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SUMMARY OF THE PROJECT

Major Goals and Objectives:

In this study, we addressed the persistent lack of adequate measures for assessing accuracy and reliability of forensic anthropology methods applied to forensic casework. Specifically, we 1) completed the development of the Forensic Anthropology Database for Assessing Methods Accuracy (FADAMA), which is a virtual database tool for tracking forensic anthropological method use, outcome, and accuracy in the actual casework context and 2) conducted research to establish accuracy rates for forensic anthropology case work and the methods used. In order to assess the accuracy of method estimations of the biological profile in the *casework* context, we adopted the practice of systematic documentation of methods-based case assessments compared with positively identified case data. FADAMA was created in order to address this need in forensic anthropology. FADAMA is an online, practitioner-accessible, repository for data from *identified* forensic anthropology cases. FADAMA data can be accessed and studied for inferring method accuracies through comparisons of methods-derived assessment of the biological profile as concluded on the forensic anthropology case report compared to the coroner or medical examiner's documentation of the decedent's actual biological profile upon identification. FADAMA was established with the goal to create a forensic anthropological community-wide collective resource for case data to be used for forensic anthropological method tracking and assessment.

As a field, forensic anthropologists have worked thousands of cases, and beyond the basic goal of providing information about the investigation, there's essentially a treasure trove of data in those case reports that can be harvested as a resource for improvement and tracking of the discipline's goals for adhering to the standards of method reliability and accuracy. FADAMA development and beta testing was completed from 2012 to 2017, and was formally released for general data submission and research use in 2017 with over 200 cases submitted during this early phase. Case data submitted per case included: 1) documented decedent data, including their sex, stature, age, and race, and 2) the methods-based forensic anthropology estimations of the biological profile. The submitted data is anonymous, in that no identifiable information is available to other FADAMA users about the decedent nor the individual submitting the case information to FADAMA. The goals of this project were to expand on the type of data and the number of cases included in FADAMA to further promote research on methods accuracy.

Research Questions

We completed three Project Aims, which fall under the NIJ's Fundamental/Basic Research Goal, in that we collected and analyzed data, and produced a novel database for tracking and improving forensic anthropology method accuracy and reliability.

Aim 1. To improve the specificity of the data submitted to FADAMA

Aim 2. To increase the amount of data submitted to FADAMA

Aim 3. To conduct analyses and disseminate the findings on method utility and accuracy in forensic anthropology casework

Aim 1 specifically addressed database development. Prior to the funding of this project , case data submitted to FADAMA included the cumulative method outcomes, not the individual method outcomes, for estimating the biological profile. The integration of new case data during the present project included the method- specific outcomes for estimates of the biological profile. By increasing the specificity of method data entered into the data, we increased the quality of the analytical power of the database as a research tool.

In Aim 2, our goal was to increase the number of cases submitted in the database by providing support for data submission to participating agencies and actively collecting this data using our proposed FADAMA Technician. Agencies hosting a large number of cases appropriate for database submission may not have the time or personnel available to submit cases. In those locations where assistance was requested, we used funding to send out the Database Technician trained in data submission to travel to the agencies and assist in data submission, and in some cases hired local graduate students to complete the data submissions of their associated agencies. Agencies included Medical Examiner's offices where practicing forensic anthropologists are working/have worked, forensic anthropology institutes associated with universities, and state/federal agencies that are repositories of information for missing and unidentified persons. Increasing the number of cases submitted from past and present casework has ensured that the case data included in FADAMA are representative of general casework practices in the field of forensic anthropology, and thus research performed on the data regarding method use and accuracy is reflective of the field as a whole. Finally, Aim 2 established mechanisms which ensure the sustainability for case submissions to FADAMA, including comprehensive trainings and tutorials both embedded within the FADAMA user interface as well as with the Forensic Technology Center of Excellence.

With Aim 3, we used FADAMA data to study method utility and accuracy in casework. The entire purpose of producing FADAMA was to establish a tool with which the forensic anthropology community can ask, analyze, and ultimately answer questions of method performance. Without answering such questions, forensic anthropology cannot commit to the NAS Report's standards of method reliability and accuracy. While the data submitted to FADAMA is accessible to all forensic anthropology researchers and practitioners to use for research on method accuracy and utility, Aim 3 initiated research in order to highlight the analytical capabilities of the data housed in FADAMA, and established baseline error rates for methods. Establishing error rates informs future method development and/or current method refinement. For example, if inaccuracies in ancestry estimates are more common for certain groups more than others, then such a finding would help direct future methods to improve and refine ancestry assessment for targeted demographics. Beyond accuracy studies, Aim 3 examined trends in method use. Tracking of method trends in casework can highlight the discipline's training needs and inform best practices recommendations around method selection that are not presently overseen by OSAC and the AAFS Standards Board.

Research Design, Methods, Analytical and Data Analysis Techniques

Aim 1. To improve the specificity of the data submitted to FADAMA.

It is useful to begin Aim 1's design and implementation by reviewing preliminary data populating FADAMA prior to the funded project. FADAMA hosted data from *identified* forensic anthropology cases, including documented decedent data, and two tiers of case data, whose definition and purpose are outlined here:

Documented Decedent Data: This information is the "ground truth" biological profile information for the decedent's age, sex, race/ethnicity and stature. This information is sourced from standard documents, such as medical records, drivers license, or military records. This data serves as the standard to which all forensic anthropological estimations of the biological profile are compared to for accuracy assessments. In addition to accuracy analyses, this data contributes to tracking demographic trends of forensic anthropology casework over time. No identifiable information is included as part of the Documented Decedent data.

- Tier 1: Report-level Accuracy of Biological Profile Estimates: Tier 1 data includes estimates of the biological profile (sex, stature, ancestry and age) documented on the forensic anthropology case report. Accuracy of the estimated sex, stature, ancestry, and age are determined by comparing to the details of the Documented Decedent data. Tier 1 data is used for establishing *case-level* accuracy and error rates for biological profile estimates.
- Tier 2: Cumulative Methods Accuracy: Tier 2 data is the suite of methods used for each component of the biological profile. Tier 2 data includes documenting the cumulative list of methods used for each biological profile component for a given case. Tier 2 data is used for establishing the cumulative method accuracies, and method use/preferences in casework.

In addition to the above-described data previously included FADAMA, we integrated a third tier of case data and bias data, described below:

- Tier 3: Method Level Accuracy: Tier 3 data is the outcome specific to *each* method used to estimate the biological profile, and allows for the tracking of accuracy for *specific* methods. For example, a practitioner may have used five methods to estimate sex. Each method's outcome is documented (e.g. male or female), as well as the details associated with that method. If the actual sex of the decedent is male, then accuracy is reported as accurate for those methods that estimated the sex as male, and inaccurate for those that estimated sex as female. Such information is vital in order to highlight error at the method level.

- Documentation of Bias: A series of questions prompting the submitter to note (if applicable) any sources of bias that were present when performing their case analysis. For example, data includes noting whether information regarding the decedent (e.g. sex, age) was presented to them prior or during their analysis that could have influenced their method choices or outcomes.

PI Hughes, Co-PI Juarez, and graduate research assistants worked with the Computer Networking and Resources Group (a team of web developers that specialize in database management systems at the University of Illinois at Urbana Champaign's Institute for Genomic Biology), to expand the current database to handle Tier 3 data into front-end and back-end logistics for FADAMA. Aim 1 included planning, development, testing, and release phases. The front-end logistics include both the online user platform, as well as the format of the downloadable case data. The online user platform adheres to many of the same strategies integrated into the development of FADAMA's current user platform, including 1) balancing submission time and data gathered, 2) visual aids for users to acknowledge data was correctly input, and 3) ensuring coordination and proper flow between all three tiers of data submission.

To maximize case data submissions and to accommodate the highly varied approaches to casework, entry of Tier 2 and Tier 3 data is optional. The development of the downloadable case data for Tier 3 information was approached for ease of interpretation and minimization of error. For the back-end integration of Tier 3 data, consideration was given to long-term sustainability and evolution of the database. The back-end is also be user friendly, so that the ongoing database committee managing the database can easily and efficiently add new methods, including Tier 3 data to the database.

To address quality assurance and any coding errors, all Aim 1 developed features underwent extensive closed and open beta testing prior to public release. The closed beta testing phase included Aim 1 team (including CNRG personnel, PI, Co-PI, and OSC) submitting mock and real test cases into the use platform to assess FADAMA performance. Once all issues from closed beta testing were resolved, open beta testing included professional volunteers from the discipline to interact with and submit cases to FADAMA. Volunteers provided feedback to the Aim 1 team after they completed their interactions with FADMA. Any feedback and issues were addressed after the volunteer interaction phase is complete. With the completion of Aim 1, FADAMA was a fully functioning webtool for case data upload and download, with both a user front end and a FADMA management backend for incorporating new methods and managing users.

Aim 2. To increase the amount of data submitted to FADAMA

For many agencies and offices interested in submitting case data to FADAMA, the main obstacles to submission are time constraints and lack of familiarity with the database interface. The goal of Aim 2 was to alleviate these obstacles to case submission via the provision of a trained database technician that traveled to any location, upload appropriate case data, and help train local offices in database use. Furthermore, technician provision alleviated time constraints on understaffed and large volume offices. The FADAMA user interface is streamlined for efficient case data submission, uploading cases takes five minutes per case. However, time constraints occur when high volume offices have hundreds of cases to upload. Many offices that have been able to submit cases to FADAMA prior to this funded project have done so using the work of graduate students or interns, but not all offices have access to such labor. We addressed this limitation by training and utilizing a FADAMA technician for the duration of this grant (three years). The FADAMA technicians allowed high volume offices to participate in FADAMA. Additionally, we also funded local graduate students affiliated with the high-volume agencies to submit the cases to FADAMA themselves. This became a needed adjustment to our original plan given COVID restrictions for visiting researchers at many of our targeted agencies. We did remote trainings with the graduate students to ensure competency when submitting case data. Receiving assistance from a FADAMA technician or trained graduate researcher allowed high volume offices to handle the large *initial* backlog of case uploads, and thus made it approachable for these high volume offices to sustain their FADAMA submissions with only new cases in the future. This strategy directly speaks to our plan for long-term sustainability of FADAMA participation. In addition, because FADAMA technicians trained individual office users on database use, offices can access the high value research component of the database immediately and will be able to access statistics relevant to their populations of interest.

Maintaining quality control of case submission, training and outreach to local offices was carried out in several ways. FADAMA technicians and funded local researchers had three major goals in their interaction with offices, 1) assisting and maintaining case submission, 2) minimizing bias and maintain quality control in submitted materials and 3) conducting outreach and training for offices and individual forensic anthropologists. Trained FADAMA technicians helped to maintain quality control of case submissions through a two-tiered feedback loop with database administrators working to ensure the database maintains an easy to use interface that minimizes typing and submission errors. In the first tier, FADAMA technicians provided direct feedback to database administrators as technicians use and modify FADAMA. In the second tier, technicians acted as feedback resource officers during training sessions with offices providing feedback about database use from individual clients to database administrators to direct database alterations. The final portion of FADAMA technicians' employment is their training and outreach duties. FADAMA technicians developed a series of training modules for user access including face to face training within offices and at annual conferences, as well as online tutorials made available on the database website. FADAMA management team also aims to provide annual report of FADAMA statistics made available on the database website to update the user community on what is new with the database (https://www-app.igb.illinois.edu/sofadb/docs/Biannual_Case_Origins_Report.pdf).

Aim 3. To conduct analyses and disseminate the findings on method utility and accuracy in forensic anthropology casework

The FADAMA user interface has a tool that registered users can access for downloading submitted case data. One of the main purposes of creating FADAMA in a format that would allow for peer research was to establish a transparent, accessible, and representative dataset of casework details that the community could work with to address research questions of interest to them and the field of forensic anthropology. However, we recognize that research conducted on the FADAMA dataset for a consistent set of questions related to the 2009 NAS Report for method standards, reliability, and accuracy is essential. Therefore, as part of this project, we executed a series of research questions to be completed and disseminated to the greater scientific community of forensic anthropologists. The research questions addressed using FADAMA data included the following:

1. To identify error rates and accuracies for forensic anthropology estimates of sex, age, ancestry and stature presented on the final case report (e.g. Tier 1 data)
2. To identify error rates and accuracies for common batches of methods used to estimate sex, age, ancestry and stature (e.g. Tier 2 data)
3. To identify error rates and accuracies for single methods used to estimate sex, age, ancestry and stature (e.g. Tier 3 data)
4. To evaluate method use frequency trends for age, sex, ancestry and stature

Establishing error rates and accuracies for Research Questions 1-3 (e.g. Tier 1-3 case data) was completed by determining the accuracy of the biological profile estimates. Accuracies were determined by comparing the biological profile estimate to the Documented Decedent data. For stature and age, forensic anthropology estimations are a numeric range. If the range encompasses the decedent's documented numeric age or stature, this constitutes an accurate estimate by the Tier 1, 2, or 3 data. Assessing accuracy for ancestry and sex estimations requires more nuanced consideration. For example, forensic anthropologists typically estimate ancestry, and thus may not use descriptors that directly correspond to racial and ethnic labels used in the documented decedent data. Therefore, we established a protocol for determining accuracy that draws on studies which have established the spurious relationship between ancestry and race (Hughes et al., 2021). For example, if the forensic anthropologist reports the ancestry to be "African", or alternatively, "comprised of both European and African ancestries," these would both be considered accurate if the documented decedent data listed the decedent as African

American for the decedent. Our interpretations drew on relevant literature (e.g. Bryc et al. 2015) that provides the correspondence between ancestry contribution and common racial identities for U.S. population.

The error rates we established for Question 3 for single methods, were compared to the error rates published in development and/or validation studies for that method. Such a comparison established whether research-based error rates accurately depict error rates for a given method when used in the casework context.

We addressed research Question 4, which focuses on method utility trends, by analyzing frequencies of single methods in case work reported in FADAMA. Because information such as the case year is included in FADAMA, we analyzed method utility trends over time. Therefore, we assessed whether method selection and use has changed over time, and whether more recent cases are integrating more recently established methods, or still relying on older methods. These findings can be compared to studies which have attempted to track practitioner method use and method preferences (Garvin and Passalacqua, 2012; Klales, 2013). While these studies provide an appropriate first step in methods tracking, because they were survey-based they do not necessarily accurately reflect what the true method use frequencies are in the actual casework context. FADAMA's actual case data reflects real trends in casework, such as incomplete skeletons and other contexts that impact what methods can actually be used, instead of which methods are *preferred* if there are no issues with the skeleton.

Expected Applicability of the Research

The three Project Aims improve and standardize forensic anthropology practices, which in turn improves the general quality of the criminal justice system as a whole. While the data in FADAMA uniquely addresses forensic anthropology, the model of FADAMA we developed could be used in other forensic branches where method and case accuracy outcomes would be beneficial to track. Therefore, Aim 1 provides a repository template in GitHub (https://github.com/IGBIllinois/sofadb) that is publicly available as a resource to other sciences. Specific to forensic anthropology, Aim 1's goal of developing a comprehensive repository for forensic anthropology case method data allows for the assessment of method accuracies and utility, both of which directly impact the odds of an unidentified decedent being identified. In addition, the results of the research on method error rates in Aim 3 are challenging the current forensic anthropology paradigm of considering error rates established in a research context as authentic. Here, we propose that the nuances of the casework context, and the cognitive biases associated with the casework context, can ultimately impact the way in which a method is used, and thus produce alternative error rates that may not reflect those established through research. The FADAMA-based error rates (see Hughes et al., 2021) more accurately represent the error rates of the methods when applied to actual casework, and thus provides a new mechanism for establishing "ground truth" error rates for any method developed and utilized in forensic anthropology casework. By improving the understanding of forensic anthropology method accuracy in the casework context, we are ensuring proper handling and interpretation of evidence, which directly aligns with 2009 NAS Report's call to establish pathways for validating and assessing the accuracy of the current methods employed in casework analysis.

Beyond establishing method accuracies, the data housed in FADAMA contributes to Forensic Anthropology as a discipline in vital ways. First, analyses of FADAMA data can track temporal tends of decedent demographics, which in turn would highlight the discipline's method development needs. For example, if an increase in decedents from a particular demographic was found, this would provide foundational support for targeting methods development specific to that demographic. Furthermore, with FADAMA data accessible to practitioners and researchers, FADAMA becomes a resource one can use to understand what their peers' casework practices are. While individual practitioners likely have a small cohort with whom they mentor or share their casework practices, FADAMA provides a centralized resource for learning about the method use trends of the discipline as a whole. This resource benefits not only practitioners well established in their careers, but also those in the early stages of learning, such as graduate students studying forensic anthropology. In this context, FADAMA acts as a guide for students to see what methods are being used by the discipline, and also which methods are producing accurate results. Traditionally, students potentially only learn well those method preferred by their direct mentor, yet FADAMA provides students with a broad perspective on method preferences among the discipline's diverse practitioners. In this way, we are providing a collective resource beyond the publications that directly teaches the next generation of forensic anthropologists about the trends in our casework.

Finally, as there is no existing network where practicing forensic anthropologists are transparent about the methods they use and their subsequent accuracy when applied to actual casework, FADAMA's tracking of such trends in casework can highlight the discipline's training needs and inform best practices recommendations around method selection. For example, analysis of FADAMA data could establish that an older method for aging the pelvis is used in higher frequency than a newly published method for aging the pelvis that has lower error rates. Such a finding may suggest that the discipline does not readily understand how to use the new method, and could possibly benefit from alternative resources for disseminating this method, such as a training workshop at the annual AAFS conference, or the development of a publicly-accessible tutorial associated with the method. Forensic anthropology has already established a precedent for such resources for traditional methods that are commonly used, and thus similar needs would likely be addressed by method's authors or other proactive practitioners.

The dissemination and accessibility plan of the resources developed in this project also speak to this project's impact. Dissemination of Aim 3's research manifested as both public presentations at the American Academy of Forensic Sciences and the American Association of Biological Anthropologists, as well as two peer-reviewed publications, and one forthcoming.
Finally, FADAMA annual reports of basic database specs will be accessible on the FADAMA interface, included under the FAQ section. Collectively, these potential impacts address the critical need for improved forensic science standards and quality assurance related to forensic anthropological method-based analyses of skeletal evidence. The completed project provides resources, both in the

form of research-based assessments (Aim 3) and as a sustainable infrastructure (Aims 1 and 2) for forensic method accuracy and utilization.

PARTICIPANTS AND COLLABORATING ORGANIZATIONS

FADAMA actively collaborated with the Society of Forensic Anthropologists, Pima County Office of the Medical Examiners office, the New York Office of the Chief Medical Examiner, the New Mexico Office of the Chief Medical Examiner, as well as OSC Dawnie Wolf Steadman and OSC Richard Jantz of the Forensic Anthropology Center at the University of Tennessee at Knoxville. FADAMA collaborates directly with the Forensic anthropology databank (FDB) on data collection and sharing. FADAMA currently has 110 members that have registered to use the database.

During our Beta testing phase, twenty-four forensic anthropologists were contacted to participate in beta testing of the FADMA user interface including:

1. Dawnie Wolf Steadman University of Tennessee
2. Joseph Hefner, Michigan State University
3. Lindsay Trammel, Office of the Chief Medical Examiner Missouri
4. Lauren Zephro, Santa Cruz County Sheriff’s Office
5. Alison Galloway, University of California at Santa Cruz
6. Bridget Algee Hewitt, Stanford University
7. Robin Reinike, University of Arizona
8. Jennifer Love, District of COlumbia OCME
9. Christian Crowder, Harris County Institute of Forensic Science
10. Kat Pope, Delaware OCME,
11. Mark Ingraham, UNT Center for Identification
12. Wendy McQuade, UNT Center for Identification
13. Lyle Konigsberg, University of Illinois

14. Chris Rainwater, NYC OCME
15. Richard Jantz, University of Tennessee,
16. Brad Adams, NYC OCME
17. Angela Soler, NYC OCME
18. Heather Walsh-Haney, FGCU
19. Lindsay Trammel, St. Louis County OCME
20. Brian Spatola, Army Medical Museum
21. Sachin Pawaskar, University of Omaha
22. Sharon Derrick, Harris County Institute of Forensic Science
23. Franklin Damann DPAA-Offutt
24. Heather Edgar, University of New Mexico

OUTCOMES

Activities and Accomplishments

Aim 1. To improve the specificity of the data submitted to FADAMA

- Activities: Integration and Collection of Tier 3 Data

Tier 3 data is the outcome specific to *each* method used to estimate the biological profile, and allows for the tracking of accuracy for *specific* methods.

a. FADMA currently contains 113 methods (24 sex estimation; 56 Age estimation; 17 Ancestry estimation; 16 Stature estimation).

b. Tier three data integration: All methods have the capability for tier three data integration within the database however data population reflects methods usage, thus 21/24 sex methods; 50/56 age methods; 16/17 14/16 are currently populated with data including tier three data.

- <u>Activity: Refining User Interface and Back End Management</u>

  The FADAMA database underwent rigorous development and beta testing to produce the final product.

- <u>Accomplishment: Publication to increase general knowledge and functionality of the FADAMA with American Journal of Physical Anthropology.</u>

  Juarez, C. Yim, A., Hughes C.2021.A Review of the Forensic Anthropology Database for Assessing Methods Accuracy. Am. JPhys Anthropol. DOI:10.1002/ajpa.24167

  In this paper we reported on the functionality, available support, and research capability of the Forensic Anthropology Database for Assessing Methods Accuracy. Main points:

  a. Introduction to FADAMA: is an online repository for case data from identified forensic skeletal cases.

  b. The goal of FADAMA is to address the lack of adequate measures for assessing accuracy and reliability of forensic anthropology methods. FADAMA requires users to apply for access with their university or organization credentials.

  c. Functionality of FADAMA: Verified users may upload and download anonymized case data via the user interface, after signing a terms of service agreement outlining ethical behavior. Case data uploads require information about the actual biological profile of the decedent and the forensic anthropology estimations. Uploading case data takes approximately 15–25 min.

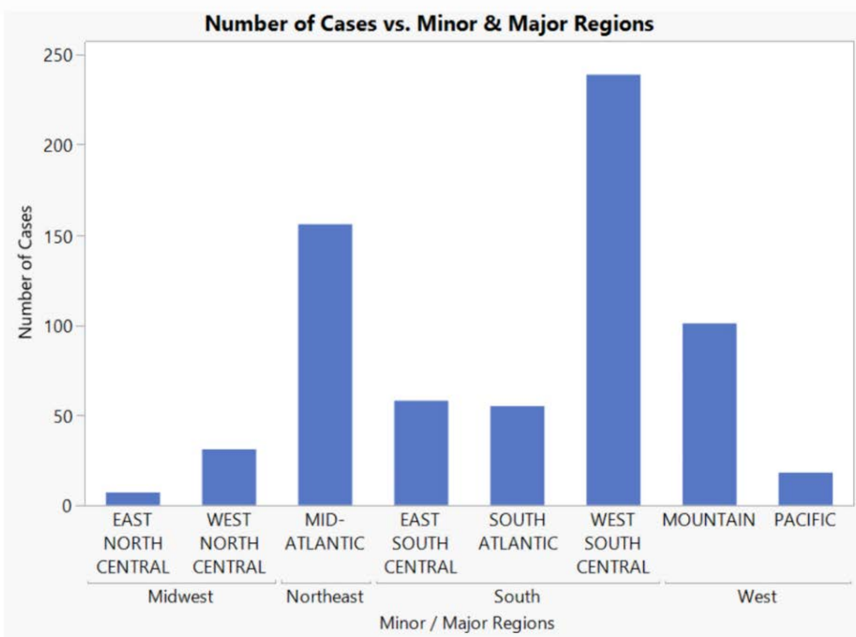
  d. Introduction to FADAMA specifics: users currently have 85 methods to select from when entering case data, with the capability to add new methods as they are developed. Access to the database is free, and online video tutorials are available for users covering database functionality. Currently, the database houses anonymized case data for over 350 identified cases from across the U.S. Funding has been allocated for a database technician to assist offices with large caseloads to upload cases. As it stands, the database is easy to use, and maintains thoughtful tools to assist users. The power of the database to identify trends in both method accuracy and usage is apparent, and will continue to grow as more cases are added.

Aim 2. To increase the amount of data submitted to FADAMA

- <u>Activities: Increase in data collection with creation of new strategies to deal with COVID-19 impact</u>

  Co-PIs Hughes and Juarez worked to expand the geographical focus and number of cases included in FADAMA. In order to increase the case numbers submitted to FADAMA we conducted a series of targeted outreach strategies which included: 1) directly contacting large agencies with high case work numbers as data sharing partners with the database; 2) providing free training and support videos accessible by any agency or individual that was interested in uploading cases 3) providing paid interns that could travel to agencies with large caseloads and upload data into the database 4) training and paying local interns pre-existing within the agencies to upload data.

Number of U.S. states with FADAMA users with cases in the database: 16 states*
Number of FADAMA accounts with cases in the database: 23*



We used the American Academy of Forensic Sciences as well as our relationship with the Society of Forensic Anthropologists as a platform to promote the database. In these forums the database was promoted directly to all members of the forensic anthropology section with research talks, and direct email campaigns.

- <u>Activities: Increase Data Submission to FADAMA Database</u>

Upon submission of the report, FADAMA contains 641 cases (12 May 2023), over a 300% increase in number of cases prior to funding and execution of this project. The list of entities below represents the partnerships created to enter cases into the database either at present or in the future. This is not a comprehensive list of individuals or agencies that have participated in FADAMA, but is presented to show the support and engagement of the professional community with the database.

a. Forensic Anthropologist for the State of Kansas (Dr. Alexandra Klales)
b. FACTS and OpID casework at Texas State San Marcos (Dr. Tim Gocha)
c. Florida Gulf Coast University Forensic Anthropology Lab (Dr. Heather Walsh-Haney)
d. Office of the Medical Investigator, University of New Mexico (Dr. Heather Edgar)
e. Harris County Institute of Forensic Sciences (Dr. Julie Fleischman)
f. New York City Office of the Medical Examiner (Dr. Bradley Adams)
g. Tidal Forensic Anthropology Services Laboratory (Dr. Sharon Derrick)
h. Des Moines Medical University (Dr. Heather Garvin)
i. OCME NYC Office of Chief Medical Examiner New York (Dr. Brad Adams)
j. Pima County Office of the Chief Medical Examiner (Dr. Bruce Anderson)
k. UNT University of North Texas (Dr. John Servello)
l. University of Tennessee Knoxville (Dr. Dawnie Steadman)

- <u>Accomplishment: Increased total number of FADAMA cases by over 300% and includes cases from all major regions of the United States.</u>

Aim 3. To conduct analyses and disseminate the findings on method utility and accuracy in forensic anthropology casework

- <u>Activities: Promotion of Database and Research Findings:</u> In total we have published two peer reviewed publications on FADAMA, given three conference presentations, one workshop, and created wiki tutorials to promote the database. Below is a summary of this activity.
    - Oral presentation at the American Academy of Forensic Sciences annual conference 2023: *Data on methods usage in forensic anthropology casework from 1972-2022 using the Forensic Anthropology Database for Assessing Methods Accuracy (FADAMA)*
    - Continued preparation of manuscript for submission to Journal of Forensic Sciences, based on above presentation
    - Oral Research Presentation give at American Association of Biological Anthropology National meeting (AABA) 2022: *The current status of methods usage in forensic anthropology casework using the Forensic Anthropology Database for Assessing Methods Accuracy (FADAMA)*
    - 2021 American Academy of Forensic Sciences annual conference oral presentation: *Forensic Anthropology Casework Performance: Assessing Accuracy and Trends for Biological Profile Estimates on a Comprehensive Sample of Identified Decedent Cases*
    - Workshop with Forensic Technology Center of Excellence to be held in August 2021 for FADAMA researcher training: *Introduction to the Forensic Anthropology Database for Assessing Methods Accuracy.* Archive: https://forensiccoe.org/forensic-anthropology-database-fadama/
    - 2021 Publication *Journal of Forensic Sciences* entitled: *Forensic Anthropology Casework Performance: Assessing Accuracy and Trends for Biological Profile Estimates on a Comprehensive Sample of Identified Decedent Cases*
    - 2020 Publication in *American Journal of Biological Anthropology* entitled: *Technical note: A report on the Forensic Anthropology Database for Assessing Methods Accuracy*

- PI, Co-PI and RA created WIKI tutorials, frequently asked questions and video demonstrations. These tutorials are integrated into the database via clickable access and can also be accessed via emailable links.
- PI, co-PI and RA drafted and submitted a technical note introducing the FADAMA database to the American Journal of Physical Anthropology (AJPA).
- 2020 American Academy of Forensic Science (AAFS) poster presentation: *Learning from Our Casework: The Forensic Anthropology Database for Assessing Methods Accuracy (FADAMA)*

Results and Findings

Aim 3: To conduct analyses and disseminate the findings on method utility and accuracy in forensic anthropology casework, addressed by the following targeted deliverables:

1. To identify error rates and accuracies for forensic anthropology estimates of sex, age, ancestry and stature presented on the final case report (e.g. Tier 1 data)

2. To identify error rates and accuracies for common batches of methods used to estimate sex, age, ancestry and stature (e.g. Tier 2 data)

3. To identify error rates and accuracies for single methods used to estimate sex, age, ancestry and stature (e.g. Tier 3 data)

4. To evaluate method use frequency trends for age, sex, ancestry and stature

Aim 3.1 To identify error rates and accuracies for forensic anthropology estimates of sex, age, ancestry and stature presented on the final case report (e.g. Tier 1 data)

We accomplished this aim through a published paper in 2021in the *Journal of Forensic Sciences,* entitled "Forensic anthropology casework performance: assessing accuracy and trends for biological profile estimates on a comprehensive sample of identified decedent cases." The following results are directly extracted from this published work. The study included the total FADAMA sample at the time of study (*n*

= 359), and accuracy rates for each biological profile component while considering factors related to (in)accuracy were also considered. The results of the accuracy are presented in Table 1.

Accuracy rates for the four biological profile components ranged from 83% to 98%, with sex estimation performing the best and stature performing the poorest. While the overall sex estimation inaccuracies were the lowest of any biological profile component, we found that females are missexed approximately ten times more often than males. This trend was statistically supported by the rejection of Fisher's exact test null hypothesis that the estimated sex for male and female cases is equally likely to be accurate ($p = 0.0132$). Age estimations were 91% accurate, and we found that decedent age (Children/Adolescents, Young Adults, Middle Adults, Older Adults) had no statistically significant relationship with age accuracy rates ($p = 0.917$).

Table 1 (from Hughes et al., 2021). Accuracy rates of the biological profile estimations for FADAMA cases.

Bio Profile	Accurate	Count	Frequency
Stature	No	17	0.17
	Yes	81	0.83
	Total	98	1.00
Age	No	30	0.09
	Yes	310	0.91
	Total	340	1.00
Ancestry	No	23	0.09
	Yes	241	0.91
	Total	264	1.00
Sex	No	6	0.02
	Yes	320	0.98
	Total	326	1.00

Inaccurate age estimates were more frequently the result of overestimation than underestimation. Regarding ancestry estimation performance, overall accuracy was at 91%. African American/Black and White decedents had the lowest inaccuracy rates, while Hispanic and Asian/Pacific Islander decedents demonstrated greater inaccuracy rates. However, a Fisher's exact test showed that ancestry accuracy rates did not significantly differ among decedent racial or ethnic groups (adjusted $p = 0.1587$). Additionally, decedent sex was not related to ancestry accuracy (adjusted p = 0.1587), although females decedents' ancestry was more frequently (twice more often) inaccurately estimated than male decedents. Stature estimations were the least accurate component of the biological profile (83% accurate), with inaccurate stature estimates more frequently the results of underestimation than overestimation. Fisher's exact tests revealed that identified decedent sex, age, or race and/or ethnicity did not yield statistically significant relationships with stature accuracy (adjusted p = 0.1781, 0.4343, and 0.4343, respectively). Finally, logistic regression indicated decedent stature had no significant effect on stature accuracy (p = 0.6750).

Aim 3.2. To identify error rates and accuracies for common batches of methods used to estimate sex, age, ancestry and stature (e.g. Tier 2 data)

Aim 3.2 results are preliminary and are in preparation for submission for publication. Examining batch methods, or cohorts of methods used to assess for example, age, can be useful to infer which methods are being used simultaneously and whether or not their collective employment improves the report-level accuracy rates. Because sex estimations have virtually no error (2% inaccuracy established in Aim 3.1), there was not a substantial enough sample size of accurate *versus* inaccurate cases in order to compare changes in accuracy rates among batch methods. In addition, stature was not examined for Aim 3.2 because most users only employ a single method to estimate stature, and thus batch methods could not be studied. Therefore, in the following section we focus on age and ancestry estimation.

Age estimation by far presents the greatest number of methods used in tandem to arrive at a final age estimation. Practitioners use anywhere from one to ten methods to estimate age for a given case, with the median number of methods being 3 (interquartile range is 2-4 methods). We found no significant difference in the number of methods used for those cases with accurate *versus* inaccurate estimates, (Wilcoxon chi-sq =0.097, df=1, p = 0.755). This suggests that accuracy is more related to the particular method employed, and possibly how that particular method is used by the practitioner.

For ancestry estimation, practitioners employ anywhere from 1-5 methods (median number of methods = 2, interquartile range 1-3 methods). There is a significant difference in ancestry estimation accuracy, such that using more ancestry methods is associated with greater accuracy, (Wilcoxon chi-sq =4.35, df=1, p = 0.037). Given that method used isn't related to report-level ancestry estimation accuracy (because all three methods observed have comparable accuracy rates, see Aim 3.3), it would makes sense then that number of methods used may contribute in order to bolster user confidence with consensus across methods.

Batch methods allowed for the exploration of consensus outcomes across methods and how that relates to overall accuracy as well as investigator inference trends. It is useful to compare the consensus results of methods used to estimate ancestry or age, and to compare performance of these methods when consensus is lacking. We begin with ancestry estimation methods. There were a total of 56 cases for which both Fordisc and Hefner's 2009 methods were employed. Of those 56 cases, 86% had consensus in their estimates of ancestry, yet 100% of these cases had an accurately estimated ancestry on the final case report, which is often where practitioner interpretation and subjective weighting of the various methods employed takes place. Therefore, 14% of those cases are grounds for exploring where consensus between methods is lacking, yet the practitioners still accurately estimate ancestry for their cases. In Table 2, we compare the two methods' outcomes, as well as the report-level description of ancestry generated by the practitioner and the known race and/or ethnicity of the decedent. Here we can see that when consensus between methods is lacking, forensic anthropologists are making interpretations of the data presented in a way that allows for accurate estimations and/or are choosing to not report an ancestry estimate. In this way, the accuracy rates remain high. Furthermore, it appears that the Fordisc ancestry estimates are more often correct than the Hefner (2009) estimates rather consistently.

Table 2. Comparing Fordisc and Hefner methods where consensus in ancestry estimations *was lacking*. Each row represents a single case. Highlighted cells corresponds to whether the methods' estimated ancestry is directly related to the known decedent race and/or ethnicity for that case.

Fordisc Estimate	**Hefner 2009 Estimate**	**Report Description**	**Known race/ethnicity**
Black	European	"Indeterminate"	"African-American/Black"
Black	European	"Black"	"African-American/Black"
American Indian	European	"White"	White
Hispanic	Asian	"Asian (Hispanic)"	"Hispanic"
Hispanic	European	"Probable Hispanic"	"Hispanic"
White	African	"Indeterminate"	"White"
American Indian	European	"Hispanic and/or Amerindian"	"Hispanic"

For age, consensus can be discussed in terms of overlap of estimated ages among methods used, but that is not necessarily useful for the practice of anthropology. What is clear from the FADAMA data is that the final age estimation produced on the case report rarely reflects any single method's age estimation outcome, and instead is subjectively expanded and/or contracted by the investigator as they decide how and what to emphasize from each method. While subjectivity is typically not preferred in casework interpretations, very little has been proposed to standardize it.

We also explored how batch estimates related to accuracy of the final age estimate provided on the report. Here we focused on age, since it has the most method variation and substantial number of cases with data in FADAMA. We focused on three of the most frequently used methods: the pubic symphysis (Brooks and Suchey 1990), rib aging method (Iscan et al., 1984), and the auricular surface (Lovejoy et al., 1985). From Table 3 below, we can see that the pubic symphysis is most frequently used singularly, with only minimal improvement when the rib end is included, and actually a decrease in performance when the auricular surface is coupled with the pubic symphysis. Interestingly, when all three methods are used, we see peak accuracy rates at 94%. This suggests that the additional data included in the analysis may provide the anthropologists with more information to make accurate final age estimates on the forensic anthropology report. However, as with the previous batch analysis of age, here the three specific methods combinations are not enough to produce statistically significantly differences in accuracy rates for final reported age estimates.

Table 3. Age estimation methods batch use and accuracy trends.

	All three methods	Pubic symphysis only	Rib end only	Auricular Surface only	Pubic Symphysis and Rib end	Pubic Symphysis and Auricular surface	Rib end and Auricular surface
Sample size	16	129	10	6	105	30	2
Accuracy	94%	88%	n/a	n/a	91%	80%	n/a

Aim 3.3 To identify error rates and accuracies for single methods used to estimate sex, age, ancestry and stature (e.g. Tier 3 data)

Aim 3.3 results are preliminary and have not yet been submitted for publication and peer review. For ancestry estimation, those methods identified in high frequency use (determined in Aim 3.4 below) were analyzed, including Fordisc, Rhine (1990), and Hefner (2009). In Table 4, we can see that although Fordisc is the most commonly used method by far, it has the lowest accuracy rate of the methods, although this is not statistically significantly different from the other two methods' accuracy rates. However, given that Fordisc has been applied to more cases, it may be that the range of diversity of the cases where Fordisc is employed is greater that those currently using Hefner (2009) or Rhine (1990) and thus producing greater inaccuracies.

Table 4. Accuracies rates from FADAMA case sample for commonly used ancestry methods.

Ancestry Method	**FADAMA Case Sample**	**Method Accuracy based on FADAMA sample**	**Published/Reported Accuracy per Method**
Fordisc	293	80%	58%-60%
Hefner (2009)	54	85%	84-93%
Rhine (1990)	103	88%	Not reported

The above accuracies in table 4 highlight that for some methods, like Fordisc, the accuracy rates are greater than reported in the method itself. Importantly, the accuracy rates reflected here for Fordisc's reported accuracy in methods (58-60%) are based on two runs of the program, using 18-23 craniometric variables and all Forensic Data Bank reference samples run two different ways, with varying criteria such as stepwise and outlier removal employed. The accuracies themselves are gleaned from the leave-on-out cross validations performed in the program. Because Fordisc's reported accuracy will vary with each unique run by a user and the options they choose, there is in effect a wide variety of accuracies that can be gleaned, and the provided range to represent model accuracy is simply an estimate. However, the accuracy range remains well below the accuracy generated from the FADAMA cases.

The substantial difference in the FADAMA-based accuracy (80%) and the Fordisc-based accuracies may be a result of several conditions. First, in the program itself, Fordisc-based classifications are only considered accurate when both the sex *and* ancestry (e.g. Hispanic Female classified as Hispanic Female) are correctly classified, yet in actual casework practice, this is not how it is used when examined within the FADAMA case sample. For example, when Fordisc classifies a case as Guatemalan Male, case reports uploaded to FADAMA do not provide the ancestry to be exactly "Guatemalan Male", but more often incorporate a broader description such as Hispanic which includes the Fordisc classification group yet is not limited to it. Another reason that there could be a marked increase in the FADAMA-based accuracy could be related to the case demographics. Based on Fordisc-reported accuracies, it is well established that the program performs more accurate classifications for some references groups than others. In particular, White males and White females tend to have the greatest accuracies, while Hispanic males tend to consistently have the lowest accuracies. Therefore, instead of looking at the overall accuracy of the FADAMA-based Fordisc results, it is better to examine it per FDB reference sample with $n \geq 15$.

Table 5 provides these reference sample results and compares them to the range of accuracies estimated by Fordisc using the same parameters described in the above section. Here we see that in actual casework, as represented by the FADAMA cases, that accuracies for all groups are greater than the Fordisc-estimated accuracies. Again, this is likely explained by discrepancies in classification approaches between practitioners (represented by their FADAMA cases) and the program Fordisc. FADAMA practitioners would classify a Black female OR a Black male as Black and/or African American and both would ultimately get the ancestry correct, whereas Fordisc's accuracies are always tied to getting both the ancestry *and* sex correct. Thus, these distinctions in extrapolating accuracy rates may be what is driving the accuracy differences highlighted in Table 4 and suggest that it might be useful for Fordisc to provide a classification matrix that removes sex from the classification criteria.

Table 5. Accuracies rates from FADAMA case sample for commonly used ancestry methods and specific outcomes.

Fordisc Outcome for FADAMA Cases	**FADAMA Case Sample Size**	**Accuracy for FADAMA cases**	**Method Accuracy per Fordisc Reference Group**	**Method Accuracy per Merged Fordisc Groups**
Black Females	15	80%	52-59%	66-69%
Black Males	31	81%	55-58%	
Hispanic Females	26	81%	57-68%	65-68%
Hispanic Males	38	71%	38-43%	
White Females	54	94%	76-79%	85-87%
White Males	94	87%	76-78%	

In order to assess whether such a classification matrix improves accuracy rates, we took the two outcome reports generated from Fordisc that were used to establish the accuracy range for the method itself in Table 4, and we merged the Fordisc references groups into three broader levels excluding sex (far right column in Table 5). It is important to note that this is not an *a priori* adjustment to the reference groups for the discriminant function used in Fordisc, but instead only combining the reference groups in the Fordisc output such that accuracy rates for these merged references groups could be assessed. Indeed, we found that the accuracy rates improved and were closer to those observed in the FADAMA cases, although still not comparable. This suggests that while the accuracies related to sex *and* ancestry do impact the accuracy rates, there are still unaccounted for factors contributing to the greater outcomes in Fordisc with the practitioner casework sample we see in FADAMA.

Fordisc is three times more commonly used in FADAMA casework than any other ancestry estimation method, however Rhine (1990) and Hefner (2009) also has a substantial number of cases. Given the array of criticism and resulting limited use of Rhine (1990) for recent cases (Juarez et al., 2022), we only analyze Hefner (2009) outcomes in more detail. Table 4 indicates that the Hefner (2009) accuracy rate based on FADAMA case data of (85%) is consistent with the provided accuracy range in Hefner (2009) of 84-93%, which varies with the statistical approach and traits used. In Table 6, we provide accuracies per Hefner (2009) outcomes for the FADAMA case data, and see that the performances remains high and consistent across the two groups, although the sample sizes are small for the African group estimations and require additional data.

Table 6. Group-level accuracy rates for Hefner (2009).

Hefner (2009) Outcome for FADAMA Cases	**FADAMA Case Sample Size**	**Accuracy for FADAMA cases**
African	13	92%
European	37	87%

Stature Methods Accuracy

Stature methods used in FADAMA cases are heavily dominated by Fordisc estimations (n = 310 cases), while all other available methods collectively were used in much less frequency (n=75 cases). Comparing accuracy of overall report level stature estimations is significantly related to the method used, such that those using Fordisc had a greater proportion of accurate stature estimates reported (92% accuracy) than when any alternative method was used (74% accuracy). When focusing on specific methods beyond Fordisc, the next most frequently used method is Raxter et al., (2006) with only 15 cases. When Raxter (2006) was employed, it resulted in an accurate stature estimation only 54% of the time. Of note, inaccuracy of the estimates for stature techniques is often calculated as the mean error between the predicted point estimates and known stature. In contrast here, accuracy is defined as whether or not the known stature was included in the stature interval produced by a given method. In contrast here, accuracy is defined as whether or not the known stature was included in the stature interval produced by a given method. Given these discrepancies, comparisons of FADAMA-generated accuracies do not have a published reference accuracies to compare to. Interestingly, consensus across methods is not possible for reviewing, because there is only one instance in which both Raxter (2006) and Fordisc are used, suggesting that practitioners rarely employ multiple methods for stature estimation, which is in direct contrast to other components of the biological profile where employing multiple methods is more common.

Age Methods Accuracy

Age methods are the most abundant, yet similar to other biological profile components, the vast majority of cases utilize a handful of methods. Here, we will review the method-specific accuracies for three of the top methods: the pubic symphysis (Brooks and Suchey 1990), rib aging method (Iscan et al., 1984), and the auricular surface (Lovejoy et al., 1985). In Table 7, we see that the accuracy rates for age estimation deviate, with the pubic symphysis clearly outperforming other methods. This is consistent with previous literature, given that the age intervals provided in the pubic symphysis estimates tend to be wider than those reported for the rib and auricular surface methods. Of note, inaccuracy of the estimates for aging techniques is often calculated as the mean error between the predicted point estimates and known ages. In contrast here, accuracy is defined as whether or not the known age was included in the age interval produced by a given method. Given these discrepancies, comparisons of FADAMA-generated accuracies do not have a reference accuracy by which to compare.

Table 7. Accuracy rates for age estimation methods.

Age Method	**FADAMA Case Sample Size**	**Method Accuracy based on FADAMA sample**
Brooks and Suchey 1990	293	94%
Iscan et al., 1984	54	65%
Lovejoy et al., 1985	103	64%

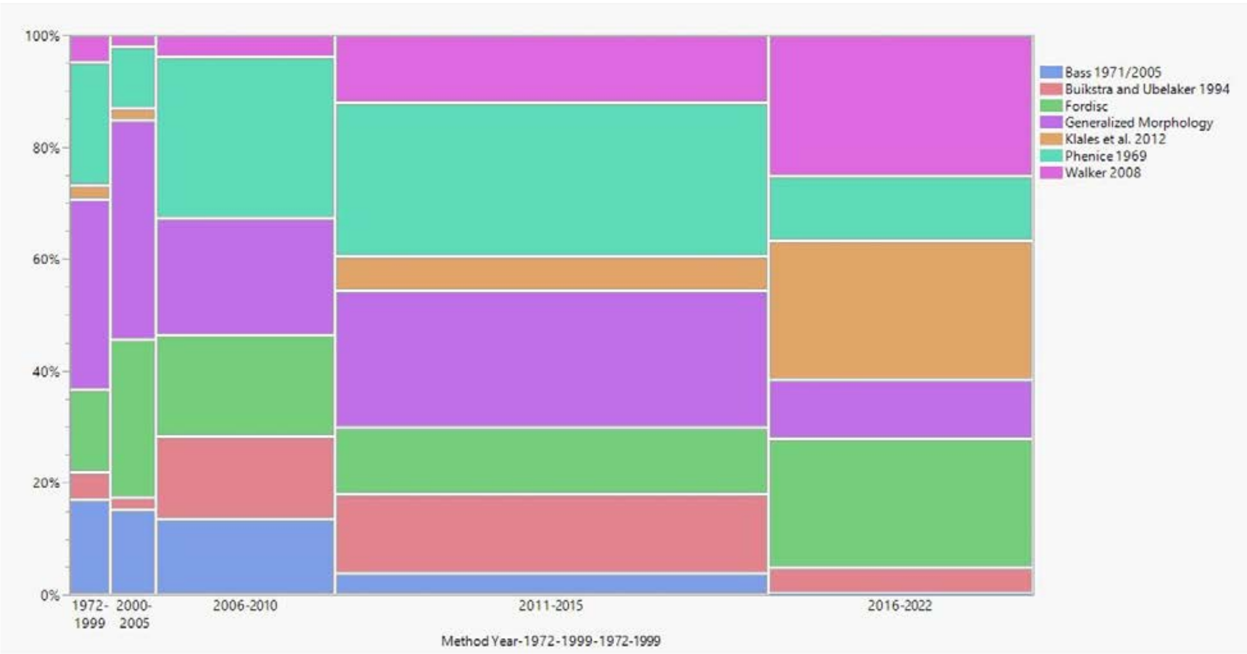
Aim 3.4. To evaluate method use frequency trends for age, sex, ancestry and stature

The results for Aim 3.4 have been presented at the annual conferences for the American Association of Biological Anthropology in 2022 and the American Academy of Forensic Sciences in 2023, with a manuscript in preparation. The discipline of forensic anthropology has no oversight or best practice recommendations related to which methods should be used in casework. Instead, general recommendations by the 2009 NAS report as well as the OSAC and ASB standards emphasize the use of statistically-grounded methods by forensic anthropologists. What drives a practitioner to choose one method over another may be changing over the years, and can be influenced by factors such as: access to needed equipment, access to training on the methods, SOPs of the agency in which they work, presence or absence of particular skeletal elements, and/or the validation status of a method. Here we report on the methods used over time to assess whether trends are emerging to reflect the uptake of newer methods.

<u>Sex Estimation Methods</u>

There are currently 472 cases that estimated sex. Of the 24 methods present in FADAMA for sex estimation, practitioners have used 20. Seven of these methods comprise 91% of all the methods used across FADAMA cases. Figure 1 presents the temporal trends for the top seven sex estimation methods. Of these, four of the seven have no statistical components to them and/or are secondary sources including Bass (1971/2005), Buikstra and Ubelaker (1994), "Generalized Morphlogy", and Phenice (1969). All four of these are trending towards reduced use in recent years (2016-2022), yet still persist. Importantly, Figure 1 indicates the uptake of newer methods, particularly those that have essentially built upon earlier methods to incorporate improved methodological descriptions, statistical probabilities and/or expanded/relevant reference samples. For example, Klales et al. (2016) is an updated version of Phenice (1969) and is in effect replacing the use of Phenice in the 2016-2022 temporal block in Figure 1. This is a promising trend which indicates the practice is moving towards the replacement of older, nonstatistical methods. Similar trends exist for Walker 2008 replacing Bass 1971/2005 and Buikstra and Ubelaker 1994.

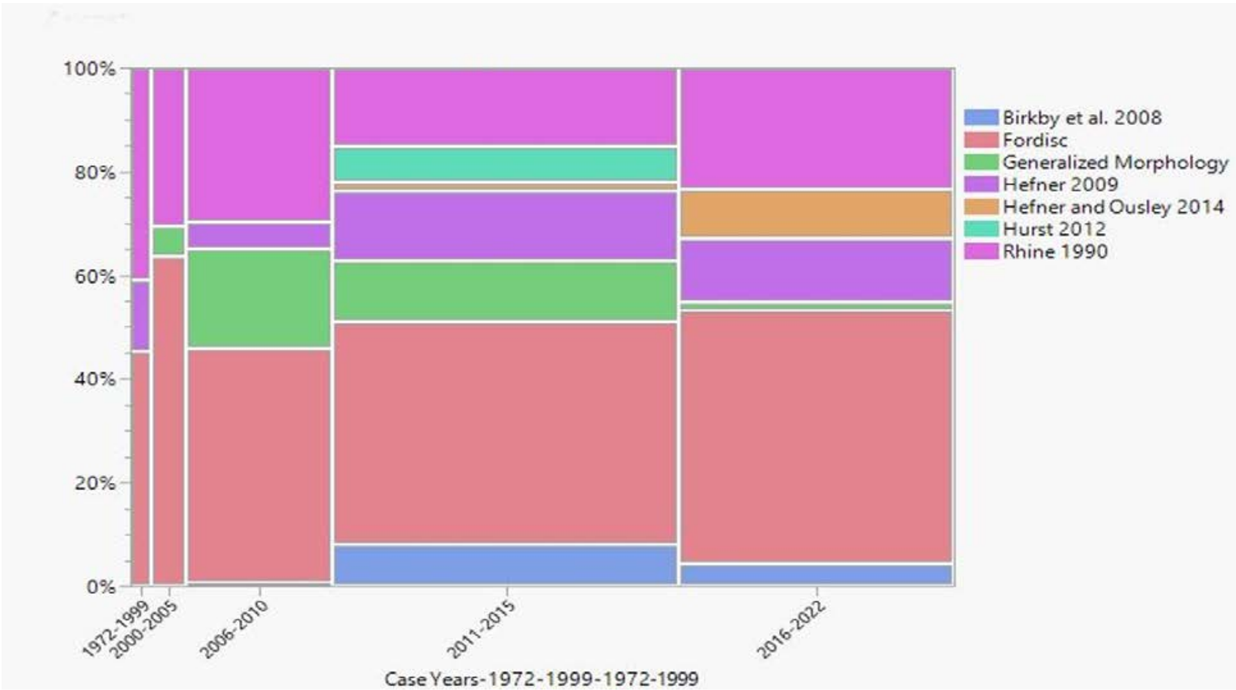
Figure 1. Sex estimation methods use over time.



<u>Ancestry Estimation Methods</u>

There are 436 cases that employed at least one ancestry estimation method. Again, seven methods make up approximately 94% of methods used in FADAMA cases. There is a heavy and consistent reliance on Fordisc persisting over all year cohorts. While some methods lacking statistical rigor like "Generalized Morphology" all but disappear in the most recent year cohort, others strongly persist like Rhine (1990). Interestingly, even though a statistically-informed approach to replace the Rhine method has been developed by Hefner (2009) and Hefner and Ousley (2014), Rhine (1990) is still more frequently used than both of these newer methods in the 2016-2022 cohort. Still, approximately 75% of the cases in the 2016-2022 cohort employ methods with a statistical grounding.

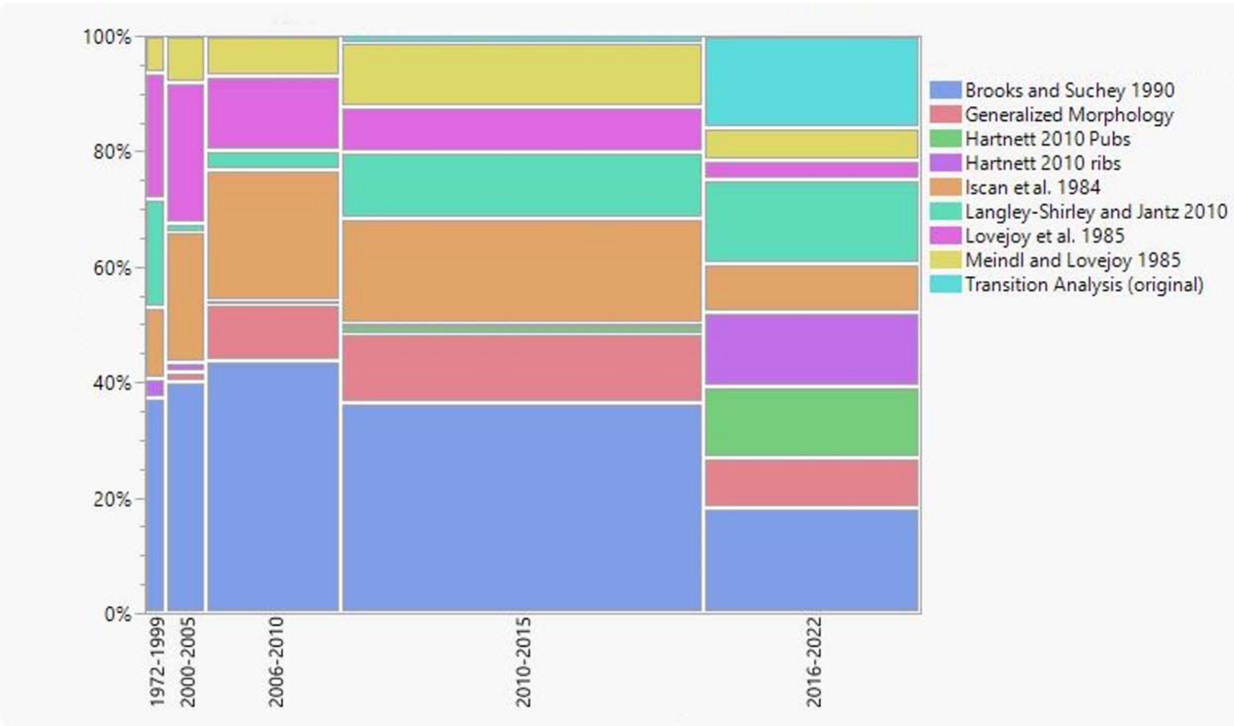
Figure 2. Ancestry estimation use over time.



Age Estimation Methods

Methods for age estimation are the most frequently used, with 585 cases employing at least one method. There is also a much greater dispersion of the methods employed for age when compared to the other biological profile components, with 18 methods comprising 90% of the case use. Of note, we can see the uptake of newer methods (e.g. Hartnett 2010) with a concomitant persistence of older methods (e.g. Brooks and Suchey 1990; Iscan 1984), resulting in an increased diversity in method use in the most recent year cohort of 2016-2022.

Figure 3. Age estimation method use over time.



Limitations

FADAMA's progress was impacted by COVID-19. Our team employed a variety of methods (no-cost extensions; online instead of in person activities) to guide the project successfully out of the pandemic. A large part of the case uploading strategy and budget for FADAMA was to partner with laboratories with large caseloads and send FADAMA trained graduate researcher technicians to these laboratories to assist in case uploading. For a two-year period, the COVID-19 pandemic made travel to these agencies impossible. Instead, we focused on working with researchers in agencies of interest and paying their affiliated graduate students. This solution was the best fit for these active laboratories as it provided hands-on training in database basics and case uploading for these facilities, while simultaneously increasing the case sample for the database. In addition, we initiated online training videos and wiki tutorials to assist agencies in training themselves to upload case data to the database. We requested two no cost extensions to delay grant completion in the hope that travel restrictions due to the pandemic would be lifted and interns would be able to travel to these locations. Finally we also paired with locations to identify and train onsite interns in data uploading. As a result, data upload into FADAMA increased by 50% between 2/2022 and 2/2023. However, this delayed the completion of two manuscripts based on Aims 3.2, 3.3 and 3.4, which are now in preparation.

ARTIFACTS

Peer Reviewed Publications

- Hughes, C., Juarez, C., Yim, A. 2021. Forensic Anthropology Casework Performance: Assessing Accuracy and Trends for Biological Profile Estimates on a Comprehensive Sample of Identified Decedent Cases. J Forensic Sci. 2021 Sep;66(5):1602-1616. doi: 10.1111/1556-4029.14782

- Juarez, CA, Hughes, CE, Yim, A-D. 2021. Technical note: A report on the Forensic Anthropology Database for Assessing Methods Accuracy. *Am J Phys Anthropol*. 2021; 174: 149– 150. https://doi.org/10.1002/ajpa.24167

Conference Papers/ Presentations

- Juarez, C., Hughes, C., Yim, A., 2023. Data on Methods Usage in Forensic Anthropology Casework From 1972–2022 Using the Forensic Anthropology Database for Assessing Methods Accuracy (FADAMA). Proceedings of the American Academy of Forensic Sciences (AAFS) 75th Annual meeting February 2023 Orlando. Advanced Program.

- Juarez, C., Hughes, C., Yim, A.,

  2022. The current status of methods usage in forensic anthropology casework using the Forensic Anthropology Database for Assessing Methods Accuracy (FADAMA). Proceedings of the American Association of Biological Anthropologists Meeting Denver March 2022. Advanced Program.

- Juarez, C. Yim, A., Hughes, C.

  2021. Forensic Anthropology Case-work Performance: Assessing Accuracy and Trends for Estimates of the Biological Profile. Proceedings of the American Academy of Forensic Sciences 2021. 73th American Academy of Forensic Sciences National meeting Virtual meeting 2021. Advanced Program

- Hughes, C., Juarez, C., Pope, K., Spatola, B.

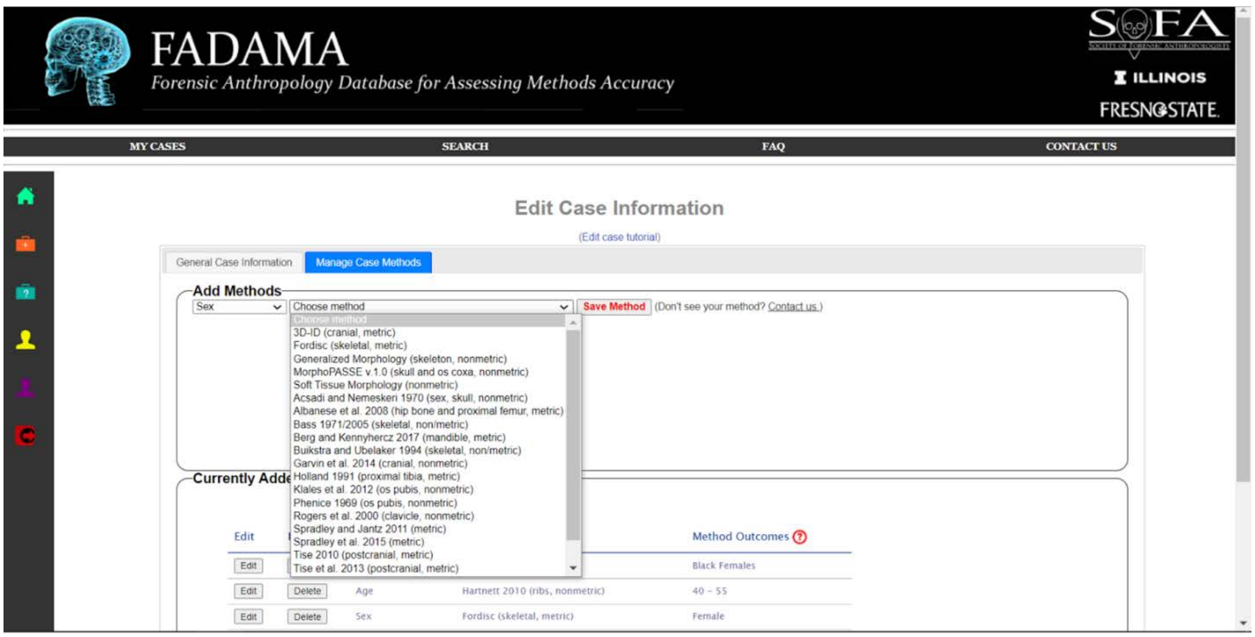
  2020. Learning from our case work the forensic anthropology database for assessing methods accuracy (FADAMA). Proceedings of the American Academy of Forensic Sciences 2020. 72th American Academy of Forensic Sciences National meeting Baltimore Maryland February 2020. Advanced Program

Technologies

- Wiki Tutorials https://github.com/andicyim/FADAMA/wiki/FADAMA-User-Tutorial
- Git hub files to assist other scientists in database creation.

Websites

- The website user interface contains the case data submission, case data access, wiki tutorials, FAQs and helpful link, including the Forensic Technology Center of Excellence archived workshop on using FADAMA for research purposes.
- FADAMA website: https://www-app.igb.illinois.edu/sofadb



Databases

- The database deliverable is fully virtual through the website user interface. https://www-app.igb.illinois.edu/sofadb

Datasets

- FADAMA contains 641 cases as of this report containing in whole or in part the following information:

Basic Case information:

1. Date submitted
2. Case Year
3. Whether the case was a cold case or not , if yes, then cold case year.
4. Estimated Sex from FA report

5. Estimated minimum and maximum age and notes from FA report
6. Estimated Ancestry from FA report
7. Estimated minimum and maximum stature from FA report
8. Identified sex of decedent and notes
9. Identified age of decedent and notes
10. Identified ancestry of decedent and notes
11. Identified stature of decedent and notes
12. Information source for decedent information
13. Case notes
14. Background knowledge

Sex methods (24 total): Users select whether they used each method and then enter the data input into each method from their case report (e.g., measurements, descriptions etc.)

- ☐ 3D-ID (cranial, metric)
- ☐ Fordisc (skeletal, metric)
- ☐ Generalized Morphology (skeleton, nonmetric)
- ☐ MorphoPASSE v.1.0 (skull and os coxa, nonmetric)
- ☐ Soft Tissue Morphology (nonmetric)
- ☐ Acsadi and Nemeskeri 1970 (sex, skull, nonmetric)
- ☐ Albanese et al. 2008 (hip bone and proximal femur, metric)
- ☐ Bass 1971/2005 (skeletal, non/metric)
- ☐ Berg and Kennyhercz 2017 (mandible, metric)
- ☐ Buikstra and Ubelaker 1994 (skeletal, non/metric)
- ☐ France 1998 (metric and nonmetric, skeletal)
- ☐ Garvin et al. 2014 (cranial, nonmetric)
- ☐ Holland 1991 (proximal tibia, metric)
- ☐ Klales et al. 2012 (os pubis, nonmetric)
- ☐ Milner and Boldsen, 2012 (humerus and femur, metric)
- ☐ Phenice 1969 (os pubis, nonmetric)
- ☐ Rogers 1999 (humerus, nonmetric)
- ☐ Rogers et al. 2000 (clavicle, nonmetric)
- ☐ Spradley and Jantz 2011 (metric)
- ☐ Spradley et al. 2015 (metric)
- ☐ Tise 2010 (postcranial, metric)
- ☐ Tise et al. 2013 (postcranial, metric)
- ☐ Walker 2005 (os coxa, nonmetric)
- ☐ Walker 2008 (cranial, nonmetric)

Age Methods 56 Users select whether they used each method and then enter the data input into each method from their case report (e.g., measurements, descriptions etc.)

- ☐ Epiphyseal Union (skeletal, nonmetric)
- ☐ Epiphyseal Union, McKern and Stuart (skeletal, nonmetric)
- ☐ Generalized Morphology
- ☐ Long bone length (skeletal, metric)
- ☐ TA3 (nonmetric, skeletal)
- ☐ Transition Analysis (skeletal, nonmetric)
- ☐ Albert and Maples 1995 (vertebrae, nonmetric)
- ☐ AlQahtani et al., 2010 (dentition, nonmetric)
- ☐ Bass 1971/2005 (skeletal, non/metric)
- ☐ Beauthier et al. 2010 (cranium, nonmetric)
- ☐ Berg 2008 (os pubis, nometric)
- ☐ Blankenship et al. 2017 (dentition, nonmetric)
- ☐ Brooks and Suchey 1990 (os pubis, nonmetric)
- ☐ Buckberry and Chamberlain 2002 (ilium, nonmetric)
- ☐ Buikstra and Ubelaker 1994 (skeletal, non/metric)
- ☐ Cho et al., 2002 (osteon, metric)
- ☐ Demirjian et al. 1973 (dentition, nonmetric)
- ☐ DiGangi et al. 2009 (first rib, nonmetric)
- ☐ Garvin 2008 (cartilage, nonmetric)
- ☐ Gilbert and McKern 1973 (os pubis)
- ☐ Ginter 2005 (cranium, nonmetric)
- ☐ Hartnett 2010 (os pubis, nonmetric)
- ☐ Hartnett 2010 (ribs, nonmetric)
- ☐ Iscan and Loth 1989 (ribs)
- ☐ Iscan et al. 1984 (White male, ribs, nonmetric)
- ☐ Iscan et al. 1985 (White females, ribs, nonmetric)
- ☐ Iscan et al. 1987 (American Black males and females, ribs, nonmetric
- ☐ Kasper et al. 2009 (third molar, nonmetric)
- ☐ Katz and Suchey 1986 (os pubis, nonmetric)
- ☐ Kvaal et al., 1995 (dentition, metric)
- ☐ Lamendin et al. 1992 (dentition, metric)
- ☐ Langley 2016 (clavicle, nonmetric)
- ☐ Langley-Shirley and Jantz 2010 (clavicle, nonmetric)
- ☐ Lovejoy et al. 1985 (os coxa, nonmetric)
- ☐ Mann et al. 1991 (cranium, nonmetric)
- ☐ Mckern and Stewart 1957 (os pubis, nonmetric)
- ☐ McKern and Stewart 1957 (sacrum, nonmetric)
- ☐ Meindl and Lovejoy 1985 (sutures, nonmetric)
- ☐ Mincer et al. 1993 (third molar, nonmetric)
- ☐ Moorrees et al. 1963 (dentition, nonmetric)
- ☐ Nawrocki 1998 (cranium)
- ☐ Osborne et al. 2004 (os coxa, nonmetric)
- ☐ Passalacqua 2009 (sacrum, nonmetric)
- ☐ Prince and Ubelaker 2002 (dentition, metric)
- ☐ Rejtarova et al. 2009 (costal cartilage, nonmetric)
- ☐ Rios and Cardoso 2009 (rib, nonmetric)
- ☐ Rios et al., 2008 (sacral fusion, nonmetric)
- ☐ Samworth and Gowland 2007 (os coxa)
- ☐ Schaefer 2008 (Epiphyseal Union nonmetric)
- ☐ Shirley and Jantz 2011 (cranium, nonmetric)
- ☐ Solari and Abramovitch 2002 (third molar, nonmetric)
- ☐ Stout and Paine 1992 (osteons, metric)
- ☐ Thompson, 1979 (osteon, metric)
- ☐ Todd 1920 (os pubis, nonmetric)
- ☐ Todd 1921 (os pubis, nonmetric)
- ☐ Webb and Suchey 1985 (os coxa and clavicle, nonmetric)

Ancestry Methods 17 Users select whether they used each method and then enter the data input into each method from their case report (e.g., measurements, descriptions etc.)

- [ ] 3D-ID (cranial, metric)
- [ ] Fordisc (skeletal, metric)
- [ ] Generalized Morphology
- [ ] MaMD Analytical
- [ ] rASUDAS (dentition, nonmetric)
- [ ] Bass 1971/2005 (skeletal, non/metric)
- [ ] Berg and Kennyhercz 2017 (mandible, metric)
- [ ] Birkby et al. 2008 (skeletal, nonmetric)
- [ ] Buikstra and Ubelaker 1994 (skeletal, non/metric)
- [ ] Edgar 2005 (dentition, nonmetric)
- [ ] Edgar 2013 (dentition, nonmetric)
- [ ] Gill 1998 (nonmetric, cranial)
- [ ] Hefner 2009 (skull, nonmetric)
- [ ] Hefner and Ousley 2014 (skull, nonmetric)
- [ ] Hurst 2012 (cranial, nonmetric)
- [ ] Kenyhercz et al. 2017 (skull, nonmetric)
- [ ] Rhine 1990 (skull, nonmetric)

Stature Methods 16 Users select whether they used each method and then enter the data input into each method from their case report (e.g., measurements, descriptions etc.)

- [ ] Auerbach and Ruff, 2010 (long bones, metric)
- [ ] Bass 1971/2005 (skeletal, metric)
- [ ] Buikstra and Ubelaker 1994 (skeletal, non/metric)
- [ ] Fordisc (skeletal, metric)
- [ ] Fully 1956 (skeletal, metric)
- [ ] Genoves 1967 (long bones, metric)
- [ ] Jantz et al 2008 (femur, metric)
- [ ] Ousley 1995 (long bones, metric)
- [ ] Raxter et al. (skeletal, metric)
- [ ] Simmons et al 1990
- [ ] Sjovold 1990 (long bones, metric)
- [ ] Spradley et al. 2008 (long bones, metric)
- [ ] Steele 1970 (long bones, metric)
- [ ] Trotter 1970 (long bones, metric)
- [ ] Trotter and Gleser 1952 (long bones, metric)
- [ ] Trotter and Gleser 1958 (long bones, metric)

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