

A38 Vertebral Neural Canal (VNC) Dimensions in Contemporary Subadult Samples: Indicators of Stress, Population Variation, or Both?

Louise K. Corron, PhD*, University of Nevada, Reno, Reno, NV 89557; Christopher A. Wolfe, MA, University of Nevada, Reno, Reno, NV 89557; Kyra E. Stull, PhD, University of Nevada, Reno, Reno, NV 89557

Learning Overview: VNC measurements are historically thought to be an indicator of biological stress or Socio-Economic Status (SES). After attending this presentation, attendees will appreciate that both population affiliation and socio-economic backgrounds may be embodied in VNC dimensions.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by advocating caution on the interpretation of “traditional” skeletal indicators of stress in contemporary skeletal remains.

Forensic anthropologists have recently started to incorporate bioarchaeological indicators of stress into the estimation of the biological profile. Small VNC dimensions are common indicators of biological stress or low SES. VNC growth ceases during late childhood and, therefore, the impact of these negative factors is “locked in” as permanent skeletal markers thereafter. The goal of this study was to analyze the relationship between VNC size, SES, and population affiliation in contemporary subadult samples to provide a better understanding of the variation presented by this skeletal indicator.

Antero-posterior and transverse VNC diameters and the ratio of these diameters of eight vertebrae (thoracic 10 to lumbar 5) were measured on five samples of dry and virtual skeletal remains. The dry skeletal remains were from Colombia ($n=28$) and included individuals from birth to 22 years. The virtual vertebrae were reconstructed from computed tomography scans of individuals from France ($n=484$, birth to 15 years), the Netherlands ($n=23$, birth to 15 years), Taiwan ($n=31$, birth to 16 years), and the United States ($n=838$, birth to 20 years). Each country is characterized by two socio-economic parameters: the Human Development Index (HDI) as a measure of life expectancy, education, and standard of living, and the Gini coefficient as a measure of inequality. Principal Component Analyses (PCA) were run to visualize the variation of VNC variables according to age, sex, socio-economic indicators, and country of origin. Discriminant Function Analyses (DFA) were run on the raw data to classify individuals into socio-economic level and population. To account for missing data, sequential nearest-neighbor imputations were done on subcategories of vertebrae and countries (Th10–L4 for Colombia, France, and the United States, and L4–L5 for all populations).

PCAs captured 83.4% of the variation in VNC for size (diameters) and 79.0% for shape (ratios) with the first two dimensions. DFA results showed that the Colombian sample clearly separated from the others for all variables and vertebrae according to HDI. Classification accuracy using VNC measurements was highest for HDI (94.00%–99.00%, two HDI groups), followed by Gini (58.00%–66.00%, three Gini groups) and population (38.00%–five groups/all populations, 66.00%–three groups/France, the United States, and Colombia). Ratios did not classify individuals as well, with inconsistent accuracies ranging from 18.00% (population, L4 and L5 of all five samples) to 71.00% (HDI, Th10 to L4 for three samples). Classifications into sex or age categories did not yield high accuracy rates in either size (45.00%–58.00%) or shape (37.00%–58.00%) of the vertebrae. Although classification accuracies were moderately high at best, these findings indicate that VNC size may be more sensitive to socio-economic factors than population affiliation. However, sampling and the differing number of groups for each set of analyses could have impacted the results.

The Colombian sample is the only sample that presents with high inequality (high Gini index) and has the lowest HDI (High) compared to the other four samples (Very High). This, as well as the sample’s small size ($n=28$), may explain why accuracy rates for classifying according to HDI were the highest (94.00%–99.00%). It is also the only sample composed of individuals with a Mestizos ancestry (i.e., a particular mix of indigenous and European backgrounds). As such, and despite these higher classification rates into HDI compared to population or Gini categories, it remains unclear whether the specific ancestry composition or socio-economic level of the Colombian individuals is the causal factor behind their smaller VNC size. Results of the current study serve as a cautionary tale to warn forensic anthropologists that skeletal indicators first need to be compared to extensive, verified, and varied reference data and that statistical analyses need to account for imbalanced samples, missing data, and categories for classification before drawing any conclusions concerning individual life histories (e.g., past episodes of stress) or population affiliation.

Human Variation, Socio-Economic Status, Vertebral Canal