Frontal bone shape and sinus size across US based populations.

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Human facial sinus cavities have long been a mystery bringing about many questions—particularly regarding individualistic and group variation in structure. This study was performed to determine if frontal sinus volume correlates specifically with midline frontal curvature, which has been suspected in the literature. This research specifically investigated how the frontal sinus varies with skull size and shape, on genetically determined sex and ancestral origins. Using Slicer3D, skull shape and midline frontal bone curvature was measured via landmark and principal component analyses (PCA) and compared to pre-collected frontal sinus volume in a total of 233 pre-formed 3D skull models: Smithsonian Institute Terry Collection n=113 (African Female=22; African Male=39; European Female=18; European Male=34) and New Mexico Descendent Image Database n=120 (African Female=30; African Male=30; European Female=29; European Male=29). Analyses comparing sinus volume and midline frontal bone curvature showed no significant correlation. However, data trends for sex and ancestry differences in frontal bone shape were noted. Males had more prominent supraglabellar depression in midline curvature compared to females (PC1: $t=6.77$, $p<.001$). Individuals of African descent had more rounded frontal bones, while Europeans had flatter frontal bones (PC3: $t=7.53$, $p<.001$). These findings depart from the proposed assumption of larger supraglabellar depression correlating with smaller frontal sinus size, indicating the need for further investigation into what may be driving frontal sinus size. This study and others in its field pose theoretical uses in the fields of osteoarchaeology, forensics, and potentially in the management of sinus related conditions with medication treatment and surgery.