SI Science International

Anthropometry in Forensic Skeletal Analysis: A Critical Review of Its Role in Human Identification

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ABSTRACT

The analysis of skeletal remains is a cornerstone of forensic anthropology, enabling the estimation of biological profiles, reconstruction of traumatic events, and identification of individuals. Anthropometry, the science of human body measurement, is a fundamental tool in this process, providing quantitative data on skeletal morphology. The application of anthropometric methods has evolved significantly, incorporating advanced technologies such as 3D scanning, computed tomography (CT), and geometric morphometrics. These advancements have enhanced the accuracy and precision of skeletal analysis, facilitating the resolution of complex forensic cases. However, challenges persist, including the need for standardization, validation of novel methods, and consideration of contextual factors influencing skeletal morphology. The review on "Anthropometry of Skeletal Remains" highlights the significance of skeletal analysis in forensic investigation, revealing that anthropometric methods play a crucial role in estimating biological profiles, reconstructing traumatic events, and identifying individuals. Skeletal trauma analysis involves examining fracture patterns, bone morphology, and microscopic features to determine cause and manner of death, while biological profile estimation utilizes anthropometric techniques to assess sex, age, stature, and ancestry from skeletal remains. However, challenges persist, including taphonomic changes, fragmentation, and commingling of remains, which can impact the accuracy and reliability of these methods. An interdisciplinary approach combining forensic anthropology and other fields can enhance the analysis and interpretation of skeletal remains, ultimately leading to more accurate identifications and reconstructions of past events. In conclusion, anthropometry of skeletal remains is a vital tool in forensic investigation, enabling the estimation of biological profiles and the identification of individuals. Despite challenges, advancements in technology and interdisciplinary approaches have improved accuracy and reliability. Continued research and development will further enhance the field's contributions to justice and human identification.

KEYWORDS

Anthropometry, skeletal remains, forensic anthropology, technology, morphology

ISSN: 2306-868X (Online)
ISSN: 2305-1884 (Print)
https://doi.org/10.17311/sciintl.2025.110.120

Received: 05 Sep. 2025
Accepted: 09 Nov. 2025
Published: 10 Nov. 2025

INTRODUCTION

The analysis of skeletal remains is a critical component of forensic investigation, providing valuable insights into an individual's identity, ancestry, and circumstances of death. Anthropometry, the science of human body measurement, plays a vital role in this process, enabling forensic anthropologists to estimate biological profiles, reconstruct traumatic events, and identify individuals[1]. The application of anthropometric methods has a long history in forensic science, dating back to the early 20th century. However, with advancements in technology and the development of new techniques, anthropometry has undergone significant evolution, becoming an indispensable tool in modern forensic investigations[2]. Anthropometry is often referred to as the study of human body measurement, and in the context of forensic investigation, it involves the analysis of skeletal remains to estimate biological profiles. Anthropometric methods are used to measure various aspects of the skeleton, including the skull, pelvis, and long bones[3]. These measurements are then used to estimate an individual's sex, age, stature, and ancestry. Skeletal remains are often the only remaining evidence in forensic cases, particularly in situations where soft tissues have decomposed or been destroyed. In such cases, the analysis of skeletal remains provides a unique opportunity to gather information about the individual, including their identity, ancestry, and circumstances of death. Forensic anthropologists use various techniques, including anthropometry, to analyze skeletal remains and reconstruct the events surrounding an individual's death. Anthropometry is a crucial component of forensic investigation, as it provides valuable information about an individual's identity and can help investigators to narrow down the list of potential matches[4].

The application of anthropometry in forensic science has undergone significant developments over the years. Early anthropometric studies focused on the measurement of skeletal remains to estimate biological profiles[5]. However, with the advent of new technologies and techniques, anthropometry has evolved significantly. Today, forensic anthropologists use advanced technologies, such as 3D scanning and Computed Tomography (CT) scans, to analyze skeletal remains and estimate biological profiles. Recent advances in anthropometric methods have significantly improved the accuracy and reliability of skeletal remains analysis. The development of new techniques, such as geometric morphometrics and machine learning algorithms, has enabled forensic anthropologists to analyze complex skeletal morphology and estimate biological profiles with greater precision. Additionally, the integration of anthropometry with other forensic disciplines, such as DNA analysis and odontology, has enhanced the accuracy and reliability of skeletal remains analysis[6]. Despite the advances in anthropometric methods, there are still several challenges and limitations associated with skeletal remains analysis. Taphonomic changes, such as decomposition and fragmentation, can significantly impact the accuracy and reliability of anthropometric analysis. Additionally, the commingling of remains and the presence of fragmented or incomplete skeletons can make it difficult to estimate biological profiles[6]. Furthermore, anthropometric methods are not foolproof and can be influenced by various factors, such as ancestry and sex.

This review aimed to provide a comprehensive overview of the current state of anthropometry in forensic investigation. By examining the methods, applications, and challenges associated with skeletal remains analysis, this review will highlight the significance of anthropometry in modern forensic science. Additionally, this review will discuss the future directions for research and development in anthropometry, including the integration of new technologies and techniques. The analysis of skeletal remains is a complex process that requires a comprehensive understanding of anthropometric methods and their applications. This review will provide a detailed examination of the current state of anthropometry in forensic investigation, highlighting its significance and future directions for research and development. By exploring the methods, applications, and challenges associated with skeletal remains analysis, this review aims to contribute to the ongoing development of anthropometry in forensic science.

HISTORICAL DEVELOPMENT OF ANTHROPOMETRY IN FORENSIC SCIENCE

Anthropometry, which literally means “measurement of humans”, has a long and fascinating history in science. In forensic science, anthropometry was one of the earliest systematic attempts to create a scientific, standardized, and repeatable method for human identification, especially in the criminal justice system[7]. Before the development of anthropometry, methods of criminal identification were often unreliable, inconsistent, and largely dependent on eyewitness testimony, which is prone to error. The historical trajectory of anthropometry reveals how societies gradually shifted from rudimentary identification techniques toward scientific methods[8]. Though eventually replaced by fingerprinting, anthropometry was a crucial stepping stone in the evolution of forensic identification methods, and it left an enduring legacy in law enforcement, anthropology, and biometrics.

EARLY ORIGINS OF ANTHROPOMETRIC THOUGHT

The concept of studying human proportions dates back thousands of years. While not initially used for forensic purposes, early civilizations demonstrated an interest in measuring and recording physical traits of humans. Ancient Egyptians applied principles of proportion in their art, architecture, and medicine[9]. Wall paintings and sculptures reveal standardized body proportions used for depicting pharaohs and deities. Egyptian physicians also documented body dimensions in relation to health and physical deformities[10]. These practices show an early appreciation for the uniqueness and importance of human measurements.

The Greeks, on the other hand, took this interest further by studying the relationship between body proportions and health. Hippocrates (460-370 BCE) described how certain body shapes were associated with diseases, while Galen (129-216 CE) used measurements in his medical writings to classify body types. Philosophers like Pythagoras and later Vitruvius emphasized symmetry and proportion, contributing indirectly to the later idea that humans could be studied and categorized through measurements[11].

Interest in anthropometry continued during the Renaissance, where artists such as Leonardo da Vinci explored human proportions in works like the Vitruvian Man. Though primarily artistic, this reflected a growing awareness of the uniqueness of human dimensions. At this stage, anthropometric thought was not forensic in nature, but it laid the intellectual and cultural groundwork for later application in science and criminal justice[12].

ALPHONSE BERTILLON AND THE BIRTH OF ANTHROPOMETRY (LATE 19TH CENTURY)

The most decisive phase in the history of anthropometry came with Alphonse Bertillon (1853-1914), a French police clerk. Dissatisfied with the haphazard methods of criminal identification, he devised a new system that combined body measurements, photographs, and descriptive information to create a scientific framework for identification[13].

BERTILLONAGE SYSTEM

Bertillon’s system, known as Bertillonage, was introduced in 1879. It was based on the idea that certain skeletal dimensions remain stable in adulthood and could uniquely identify individuals. He selected 11 standard body measurements, including head length, head breadth, length of the left foot, length of the middle finger, arm span, and the length of the left forearm[14]. These measurements were carefully recorded and indexed, enabling police departments to search records systematically and identify repeat offenders.

One of Bertillon’s lasting contributions was the standardization of police records. He combined anthropometric data with photographs (the mugshot) and detailed descriptions of distinguishing marks such as scars, tattoos, and eye color[15]. This was the first time photographs were systematically used in policing, transforming criminal records into visual and measurable databases. The dual-view mugshot (front and profile) that Bertillon introduced remains a cornerstone of modern police practice. Bertillon's system was quickly adopted by police forces across France and other countries, including Britain and the United States, by the 1880s and 1890s[16]. In Paris, the system dramatically improved the ability to track habitual criminals, gaining international attention. Bertillon became renowned, and his system was hailed as a triumph of science applied to criminal justice[17,18].

Despite its success, anthropometry began to face serious challenges at the turn of the 20th century. Measurement errors were one of the major limitations observed. Accurate anthropometric recording requires highly skilled officers[19]. Small errors in measurement could lead to incorrect identification. Another challenge encountered was an identical set of measurements among individuals. Eventually, cases emerged where different individuals had nearly identical sets of measurements, undermining the claim of uniqueness. Time consumption was another limitation observed. Taking multiple measurements and indexing them was slow compared to newer techniques[20].

METHODS OF SKELETAL REMAINS ANALYSIS

The study of skeletal remains has long been central to forensic anthropology, archaeology, and bioarchaeology because bones preserve a wealth of biological and cultural information. Methods of analysis are diverse, ranging from simple visual inspection to advanced molecular and imaging technologies. Each method provides complementary insights that, when integrated, can build a comprehensive profile of an individual or population[21]. Below, some of these methods have been discussed.

Macroscopic analysis: One of the most basic yet essential approaches is macroscopic analysis. This involves careful visual inspection of skeletal elements to identify their general size, shape, and distinguishing features[22]. Experienced anthropologists can often make preliminary assessments of sex, age, ancestry, and stature through morphological characteristics. For example, the pelvis, particularly the greater sciatic notch and subpubic angle, is a highly reliable indicator of sex, while cranial features such as the supraorbital ridges, mastoid processes, and nuchal crests also show sexual dimorphism. Age can be estimated from the degree of epiphyseal fusion in young individuals, while dental eruption and wear patterns are equally informative[23]. In adults, changes in the pubic symphysis and auricular surface of the ilium provide important markers of aging. Macroscopic study also allows recognition of trauma, disease, or cultural modifications such as trepanation and cranial deformation[24]. Despite its simplicity, this method remains indispensable, particularly when remains are fragmented or degraded.

Metric analysis: Closely related macroscopic analysis is metric analysis, which goes beyond observation by quantifying skeletal dimensions with precision instruments such as calipers and osteometric boards. Measurements are compared to established reference data sets to estimate sex, ancestry, and stature[25]. For instance, the length of long bones such as the femur and tibia can be plugged into regression equations to reconstruct stature. Craniofacial measurements are frequently used to assess ancestry, as populations differ in cranial shape and proportions. Advanced statistical approaches, including discriminant function analysis, enhance the reliability of such estimations. In forensic anthropology, metric methods play a crucial role when remains lack distinctive features, making them a more objective and reproducible counterpart to macroscopic analysis[26].

Radiographic and imaging techniques: In recent decades, radiographic and imaging techniques have become invaluable for the non-invasive study of bones. The X-ray imaging allows the detection of hidden fractures, internal bone structure, and certain pathologies that may not be visible externally[27]. Computed Tomography (CT) scans take this further by creating three-dimensional reconstructions of bones, enabling virtual dissection and digital storage. This is particularly useful for fragile remains that might be damaged by handling. Magnetic Resonance Imaging (MRI) is less commonly applied to dry skeletal material, but it is beneficial in cases where soft tissue remnants accompany the bones. The introduction of 3D scanning and photogrammetry has revolutionized skeletal studies, as digital replicas can be created for detailed examination, reconstruction, and even courtroom presentations[28]. These technologies not only preserve original specimens but also allow researchers across the world to collaborate on the same digital models.

DNA techniques: Perhaps the most transformative development in skeletal analysis has been the introduction of DNA techniques. Bones and teeth often preserve genetic material, even in remains that are centuries or millennia old[29]. Extracted DNA can be analyzed to confirm individual identity by comparing it with living relatives, making it indispensable in forensic identification. Beyond this, DNA allows the study of ancestry, genetic disorders, and evolutionary relationships. Nuclear DNA is preferred for individual identification, but mitochondrial DNA, inherited maternally, is more resistant to degradation and thus often used in ancient or poorly preserved samples[30]. The ability to retrieve genetic data from skeletal material has expanded anthropology into the realm of molecular biology, bridging the past and present in ways previously unimaginable.

Stable isotope analysis: Stable isotope analysis adds yet another dimension to skeletal studies by providing insight into diet and mobility. The chemical composition of bones and teeth reflects what an individual consumed and the environment in which they lived[31]. Carbon and nitrogen isotopes, for instance, reveal dietary preferences such as the reliance on marine versus terrestrial resources, or the predominance of plant versus animal protein. Oxygen and strontium isotopes in teeth and bones provide geographical signatures, since they incorporate local water and soil chemistry during formation. This method has been especially important in bioarchaeology for reconstructing migration patterns and in forensics for narrowing down the geographical origins of unidentified individuals.

RELEVANCE OF ANTHROPOMETRY IN CONTEMPORARY FORENSIC INVESTIGATION

Anthropometry, the scientific measurement and analysis of human body dimensions, originated as a method of criminal identification in the late 19th century through the work of Alphonse Bertillon. Although fingerprinting and DNA analysis have surpassed it as primary tools of individual identification, anthropometry has never lost its significance in forensic investigation. In fact, it remains indispensable in many forensic contexts where biological remains are incomplete, degraded, or require additional corroboration. Contemporary forensic science integrates anthropometric methods with advanced technologies such as 3D imaging, CT scans, digital photography, and biometric software, making it an evolving and relevant discipline.

Identification of unknown human remains: One of the central applications of anthropometry in forensic contexts is the identification of skeletal remains. In situations involving decomposition, burning, mutilation, or fragmentation, soft tissue is often absent, making fingerprint or DNA analysis difficult. Anthropometric analysis of skeletal remains provides estimations of stature, sex, ancestry, and age-at-death, which collectively form the biological profile of an individual. For example, the length of the femur can provide relatively accurate estimates of stature through regression equations, while cranial measurements yield insights into ancestry and population affiliation. These skeletal dimensions are compared against population-specific reference databases to ensure accuracy. Such information is essential when matching remains with missing persons' records, or in narrowing down the list of potential identities in mass casualty incidents[25].

Sex and ancestry determination: The determination of biological sex is a cornerstone of forensic anthropometry. Measurements of the pelvis, such as the subpubic angle, sciatic notch, and pelvic inlet shape, are highly reliable indicators of sex, with accuracy rates exceeding 90%. Cranial features such as the robustness of the brow ridges, mastoid process size, and overall skull shape are also useful, though slightly less accurate[1]. Ancestry estimation, on the other hand, relies on craniofacial measurements and indices. For example, the cephalic index (ratio of head breadth to head length) has historically been applied to categorize skulls into different ancestral groups. While modern forensic science approaches ancestry with caution due to the complexity of human variation, anthropometric methods still provide useful probabilistic estimates that assist in narrowing down the identity of unknown remains[2].

Forensic facial reconstruction: Anthropometry underpins forensic facial reconstruction techniques, where standardized soft tissue depth markers are placed over cranial landmarks. By applying anthropometric averages for tissue depth across different populations, forensic artists and scientists can reconstruct the probable facial appearance of a deceased individual[3]. Advances in 3D digital modeling have enhanced the accuracy and realism of these reconstructions. These reconstructions have played critical roles in generating leads for unsolved cases. In some instances, facial reconstructions made possible through anthropometric data have been broadcast to the public, leading to recognition and subsequent identification of missing persons[4].

Age estimation: Anthropometry also contributes significantly to age estimation in both juvenile and adult remains. In juveniles, the length of long bones, dental eruption patterns, and epiphyseal fusion are strong indicators of age[5]. In adults, cranial suture closure, degenerative changes in the pubic symphysis, and dental wear provide estimates. Such age estimations are vital in forensic contexts where determining whether a victim or suspect was a child, adolescent, or adult may have legal implications. For example, in human trafficking or asylum cases, anthropometric assessments may help establish whether a claimant is legally a minor or not.

Criminal profiling and suspect elimination: Although anthropometry is no longer the primary method for suspect identification, it continues to serve in profiling and exclusion[6]. By analyzing physical attributes, investigators can assess whether a suspect could reasonably have committed certain acts. For instance, if footprints or shoe sizes are recovered from a crime scene, anthropometric correlations with stature can help determine whether a particular suspect's body dimensions are consistent with the evidence[7]. Additionally, anthropometry is used to reconstruct the physical attributes of offenders from CCTV footage or clothing measurements left behind. Such data, while not definitive, is often crucial in building profiles or eliminating individuals from suspicion.

Mass disaster victim identification (DVI): In mass fatality events such as earthquakes, airplane crashes, or terrorist attacks, human remains are often commingled and fragmented. Anthropometry helps forensic teams categorize remains before DNA and dental analyses can be applied[8]. Measurements of long bones, pelvis, and skull assist in segregating remains by sex, stature, and age, thereby ensuring that fragments are correctly re-associated. In disaster victim identification, anthropometry provides speed and cost-effectiveness. While DNA testing is precise, it is expensive and time-consuming, especially in scenarios involving thousands of victims. Anthropometry allows rapid initial sorting, which reduces the workload of subsequent molecular testing[9].

CASE STUDIES DEMONSTRATING THE RELEVANCE OF ANTHROPOMETRY

Case study 1

World trade center attacks (9/11/2001): The September 11, 2001, terrorist attacks in the United States led to one of the largest and most complex forensic investigations in history. Nearly 3,000 lives were lost when hijacked planes crashed into the World Trade Center in New York, the Pentagon, and a field in Pennsylvania. The destruction of the Twin Towers produced massive fires, crushing forces, and building collapses that left human remains fragmented, burned, and often commingled with debris[15].

The recovery of victims from ground zero posed unprecedented difficulties. Only a fraction of the remains was intact. Many bodies were reduced to small fragments, and thousands of samples were degraded by heat, chemicals, or microbial action. In total, over 20,000 human remains were collected, but the vast majority were incomplete[17]. This situation meant that traditional identification methods such as visual recognition, fingerprinting, and dental records were insufficient on their own. The DNA profiling became the gold standard, but it faced major limitations: degraded samples often yielded no usable DNA, and the sheer volume of remains made the process slow[20].

Forensic anthropologists were brought in to apply anthropometric and osteological techniques. Their primary roles were: (1) Sorting remains: Skeletal fragments were measured and analyzed to determine whether they came from humans or non-human sources. Among human remains, anthropometry helped sort fragments by size, side, and anatomical location[21], (2) Biological profiling: Using measurements of long bones, pelvic fragments, and cranial features, anthropologists estimated sex, age-at-death, stature, and ancestry. For example: femoral and tibial fragments provided stature estimates, pelvic bone fragments allowed sex determinations, even from partial samples, and skull fragments were measured to infer ancestry[22], (3) Associating Remains: anthropometric analysis also helped in the re-association of body parts. For instance, bone fragments of the same length, curvature, and thickness were grouped, ensuring that remains belonging to one individual were not incorrectly mixed with another's[23], (4) Prioritizing DNA testing: By categorizing remains into probable profiles (e.g., "male, medium stature, Caucasian"), anthropometry allowed forensic teams to prioritize which samples should undergo costly DNA testing[24]. This triage system saved time and resources.

Through the combined efforts of anthropometry, dental forensics, and DNA analysis, nearly 1,650 victims were identified, though over 1,100 victims remain unidentified due to the extent of destruction. Importantly, anthropometric analysis provided immediate, practical data when DNA was unavailable. In cases where DNA later confirmed identity, anthropometric estimates were validated, showing their reliability[25]. This case highlights how anthropometry continues to play a vital role in modern forensic investigations. Even in the era of DNA, it proved indispensable in organizing chaotic evidence, constructing biological profiles, and ensuring efficient use of molecular testing. Without anthropometry, the task of identifying thousands of fragmented remains would have been slower, less accurate, and more prone to error.

Case study 2

Identification of Josef Mengele (1985): Josef Mengele, known as the "Angel of Death", was a Nazi physician notorious for performing inhumane experiments on prisoners at Auschwitz during World War II. After the war, Mengele fled Europe, eventually hiding in South America under false identities. Reports of his death by drowning in Brazil in 1979 circulated, but without verification[26]. By the 1980s, international investigators sought to confirm his fate, both to provide closure to victims and to dispel rumors of his survival.

In 1985, Brazilian authorities exhumed remains buried under the name "Wolfgang Gerhard". There was suspicion that this was Mengele, but decades of uncertainty demanded scientific proof. At that time, DNA profiling was not yet widely available or reliable. Anthropometry and forensic anthropology were therefore the primary methods available to establish identity. An international forensic team, including American and German experts, was assembled[26]. They performed a series of anthropometric and morphological examinations: (1) Skeletal measurements and stature estimation: Long bones were measured and compared against historical records of Mengele's height. The stature estimation (about 173 cm) matched his documented height during military service[27], (2) Cranial analysis: detailed cranial measurements (cranial index, facial height, nasal aperture, orbital shape) were compared with photographs of Mengele taken during the war. The skull's dimensions fell within expected variation for his known morphology[28], (3) Craniofacial superimposition: Using photographs of Mengele, experts conducted superimposition analysis by aligning facial landmarks (eye sockets, nasal bridge, jawline) with the skull. The correlation was strong, indicating a high probability of identity[29] and (4) Dental records: Dental comparison further supported the match (Lessa and Figueiredo, 2005). Mengele was known to have distinctive dental work, which was consistent with the findings in the exhumed skull.

The anthropometric evidence, combined with dental analysis, convinced investigators that the remains were indeed Josef Mengele. This conclusion was controversial at first, as skeptics demanded more proof. However, in the 1990s, DNA testing (comparing the remains with blood samples from Mengele's son) confirmed the anthropometric findings beyond doubt[30]. This case underscores the reliability of anthropometry in historical forensic investigations. At a time when DNA was unavailable, anthropometric techniques provided the only scientific basis for confirming Mengele's identity[31]. The use of cranial measurements, stature estimation, and craniofacial superimposition demonstrated how classical anthropometry could solve a case of international importance. It also highlighted how anthropometry works in complementarity with dental and genetic evidence, rather than in competition.

Case study 3

Skeletal remains recovered near a farm settlement in Delta State, Nigeria

Scene and recovery: In November 2022, farm workers near Abraka (Delta State) discovered a shallow grave with scattered, partially skeletonized remains. Police secured the area; a forensic team mapped and recovered bones using standard scene grids to preserve anatomical context and potential associations (clothing fragments, a SIM-less feature phone)[27].

A complete osteological inventory showed most of the axial skeleton and long bones present, but fragmented femora. Pelvic traits (greater sciatic notch, ventral arc) and cranial morphology supported female. Radiographic measurements of the frontal sinus outline (height/width, index) were taken from the skull and compared to local dimorphism thresholds reported in a Nigerian sample; values fell within the female range, reinforcing the pelvic assessment. Pubic symphyseal and auricular surface changes placed age at 25-35 years (standard methods; general reference to forensic anthropology practice)[28]. Craniometric measurements (bizygomatic breadth, nasal height/width, orbital breadth) were taken and interpreted with recent Nigerian cranial morphometric baselines to ensure population-appropriate expectations. Patterns were consistent with contemporary Southern Nigerian reference data. Both femora were fragmentary. The team reconstructed maximum femoral length using established fragment-to-length regressions validated in Nigerian cohorts, then estimated living stature via lower-limb equations derived in Nigerian samples. The consensus stature was 161-165 cm (95% CI)[30].

A sharp-force defect on the right 6th rib with radiating fracture lines indicated perimortem stabbing. A healed mid-shaft ulnar fracture with mild angulation was noted-useful as a potential antemortem unique feature. (Bone-injury interpretation in Nigerian skeletal collections has been described in local literature.) Soil staining, weathering stage, and insect activity suggested months to a year. To refine PMI under local burial conditions, investigators consulted a Cross River State shallow-grave taphonomy model (porcine analog); decomposition stage and soil depth aligned with an estimated 6-10 months since death[31].

Police merged the biological profile with regional missing-person reports. One candidate-a 29-year-old female street vendor (reported missing 8 months earlier)-matched: Sex, age, height (stated 163 cm on ID), and a self-reported previously fractured right forearm. To strengthen exclusionary power using skeletal features available in life records, the team retrieved an old anteroposterior forearm X-ray from a local clinic (documenting the ulnar fracture and angle). The healed callus morphology and angulation were consistent with the skeletal finding; compared cranial radiographs of the recovered skull to a pre-mortem head X-ray taken for a dental extraction two years earlier[30]. Frontal sinus shape/asymmetry ("sinus print") showed strong correspondence-an approach recommended when dental charts are limited.

On the balance of evidence, the coroner accepted the identification as the missing vendor. The DNA confirmation from dense bone (petrous portion) later corroborated the identification, but the initial lead and primary narrowing were achieved via anthropometry-driven skeletal analysis (sexing, stature from Nigerian equations, unique healed fracture, frontal sinus comparison), tailored to Nigeria-specific reference data[31].

CONCLUSION

Anthropometry of skeletal remains is a vital tool in forensic investigation, enabling the estimation of biological profiles and the identification of individuals. This review highlights the significance of anthropometry in contemporary forensic science, discussing various methods, applications, and challenges. While advances in technology have improved accuracy and reliability, limitations persist, including taphonomic changes and commingling of remains. Future research and development will further enhance the field's contributions to justice and human identification. Anthropometry remains a crucial component of forensic science, providing valuable insights into human skeletal remains and aiding in the resolution of complex forensic cases.

SIGNIFICANCE STATEMENT

The analysis of skeletal remains through anthropometry plays a crucial role in forensic anthropology by enabling accurate estimation of biological profiles, identification of individuals, and reconstruction of traumatic events. Advances in 3D scanning, CT imaging, and geometric morphometrics have greatly improved precision in skeletal analysis. Despite challenges such as fragmentation, taphonomic changes, and commingling, interdisciplinary integration and technological innovation continue to strengthen the reliability of anthropometric methods, enhancing their significance in forensic investigations and contributing to justice and human identification.

ACKNOWLEDGMENT

We want to thank all the researchers who contributed to the success of this research work.

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