A Transition from Tradition: Employing TA3 and Traditional Age & Sex Estimation Methods to Study Paleodemography in Umm an-Nar Arabia

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Introduction

Figure 1. Tombs Unar 1 (top) and Unar 2 (bottom), post-excavation.

Tombs Unar 1 and Unar 2 (**Figure 1**), located at the Shimal Necropolis in the Emirate of Ras al-Khaimah, United Arab Emirates (**Figure 2**), date to the Umm an-Nar period (2700-2000 BCE) in southeastern Arabia. The Umm an-Nar saw increasing sedentism due to the emergence of oasis agriculture, and this transition from an earlier, more nomadic lifestyle to semi-sedentary settlements brought about changes in monument building and mortuary practices (Williams & Gregoricka 2019).

Unar 2 may have been used throughout the third millennium and contained roughly 400 individuals, while Unar 1 was used in the latter half of the millennium and held about 200 individuals (Ullinger et al. 2020). These remains underwent extensive cremation and commingling, which is not uncommon for communal tombs of this period (Williams and Gregoricka 2019). These practices certainly had an impact on the preservation and fragmentation of these skeletal assemblages.

Transition Analysis 3 (TA3) has enormous potential for the study of commingled skeletal material. Previous demographic analyses on Unar 1 and Unar 2 by Blau (1998) placed the majority of individuals in a generalized “adult” category using dental eruption. We employed TA3, as well as traditional age and sex estimation methods, to more specifically assess the demography of those interred in Unar 1 and 2.

Figure 2. Map of southeastern Arabia featuring Shimal and nearby Umm an-Nar sites.

Hypotheses

1. Between these two tombs, we hypothesized that Unar 2 would likely have more older-aged individuals (OAI; 50+), given its potential use earlier in the Umm an-Nar period, and that fewer OAI were interred within Unar 1. This is because of the enhanced nutritional and environmental stressors expected due to agricultural intensification and increasing aridity towards the end of the third millennium.
2. For both tombs, we hypothesized that we would identify more OAI compared to previous analyses (Blau 1998), given that Transition Analysis is more precise than traditional methods for adult age estimation and can more successfully identify older age categories (Boldsen et al. 2002; Getz 2020).

Materials & Methods

Skeletal remains from Unar 1 and 2 were highly fragmented, commingled, and cremated to varying degrees, resulting in variable preservation levels from fragment to fragment.

We chose to employ both traditional age/sex estimation methods and Transition Analysis 3 (TA3) (**Figure 3)** to better understand the adult age demography of those living in the Umm an-Nar period**:**

- AGE: For traditional methods, we used a modified Suchey-Brooks (SB; 1990) system for all pubic symphyses with at least one-third of the symphyseal face remaining, that included Hartnett (2010) Phase 7 for OAI.
- SEX: Pubic symphyses with at least one feature used in the Phenice (1969) Method were also examined for sex estimation.

TA3 allows for the study of typically unused bony fragments to estimate age and operates under the logic of traditional adult age estimation – that there is an “invariant series of senescent stages” for individual features on bone, and we can estimate the timing of these transitions (DeWitte, pers. comm., 2021). We selected the pubic symphysis, the proximal and distal humerus, and the proximal femur for analysis. Fragments were included only if two features were visible and preserved enough for scoring given the TA3 Trait Scoring Manual (2021) (**Figure 4**). Feature scores were put into the TA3 software system, and we documented the estimated age at death (**Table 1**) as well as the estimated age range for each individual.

Figure 3. Authors AB and HJ score proximal femora using TA3.

Statistically, Fisher's Exact (FE) tests were employed to test significance in both SB and TA3 results.

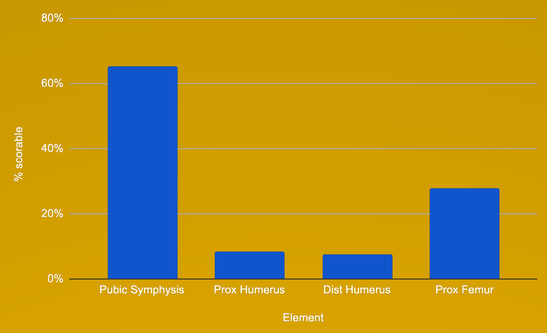

Figure 4: Percent scorable fragments

Figure 5. Seriated SB / Hartnett Phases
From L to R: Phase 1, 3, 5, 7
(billowing difficult to see in photos of cremated remains)
TA3 Estimates: 22.7, 27.9, 33.1, 60 years

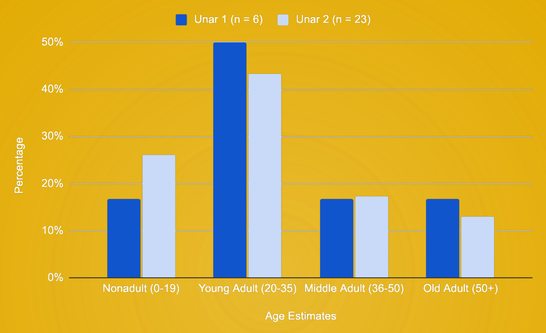

Figure 6. Suchey Brooks Age Estimates (Right side)

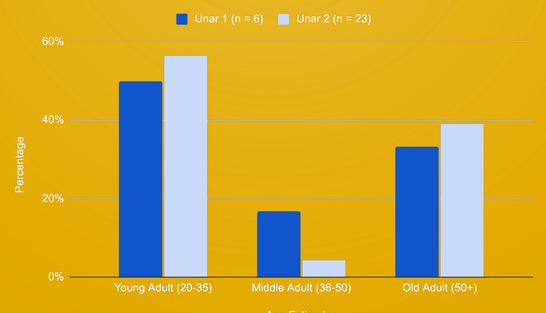

Figure 7. Pubic Symphysis by TA3 Age Estimate (Right side)

Figure 8. Femora scored with TA3;
Left: exostoses absent, Right: exostoses present

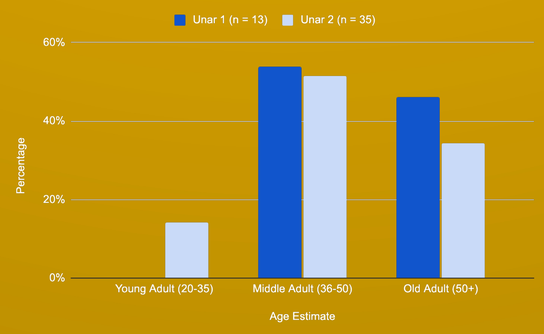

Figure 9. Femora by TA3 Age Estimate (Right side)

Results

Table 1: Mean TA3 age estimates by bone fragment.

Element	Scorable n	Total n	Mean Age at Death (TA3)
Pubic Symphysis	51	78	40.398 years
Proximal Humerus	18	214	47.824 years
Distal Humerus	67	903	42.733 years
Proximal Femur	194	697	47.799 years

Discussion

PUBIC SYMPHYSIS (**Figure 5**): TA3 appears to tackle concerns over age mimicry in SB phase scoring; the mean age estimate using TA3 was about 10 years higher than in SB (**Figures 6-7**). However, the actual age distribution between the two was not statistically significant, except for Unar 2 right sides (Fisher’s Exact: p=0.008, df=2). While we cannot be sure whether age mimicry between the TA3 reference sample and our fragments occurred, the age estimate distribution does not directly reflect the SB reference sample. There were also significantly more female OAI in Unar 2 than males (aged with TA3) (FE: p=0.000, df=3), although overall, it appears that there was no sex-based differences in interment between tombs Unar 1 and 2 (p>0.05 between tombs).

HUMERUS: While the proximal and distal humerus appeared to be a promising option for age estimation, the low number of scorable features (3 for proximal, 2 for distal) and reliance on presence/absence scoring meant the specificity of age estimation was limited in a fragmented collection. The majority of individual age estimates were technically middle-aged (35-50), but ranges typically stretched from nonadult or young adult (<25) to the old adult category (50+). We elected to not include humeral age estimates in statistical testing but recorded their mean age-at-death estimates.

FEMUR (**Figures 8-9**): There were no significant differences between Unar 1 and 2 femora age distributions (FE: p=0.469, df=2, for R sides). This does not align with our hypotheses, but the small sample size (n=13) for Unar 1 may be the cause.

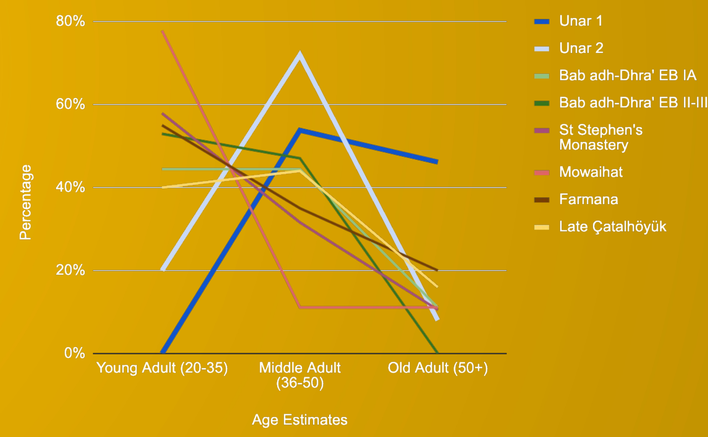

Figure 10. Age distributions in tombs Unar 1 & 2 by TA3 femora estimates, compared to other archaeological sites in the Neat East.

COMPARATIVE: For the pubic symphysis, there were no significant differences between SB estimated age distributions and other archaeological sites in Arabia and the Near East (FE: p>0.05 for 6 sites, df=2). Overall, using TA3, Unar 1 was similar to the comparative sites, but Unar 2 had several statistically significant differences (more OAI). The femur provided several significant findings. TA3 age distributions (**Figure 9**) were significantly different than most comparative sites (**Figure 10**) for both Unar 1 (FE: p<0.05 for 7 sites, df=2) and Unar 2 (FE: p<0.05 for 4 sites, df=2), with more individuals in the old age category.

Conclusions

This study highlighted the potential applications of TA3 for commingled, fragmented collections. Previously, reconstructing a statistically-based age distribution for individual features, and therefore for individuals, was restricted to few, often fragile, bony elements. TA3 provides a framework for combining these data; for the distant past, this is highly valuable.

Future directions could include a study of non-metric traits on the proximal femur and humerus (e.g., septal apertures) to examine relatedness within and between Unar 1 & 2.

Acknowledgments

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