurred in *Homo sapiens* as they migrated across the globe.
- Unique to this study is the finding of differential patterns of bony versus soft tissue nasal lengths within females of varying ancestry.
- If further explored, these findings may have impacts extending into anatomy, medical care, and even public health policies associated with respiratory health.

1. Maddux SD, Butaric LN, Yokley TR, Franciscus RG. 2017. Ecogeographic variation across morphofunctional units of the human nose. *Amer J Phys Anthropol* 162: 103-119.
2. Yokley TR. 2009. Ecogeographic variation in human nasal passages. *Amer J Phys Anthropol* 138: 11-22.