What selective forces produced eco-geographic patterns in human mid-facial morphology?

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Introduction

For many years anthropologists have known that the shape of the nose varies geographically and climatically, with tall, narrow noses generally found in cold, dry climates, and broader, shorter noses in hot, humid areas (Cox and Steegmann 1981; Thorton and Bustin 1932; Williams 1956). Inter-population studies have shown that the mid-facial skeleton reflects climatic adaptation better than other parts of the cranium (Hill 2006; Rosenman and Weaver 2004). To provide an evolutionary explanation for these patterns, anthropologists have argued that mid-facial complex variables affect how air is conditioned to meet the requirements of the lungs, and coordinating air temperature and humidity.

Energetics in Pre-Incidental People

An evolutionary approach requires us to think about energy costs in non-mammalian life. One reason is that air is a poor conductor of heat. In a hot, humid climate, and the ancestry of the other people who lived in a hot, humid climate was adapted to living in the same environment. Air is not a good conductor of heat, so the body must work harder to keep the body temperature and airway temperature regulated. Humans and other endotherms consume 5 to 10 times the energy that comparably sized reptiles do, have evolved to maintain temperature. Knowing that thermal adaptation can explain a range of craniofacial morphologies is important. Somewhat similar concepts have been shown to apply to variation among humans living in different environments (Shea 1977).

Hypothesis

Relatively narrow, tall, deep nasal morphologies retain more heat and moisture in a cold environment. We predict that broader, deeper nasal shapes will perform better in warm, humid conditions. The study varied among humans living in different environments (Shea 1977). This poster seeks to develop new anthropometric and respiratory measures with 12 subjects.

Experimental Lab Conditions

We recruited young adult male subjects to test measures of their breathing at different humidity and temperature levels in the Human Physiology Department. We tested them at rest and during exercise, using nose-only and mouth-only breathing in these conditions (both sides). We found considerable variation among our 12 subjects: the majority, but not all, proved useful and appear to have been recorded reliably. Interviews with many found nose-breathing more difficult, they felt they did not get as much air as they wanted.

Physiological Measurements

Standard physiological measures such as heart rate, VO2, total ventilation, and respiratory rate, were recorded continuously. In addition, we measured temperature and humidity of expired air with a dedicated humidity/temperature sensor-transmitter in the tube leading from the mask. Adaptations to a basic breathing mask were complex and uncomfortable.

Anthropometric Measurements

We took standard anthropometric: weight, stature, sit height, shoulder width, hip breadth, head length, head breadth and upper facial height, nasal length and nose breadth, and calculated from body mass from 7 skin fold measurements.

Conclusions

Breathing is the core function of life and exploring how natural selection maximizes energy use in adapting populations to particular environments deserves further study. This pilot study developed and tested old and new anthropometric and respiratory measures with 12 subjects. With a larger sample it is important that we have an equal balance of subjects with different morphologies and behavioral adaptations. Variation evident in studies of nose-breathing and mouth-breathing in variate forms, traits that are in a larger sample can be associated with measures of morphology and behavior. We are developing a way to make nasal attachment fit securely and comfortably in every individual. We may consider existing measures that appear not to be useful. We should investigate whether the sensor recording humidity should be more sensitive on every individual.

With a larger sample it is important that we have an equal balance of subjects with ancestry in far and distant parts of the world. We are developing new anthropometric and respiratory measures with 12 subjects. For many years anthropologists have known that the shape of the nose varies geographically and climatically, with tall, narrow noses generally found in cold, dry climates, and broader, shorter noses in hot, humid areas (Cox and Steegmann 1981; Thorton and Bustin 1932; Williams 1956). Inter-population studies have shown that the mid-facial skeleton reflects climatic adaptation better than other parts of the cranium (Hill 2006; Rosenman and Weaver 2004).

References

1. Subject physiological measures: VO2, EDR, measures of expired heat, relative humidity, and heat loss to convection – offer in cool and mouth breathing within the same subject and between subjects.

2. During mouth-breathing, many experienced thirst, whereas many found nose-breathing more difficult, they felt they did not get as much air as they wanted.

3. Anthropometric measures: VO2, EDR, measures of expired heat, relative humidity, and heat loss to convection – offer in cool and mouth breathing within the same subject and between subjects.

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