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Human pelvis and long bones reveal differential preservation of ancient population history and migration out of Africa

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Abstract

One of the main events in the history of our species has been our expansion out of Africa. A clear signature of this expansion has been found on global patterns of neutral genetic variation, whereby a serial founder effect accompanied the colonization of new regions, in turn creating a within-population decrease in neutral genetic diversity with increasing distance from Africa. This same distinctive pattern has also been described for cranial and dental morphological variation in human populations distributed across the globe. Here, we used a dataset of postcranial linear measurements for 30 globally distributed human populations, and a climatic dataset of minimum annual temperature, maximum annual temperature, and precipitation in order to separate for the first time the relative effect of neutral demographic processes and climatic selection on four long (limb) bones (femur, tibia, radius and humerus) versus the pelvic bones of the human appendicular skeleton. We implemented a stepwise regression procedure in which phenotypic variance is assumed to be affected by the iterative founder events that accompanied human expansion from Africa, as well as by climate. This model included, as independent factors, geographic distance from central Africa, the three climatic variables, and all possible interactions between the three climatic variables. We excluded all non-significant factors by backward stepwise elimination with the aim of identifying the minimal model significantly explaining variation in the phenotypic data. Our results indicate a sharp difference in the way the pelvis and the limb bones reflect the neutral signature of the out-of-Africa expansion. Consistent with previous analyses of the cranium and dentition, pelvic shape variation shows a significant within-population decrease with increasing distance from Africa. However, no such pattern could be found in the long bones. Rather, in the case of both the tibia and the femur, a significant

relationship between population-level variance and minimum temperature was demonstrated. Hence, in the case of these limb bones, it is probable that the effects of climatic selection have obliterated the demographic signature of human dispersal from Africa. Our finding that pelvic variation exhibits the neutral effects of demographic history suggests that consideration of this skeletal element might be used to shed light on factors of human population history, just as the cranium has done.