A13 Sex Estimation of Skulls and Crania From Colombia Using MorphoPASSE Program v1.0

Justin R. Maiers, MS, University of South Florida, Tampa, FL 33647; Daniela Santamaria Vargas, BA, Binghamton University, Binghamton, NY 13902; Elizabeth A. DiGangi, PhD, Binghamton University, Binghamton, NY 13902; Jonathan D. Bethard, PhD, University of South Florida, Tampa, FL 33620-8100*

Learning Overview: After attending this presentation, attendees will have learned the utility of the MorphoPASSE program and will see how it can generate sex estimates quickly and easily based only on a handful of scored skeletal features. This presentation will also show how adjusting the input parameters of the program can increase classification accuracy.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating that freeware for sex estimation can be a useful tool in the estimation of the biological profile. This presentation will also impact the forensic science community by adding to research regarding the mental eminence and its unreliance for sex estimation.

MorphoPASSE v1.0 is a free program designed to use morphological scores of the skull and pelvis to estimate the sex of human skeletal remains.[1] This program uses random forest modeling, a flexible machine learning algorithm, which creates a series of decision trees in order to produce an average prediction. The study described here investigated the classification rates of this program when applied to skull morphology using the method described in Walker.[2] One hundred thirty-one skulls from the Human Skeletal Reference Collection for the Colombian Population, a modern skeletal series curated by the National Institute of Legal Medicine and Forensic Sciences in Bogotá, Colombia, were scored. The scores were input into MorphoPASSE in four different test runs to investigate which parameters of the program yielded the highest correct classification rates. These parameters are listed below.

MorphoPASSE Test 1 (MP1) included scores for skull features glabella, nuchal crest, mental eminence, supraorbital margin, and the mastoid process. For this run, all demographic criteria were set as "Unknown." Ninety-four of the 131 cases (71.8%) were correctly classified.

MorphoPASSE Test 2 (MP2) included scores for cranial features glabella, nuchal crest, supraorbital margin, and mastoid process; however, it excluded the score for mental eminence due to issues with high inter-observer error.[1] For this run, all demographic criteria were set as "Unknown." One hundred two of the 131 cases (77.9%) were correctly classified. Excluding the score for mental eminence therefore resulted in an increase of correct classifications by 6.1%.

MorphoPASSE Test 3 (MP3) used the same skull features that were scored in MP1; however, during this test, the "Ancestry" demographic was set to "Hispanic." In this run, 105 of the 131 cases (80.2%) were correctly classified. This increased the rate of correct classifications by a total of 8.4% compared to MP1 and an increase of 2.3% compared to MP2.

MorphoPASSE Test 4 (MP4) used the same cranial features scored in MP2; however, the "Ancestry" demographic was set to "Hispanic." This resulted in 106 of the 131 cases (80.9%) being correctly classified. This run demonstrated an increase of correct classifications by 9.1% compared to MP1; by 3% compared to MP2; and by 0.7% compared to MP3.

The MorphoPASSE program worked reliably well in all four test runs despite two main limitations. First, the program is designed to incorporate data from the skull and pelvis; however, this study only included scores for skull features. Second, the data in this study were scored using Walker instead of the modified descriptions for the MorphoPASSE program.[2] Even with these limitations, the correct classification rate still ranged from 71.8% to 80.9%. Finally, as demonstrated elsewhere, the results of these analyses also suggest that the use of the mental eminence may be inappropriate for sex estimation as its inclusion resulted in reduced classification rates.

Reference(s):

1. Klales, Alexandra R. MorphoPASSE: Morphological pelvis and skull sex estimation program. Sex Estimation of the Human Skeleton. *Academic Press*, 2020. 271-278.
2. Walker, P.L. (2008). Sexing skulls using discriminant function analysis of visually assessed traits. *American Journal of Physical Anthropology*, 136(1), 39-50.

Sex Estimation, Morphometrics, MorphoPASSE