Craniofacial Phenotypic Plasticity in Mice Exposed to Various Temperatures

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Influences of environmental factors such as temperature on skeletal phenotype have been hypothesized and demonstrated for several decades. Animal models, mostly rodents, exposed to cold temperatures display significant reduction of long bone length (endochondral ossification), tail length, ear size, and foot size, without change in body mass. Regarding the craniofacial phenotype, subtle changes in facial shape and a relative decrease in the volume of the maxillary sinuses and nasal cavity were reported in rats but, to the best of our knowledge, never reproduced with other models or with different temperatures. Here we propose to compare craniofacial phenotypes of male C57BL/6J laboratory mice that were exposed from 3–12 weeks of age to 16°C, 22°C, and 26°C (N=4–5/group). The mice were sacrificed at the age of 12 weeks. Reconstructions of the 3D microCT images were performed and 58 anatomical landmarks were measured on the craniofacial skeleton. Landmark three-dimensional coordinates were then analyzed using geometric morphometrics. Our results confirmed significant shape differences between the mice exposed to different temperatures. The anatomical regions displaying the most intense shape variation depending on temperature are the anterior aspect of the snout (nasal bones and premaxilla), sphenoid, and parietal bones, with mice exposed to 16°C displaying an overall less globular skull. Bones forming through endochondral ossification do not appear to be more affected than those forming through intramembranous ossification. These findings confirm that phenotypic plasticity plays a significant role in the so-called cold adapted phenotype.