

BIOMECHANICAL INDICATORS OF WEAPON USE AND SOCIAL STATUS IN THE BAZZANO NECROPOLIS

This short report summarizes some of the results of a currently ongoing analysis of biomechanical properties in skeletal series from Abruzzo belonging to the first millennium BC. Particular emphasis will be put on the results obtained for the subject of this volume, the Bazzano necropolis (n = 266), but reference will be made also to the results of the bigger sample including all necropoleis, in order to discuss Bazzano in a more ample framework of research (n = 844, including the other Vestini necropoleis of the area: Barisciano, Capestrano, Colli Bianchi, Cinturelli, Campo Rosso, Fossa, Navelli, Peltuinum, Poggio Picenze; also a few of Archaic individuals from the Alfedena necropolis Phase-I were included).

Purpose of the general research is: 1) understanding how various activity-related biomechanical skeletal properties changed diachronically during the first millennium BC; 2) understanding how the same features are distributed in the social strata of the population within two main periods of the first millennium BC: the Orientalizing-Archaic (O-A: 800-500 BC) and the Hellenistic (ELL: 400-100 BC). In this report, the results for the level of asymmetry of the humeral mechanical strength (HUMBA) in males will be summarized.

The level of social stratification and complexity achieved by the Vestini people of Abruzzo has been discussed elsewhere in this volume (S. 727-748). For the sake of brevity, we will summarize the theoretical expectations on social stratification and military organization relevant to this part of the study. The »aristocratic warrior hero« – boasting courage, warlike prowess, and a prominent social role – was one of the ideological pillars of Italian Iron Age societies in the Orientalizing-Archaic period. Accordingly, weapons such as spears, daggers, and short swords are ubiquitous in male burial assemblages at this time. Wear studies, as well as the high level of humeral asymmetry of the Alfedena Samnite sample, suggest that those weapons were used in combat or training (Tagliamonte 1999; Sparacello et al. 2011). In the later Hellenistic period, weapons virtually disappear from the grave goods assemblages. Yet, this is the period in which Samnites waged large-scale warfare; large-scale expansionistic warfare is one of the hallmarks of statehood, and implies the development of the administrative ability to incorporate enemy villages into the sociopolitical organization (Warburton 2006).

Thus, it appears that a sociopolitical shift happened among Vestini during the first millennium BC. This shift is expected to have an influence on the distribution of the skeletal hallmarks of warfare activities in the buried population. In fact, there is a difference in »who wages war« in chiefdom and state societies. In simpler forms of organizations such as chiefdoms, conflict usually flares up between small political units, on the ground of fighting for revenge, need for booty or for social and political prestige (Claessen 2006). At this stage, an elite army is present: conflict pertains to aristocratic warrior leaders and their retinue. In fact, only wealthy individuals could afford to maintain the expensive gear for waging war (Otterbein 2004). In the population, the skeletal hallmarks of warfare activity (due to weapon training and actual involvement in close-quarter combat) are expected to be more common in the higher social strata. When a larger army of conscripts is formed, professional military personnel is drawn from both the upper and lower classes. The upper class provides officers and elite forces, placed in command of a massed infantry of conscripts drawn from the lower class (Otterbein 2004). Being a »warrior« is no more an expression of male prowess, and weapons are not a symbol of status anymore. By jointly analyzing indicators of weapon use and grave good

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richness, we will test whether in the Orientalizing-Archaic period the higher social strata of the population constituted the warring force.

METHODS

Bone mechanical properties

The method used in this research to obtain information about the levels and types of past physical activity is called cross-sectional geometry (CSG). This biomechanical method is based on the widely accepted notion that bone tissue responds dynamically to optimize itself to its loading environment. According to what is loosely referred to as »Wolff's Law«, bone tissue is deposited in the shaft's cross-section where mechanical loads require it to prevent strains in excess of the elastic limit; below a certain strain threshold, the bone tissue is resorpted (for review see Pearson/Lieberman 2004; Ruff/Holt/Trinkaus 2006). The shape and dimension of the bone cross-section, after standardization to take into account body size, is therefore informative about the mechanical loads applied *in vivo*; the engineering-derived beam model can be therefore applied in order to obtain a quantitative measure of the activity-induced mechanical competence of long bones. CSG variables are therefore informative about the general level of mechanical loads induced by subsistence activities in the upper and lower limb, mobility levels, and preferential use of one arm (HUMBA). In this research, the SolidCSG method was used to determine the mechanical competence of long bones (Sparacello/Pearson 2010).

The variable HUMBA is particularly important because it is correlated with the repetitive and intensive use of the dominant arm in unimanual activities. Modern industrialized people show asymmetry values around 10 % because of the physiological handedness in a context of absence of stressful activities, either unimanual or bimanual. High lateralization in modern samples is due to practice of sports involving asymmetric use of the upper limb (e.g. tennis and various throwing activities) (Trinkaus/Churchill/Ruff 1994; Churchill/Weaver/Niewoehner 1996; Churchill et al. 2000; Shaw/Stock 2009). In bioarchaeological research, high asymmetry has been associated to spear throwing (Churchill/Weaver/Niewoehner 1996; Churchill et al. 2000), use of small hatchets (Marchi et al. 2006; Marchi/Sparacello/Shaw 2011; Sparacello/Marchi 2008), and sword use (Rhodes/Knüssel 2005; Sparacello et al. 2011). It is important to notice that, in absence of specific activities influencing the preferential use of one arm, the level of asymmetry of agricultural groups is still around 10 %, although the level of mechanical strength (or »robusticity«) is much higher than in modern sedentary samples. Previous research on a Samnite skeletal series belonging to the necropolis of Alfedena (Abruzzo, 550-400 BC) proposed that the remarkable level of humeral bilateral asymmetry should be attributed to the frequent use of weapons, in particular swords and spears (Sparacello et al. 2011). In this research we will follow the same rationale. In addition, we will attempt to understand which social strata of the population were using weapons throughout the first millennium BC, in order to make inferences about social and military organization.

Status analysis

The Status Index is here calculated following the formulae discussed in Bernabei/Bondioli/Guidi 1995. Grave goods were divided in simple functional categories (e.g. weapons, grilling equipment, banqueting

equipment, food containers), and an »index of status« was calculated for each category; the index depends on the frequency of the category in the whole burial assemblage, and on the amount of grave goods that are present in each grave that contains the category at hand. The Status Index for each burial is the sum of the index for each category present in the burial, times its numerical consistency.

It should be noted that this is a simplistic way to determine the »richness« of a burial, because the method does not take into account the intrinsic value of the goods, i. e. whether a particular item is finely crafted or imported. A significant part of information is therefore overlooked, and a typological analysis of each grave good would certainly give a more accurate depiction of the level of prestige associated with a burial. However, this kind of study has not been performed yet for most of the burials included in this research. Therefore, in order to maximize sample size, in this preliminary phase the simplest type of analysis was performed. Future analyses and interpretations will certainly benefit from a more rigorous assessment of the quality of the items used for status determination.

Another caveat to take into account is the fact that it is often not possible to translate the richness (or poor-ness) of a burial – however calculated – into an assessment of the role of an individual in its society (S. 727-730). Funerary symbolism may be misleading due to the complex factors that mediate between status in life and treatment in death (Morris 1992; Brown 1995). This is particularly true for the Orientalizing-Archaic period: ancient literary sources evidence how individuals with high social status may be buried with rather poor assemblages in particular situations (A. D’Andrea, personal communication). The results summarized below should be therefore taken with caution and further verified.

RESULTS

Figure 1 shows the diachronic change in HUMBA in the Bazzano necropolis. O-A males ($n = 73$) are significantly more lateralized ($p < 0.01$, post-hoc Tukey’s HSD test) than ELL males ($n = 74$). No difference is present in females between the two periods. In the O-A, sexual dimorphism is prominent, with males significantly more lateralized than females ($p < 0.01$, post-hoc Tukey’s HSD test; female $n = 30$); no difference between sexes is present in the ELL period (female $n = 44$). Results obtained for the sample including all necropoleis are similar to the ones obtained for the Bazzano necropolis (results not shown here).

Figure 2 shows a scatterplot of HUMBA against the Status Index »SI« (males only). A weak, but significant positive correlation is present between the two values ($p < 0.05$ for Bazzano, $n = 73$; $p < 0.01$ for the sample including all necropoleis, $n = 207$): individuals with higher Status Index tend to have on average higher HUMBA. The correlation is not present in O-A females, or in ELL individuals (both sexes, results not shown here).

In order to further verify the above result through an ANOVA, the numerical variable »Status Index« was categorized. Looking at the histogram of the Status Index variable for all O-A necropoleis (males only; **fig. 3**) it is possible to appreciate two distinct groups with similar frequencies: a great number of individuals have a Status Index below 45, and a lesser portion show higher status. We can therefore place a cutoff at 45: burials that overpass this value are significantly richer than average, as suggested from their rarity.

Results of the ANOVA confirm that richer burials tend to show higher HUMBA (**fig. 4**). The two-sample T-test is significant ($p < 0.001$) for the Bazzano necropolis, where 66 individuals have a SI below 45, and only seven above the cutoff. It could be pointed out how the sample size is small when considering Bazzano only. However, the trend appears robust because it is shown also in the more inclusive sample ($p < 0.01$), where 168 individuals have a SI below 45, and 39 are above the cutoff.

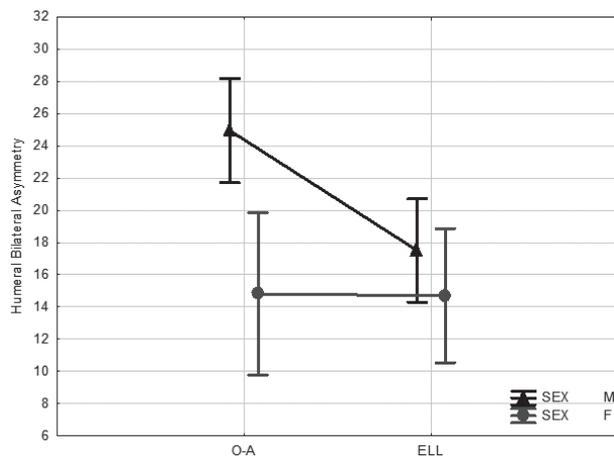


Fig. 1 Plot of the 2-ways ANOVA for humeral bilateral asymmetry, with »period« and »sex« as categorical factors. Vertical bars denote 95 % Confidence Intervals.

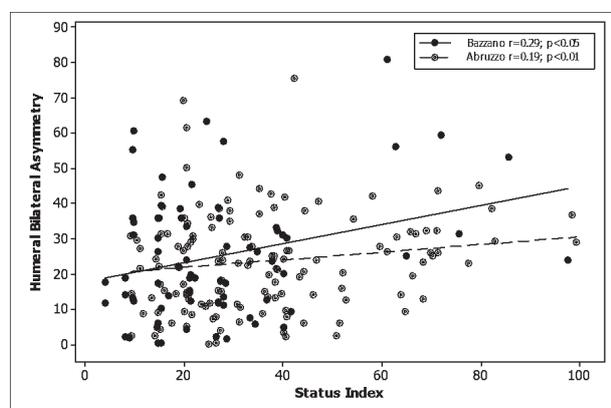


Fig. 2 Scatterplot of humeral bilateral asymmetry versus Status Index. Regression lines are shown for the Bazzano necropolis (continuous line) and the sample including all necropoleis (dotted line).

DISCUSSION AND CONCLUSIONS

Results of this preliminary analysis show a statistically significant decrease in humeral bilateral asymmetry when comparing Bazzano adult males from the Orientalizing-Archaic period with their Hellenistic counterpart. The same trend is not present in females, which are generally less lateralized. This results in a significant level of sexual dimorphism in the O-A, while ELL people are not dimorphic for this variable. High levels of HUMBA are associated with *in vivo* frequent and stressful use of unimanual tools, which most likely consist in weapons such as daggers and spears for those Iron Age people (Sparacello et al. 2011). High levels of HUMBA are found in the period on which the ideology was based on male warlike prowess; it is therefore reasonable to infer that weapon training constituted indeed a common activity, and was probably practiced from a young age, when the bone is most responsive to loading (Pearson/Liebermann 2004; Ruff/Holt/Trinkaus 2006). Interestingly, the sharp decrease in male HUMBA corresponds to the period on which people of Oscan ethnicity such as the Vestini were engaged in expansionistic warfare against Rome (the three Samnite Wars, the Pyrric War, and the later Social Wars). Future research will discuss possible explanations for this result, for example a lesser emphasis on training (especially earlier in life) with the formation of a standing army, or the possibility that soldiers were

buried close to battlefields and therefore are not included in the necropoleis assemblages.

Another purpose of this research is exploring the distribution of the level of HUMBA between the emerging social classes within each period. Theoretical expectations on social organization in a pre-state society predict that, in the O-A, warfare was waged by aristocratic warriors and their retinues. Our results are compatible with those expectations: a weak but significant correlation is present between HUMBA and SI, used as a proxy for the social status of the individual. After categorization of the continuous variable SI, the group including the richest burials shows significantly higher asymmetry than the rest of the sample. Results therefore indicate that average HUMBA varies in the skeletal series respect to the stratification inferred from grave goods analysis in a way that is theoretically coherent with the presence of an aristocratic army. Interestingly, the same correlation is not present in the Hellenistic period, when a conscript army is predicted to have formed.

Numerous caveats need to be taken into account when making inferences on past social organization based on bioarchaeological data. In this research we used a simplistic way to determine the richness of the burial, the Status Index, and we calculated it using basic functional categories. Despite its name, a direct

correspondence of the Status Index to the social role of the individual cannot be proven. This is especially true for societies that probably had a different and less polarized concept of richness.

However, this analysis provides empirical evidence that a highly informative skeletal feature such as HUMBA is correlated with a measure of grave goods richness, and proposes a possible interpretation based on the available body of theory on Iron Age sociopolitical organization. The conclusions should be considered with caution, and are meant to stimulate debate, and further analyses and interpretations.

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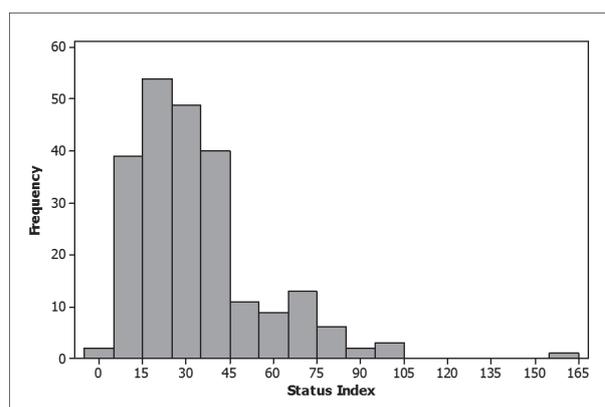


Fig. 3 Histogram of Status Index for the Orientalizing-Archaic Period, males only, all necropoleis.

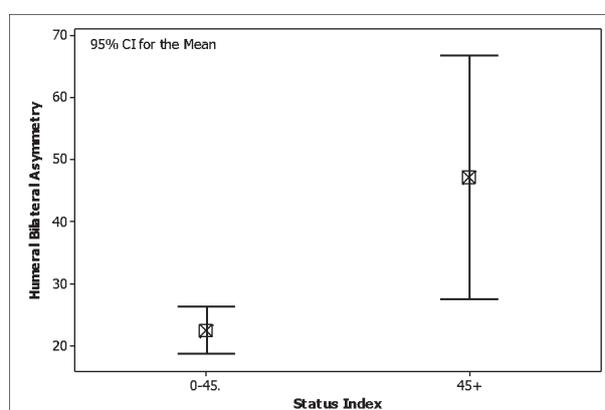


Fig. 4 Interval Plot of humeral bilateral asymmetry for categorized Status Index. Vertical bars denote 95 % Confidence Intervals.

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