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Odontometric sex estimation on three populations of the Iron Age from Abruzzo region (central–southern Italy)

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ABSTRACT

Background: In archaeological contexts, sex identification is a necessary step for a complete reconstruction of the biological profile of the individuals and to know demographic patterns of the population, nutritional stress, diseases, growth and development, and distribution of pathological conditions.

Methods: This study is based on the skeletal remains of 149 individuals from three protohistoric populations in close temporal and geographic proximity in Abruzzo region (central–southern Italy): Opi, Alfedena and Bazzano. It has been possible to develop logistic regression equations based on dental measurements of permanent teeth of adult individuals whose sex had previously been estimated based on pelvic and cranial features. These equations were subsequently applied to the permanent dentition of immature individuals and adult individuals whose sex was estimated as uncertain or unknown in order to estimate their sex.

Results: The mandibular canine is the tooth with the greatest sexual dimorphism in adults, followed by both maxillary and mandibular first and second molars, providing a correct assignment of sex ranging from 83.7% and 95.9% of cases, depending on the dimensions used for the construction of these equations. Of the 29 individuals in the target sample (14 *adultus*, 10 *juvenilis* and 5 *infans*), sex estimation was possible for 23 (10 *adultus*, 8 *juvenilis* and 5 *infans*), representing an applicability rate of 79.31% of the individuals.

Conclusions: The results indicate that odontometrics is a useful tool for sex estimation and allows to increase the data to perform more complete paleodemographic studies on archaeological populations.

1. Introduction

Sex estimation with correct allocation accuracy represents a crucial step in the reconstruction of the biological profile of skeletal remains in paleoanthropological, archaeological or forensic studies.

In archaeological contexts, the importance of sex identification is that it is necessary to know demographic patterns of the population (survival and mortality), nutritional stress, diseases, growth and development, and distribution of pathological conditions (e.g. caries, traumas, infectious diseases, etc.), among others. This is particularly important in subadult individuals because, as a rule, anthropological

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studies on archaeological populations have left aside these individuals, focusing on the adult sample. Thus, important aspects remain hidden and a bias in the paleodemographic profile is produced.

Sexually dimorphic differences between males and females have been quantified in numerous ways in physical anthropology and osteoarchaeology based on both morphological and metric criteria for most of the human skeletal elements.[1–6]

The accuracy in sex estimation depends on the integrity of the skeletal remains due to the usual fragmented state of preservation of human remains. Nevertheless, because of the hardness, durability, and resistance to postmortem insults of dentition, some teeth may be recovered when bones are in deficient condition.[7–10]

In recent years, great interest has been generated in determining the usefulness of dentition in sexing archaeological populations in cases when other criteria are absent (e.g. lack of the expression of sex-related skeletal characteristics in subadult remains or deoxyribonucleic acid not available for analysis). Recent papers have identified sexual differences in odontometrical characteristics and have found high percentages of success in differentiating males and females.[11–16] However, such methods tend to be population specific.

Thus, for sex estimation using odontometrics, the best way to solve the problem of population specificity is to use dental data of permanent dentition from adult individuals whose sex estimates are based on well-defined descriptive features of the pelvis and/or skull. These data are used to develop the methodology for sex estimation and then the population-specific equations can be applied to permanent dentition of subadults or to other adults of the same population whose sex is unknown or defined as uncertain. This methodology has been used by Rösing,[17] Beyer-Olsen and Alexandersen,[18] Okazaki,[19] Viciano et al.[20] and Thompson[21] with satisfactory results.

2. The Samnites

The Samnites were a protohistoric people living in Samnium, a region of central–southern Italy located in the Apennine Mountains, during the Iron Age.[22] The Samnite's territory was rich in fluvial resources and abundant pastures, although most of the region is mountainous, barren and unsuitable for agriculture. Although archaeologists have provided different information on farming activities in this population, the most important economic activity appears to have been stock-raising. Herding took the form of annual short-distance "vertical" transhumance, so that the herds were moved to the highlands during the summer and down to the valleys during the winter.[23] Thus, the socio-economic livelihood of this protohistoric population was agro-pastoral.[24]

The Samnite people were organized into a confederation or alliance of communities or tribes, which was called the Samnite League, which emerged as a political and military unit. It was a complex society with aristocracies organized in tribal confederacies based on multiple-patrilineal alliances,[23] which were used in order to protect resources (including land, animals and crops).[24]

The burial patterns reflect the presence of an aristocratic organization, held together by great family alliances. Graves were arranged in well-defined family areas outlined with stones placed in semicircular and circular structures, where can be distinguished a number of male and female burials with rich grave goods.[23–27] Thus, in each circle there are a variable number of individual burials with subjects of different sex, age and social status, but probably belonging to the same family or clan. Within circles, tombs show a particular position with respect to the cardinal points; the individuals were buried with the head facing east, probably in relation to sunrise and sunset. Many graves contained funerary personal objects, comprised jewellery or weapons depending on the sex of the individual.[26,28]

The existence of multiple-patrilineal alliances is supported by the analysis of skeletal and dental epigenetic traits presumably subject to a closer genetic control and benign neoplasias with an hereditary component, suggesting that men buried in the same funerary circle shared a close-kin relationship.[23–25,29,30] The locations of burials and grave goods are also useful for the justification of this point.[23]

At the same time, the increasing social complexity was accompanied by changes in the ideology of the protohistoric societies, based on extolling warfare and male audacity.[23] Warrior paraphernalia constitute the main grave goods found in the burials of male individuals, suggesting that men were farmer–warriors. Skeletal evidence of warfare activities can be found in the extraordinary incidence of injuries by sword and cranial trauma in many necropolises from the Iron Age, including the populations of this study, especially in men.[23,24,31]

With this background, the aims of this study were (i) to determine the degree of dental sexual dimorphism of the adult individuals, (ii) to develop population-specific logistic regression equations for sex estimation based on metric data from permanent teeth, and (iii) to use these equations to estimate the sex of subadult and adult individuals whose sex is unknown or uncertain. This will provide us the necessary data to carry out a more complete paleodemographic analysis of these populations, allowing the reconstruction of the behaviours of the pre-Roman populations of central Italy.

3. Materials and methods

3.1. *Sites backgrounds*

3.1.1. *Necropolis of Alfedena (V–III centuries BCE)*

The site of Alfedena is located in the Sangro Valley (L'Aquila, Abruzzo, Italy) and it was found by chance in 1847; the first excavations were carried out between 1876 and 1889, and then continued extensively between 1895 and 1901, allowing the identification and inspection of 1400 graves. Since 1974, excavations began again and were able to uncover further 132 graves.[27] Unfortunately, most of the skeletal material has been lost or is scattered in various institutions, so relatively few skeletal remains are available for their study.

3.1.2. *Necropolis of Opi (VI–V centuries BCE)*

Located in the heart of the Natural National Park of Abruzzo (L'Aquila, Abruzzo, Italy), the necropolis was discovered in the