Temperature and humidity of ancestral environment are linked to differences in nostril width across human populations

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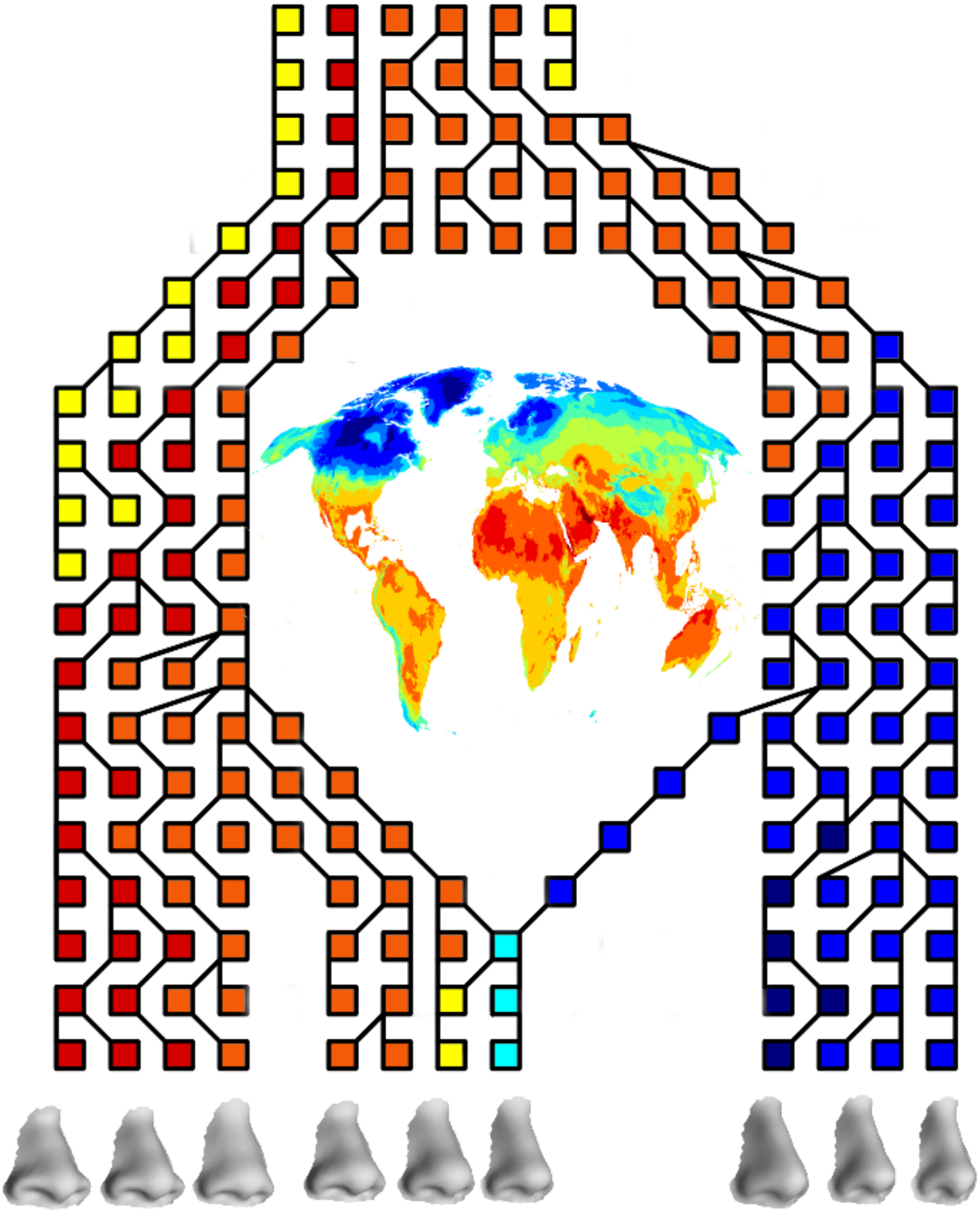

It is thought that differences in nose shape evolved across human populations as a result of local adaptation to climate, and not merely due to genetic drift. By

comparing phenotypic and genetic differentiation across populations, we show that while most aspects of nose shape seem to be evolving neutrally, the width of the nares shows signals of climate adaptation. The figure is an artistic representation of our findings. The diverging tree represents the evolutionary process underlying population-differentiation in nose shape, a quantitative trait. Blue boxes represent alleles for narrower nares while red boxes represent alleles for wider nares. Colors in between represent intermediate phenotypes. The color scale was chosen to correspond with color scale representing climatic variation in temperature and humidity, to show that narrower nares are favored in cool-dry climates while wider nares are favored in hot-humid climates. Studying phenotypic differentiation across populations can be tricky in making evolutionary inferences because of the confounding effects of genetic and environmental factors. This limitation can be overcome to a certain extent by studying the phenotypic and genetic variation in admixed populations. Credit: Arslan A. Zaidi and colleagues.

Big, small, broad, narrow, long or short, turned up, pug, hooked, bulbous or prominent, humans inherit their nose shape from their parents, but ultimately, the shape of someone's nose and that of their parents was formed by a long process of adaptation to our local climate, according to an international team of researchers.

"We are interested in recent human evolution and what explains the evident variation in things like skin color, hair color and the face itself," said Mark D. Shriver, professor of anthropology, Penn State. "We focused on nose traits that differ across populations and looked at geographical variation with respect to temperature and humidity." The researchers noted today (Mar. 17) in *PLOS Genetics* that "An important function of the nose and nasal cavity is to condition inspired air before it reaches the lower respiratory tract."

They considered a variety of nose measurements, looking at the width of

the nostrils, the distance between nostrils, the height of the nose, nose ridge length, nose protrusion, external area of the nose and the area of the nostrils. The measurements were made using 3D facial imaging.

Differences in the human nose may have accumulated among populations through time as a result of a random process called genetic drift. However, divergent selection—variation in natural selection across populations—may also be the reason that different populations have differing noses. Teasing the two apart is difficult, especially in humans.

The researchers found that the width of the nostrils and the base of the nose measurements differed across populations more than could be accounted for by genetic drift, indicating a role for natural selection in the evolution of nose shape in humans. To show that the local climate contributed to this difference, the researchers looked at the spatial distribution of these traits and correlated them with local temperatures and humidity. They showed that the width of the nostrils is strongly correlated with temperature and absolute humidity The researchers noted that "the positive direction of the effects indicate that wider noses are more common in warm-humid climates, while narrower noses are more common in cold-dry climates."

"It all goes back to Thompson's Rule (Arthur Thompson)," said Shriver. "In the late 1800s he said that long and thin noses occurred in dry, cold areas, while short and wide noses occurred in hot, humid areas. Many people have tested the question with measurements of the skull, but no one had done measurements on live people."

One purpose of the nose is to condition inhaled air so that it is warm and moist. The narrower nostrils seem to alter the airflow so that the mucous-covered inside of the nose can humidify and warm the air more efficiently. It was probably more essential to have this trait in cold and dry climates, said Shriver. People with narrower nostrils probably fared

better and had more offspring than people with wider nostrils, in colder climates. This lead to a gradual decrease in nose width in populations living far away from the equator.

Shriver notes that this is not the only explanation for nose-shape variation in humans. The researchers also found differences between men and women in nose features across the board. This sexual dimorphism is not unusual, as human men tend to be larger than human women, and their noses would be larger as well.

He thinks another way that the cross-population differences in nose size may occur is through sexual selection. People may choose mates simply because they find a smaller or larger nose more attractive. If an entire group thinks small is better, then those with large noses will have less success in reproducing and fewer large-nosed people will be in the group. Over time, the nose size in the group will shrink relative to other groups where large noses are favored. These notions of beauty may be linked to how well-adapted the nose is to the local climate.

Ecological selection and sexual selection could reinforce each other, according to the researchers. However, whether this connection between the two types of selection was important in the evolution of the nose requires further investigation.

More information: Arslan A. Zaidi et al, Investigating the case of human nose shape and climate adaptation, *PLOS Genetics* (2017). DOI: 10.1371/journal.pgen.1006616

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