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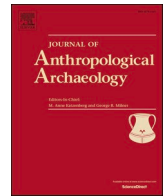
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# Daily life in a New Kingdom fortress town in Nubia: A reexamination of physical activity at Tombos

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## ABSTRACT

Previous analysis of skeletal indicators of physical activity suggested that the population at Tombos, an Egyptian colonial town in Nubia, may have benefited from an imperial framework through occupations that were not physically demanding. With more than ten years of continued excavations, coupled with further biomolecular testing, we reanalyze enthesal changes at Tombos. We compare enthesal changes between the three areas of cemetery, which house drastically different tomb types. Additionally, we also assess burial position (Egyptian, Nubian) and we incorporate the results of previous strontium isotope analysis to better understand the mortuary, socioeconomic, and occupational landscapes of this colonial space.

Our findings suggest that pyramid tombs, once thought to be the final resting place of the most elite, may have also included low-status high-labor staff. We support this argument with comparative data from Egypt and Nubia. Other cemetery areas seem to include individuals whose activity levels were more moderate. Nubian-style burials have relatively low enthesal scores, suggesting that they may have had low-labor occupations during the Egyptian colonial period, despite possibly identifying as Nubian. Lastly, locals and non-locals appear to have similar levels of physical activity, suggesting that migration status was also neither an advantage nor disadvantage in such a multicultural community. This study speaks to the importance of reanalyzing data; with continued excavations, dating, and biomolecular analysis, interpretations of lived experience in the past can be completely altered.

## 1. Introduction

Repetitive bodily movements are an imperative part of our lived experience and daily lives. This can encompass occupational labor, but also leisure, household, and sport activities. Quotidian actions are a critical component to identity formation and maintenance, but can also reinforce or contradict and, eventually, subtly change cultural systems, values, and norms (Bourdieu, 1977; Giddens, 1984). We can study these quotidian experiences using a bioarchaeological approach, as the skeletal frame adapts to physical activity during the life course (Schrader and Torres Rouff 2021). More specifically, we can examine osteological evidence of muscle and ligament attachment, otherwise known as enthesal changes.

Here, we analyze physical activity via enthesal changes at the site of Tombos, which is situated at the Third Cataract of the Nile (Fig. 1) and was occupied from the 18th Dynasty of the New Kingdom through the

Late period (c. 1400–650 BCE). Shortly after the Egyptian conquest of Nubia, Tombos was constructed by the Egyptians in what was Nubian territory to facilitate colonial control (Smith, 2021; Valbelle, 2021). This was a very intentional strategy designed to encourage coexistence with the local population and differed from earlier attempts at colonization of Nubia (Smith, 2003). Previous archaeological and bioarchaeological research has suggested that Nubians and Egyptians lived together in this colonial space and their social and biological lives became entangled (Buzon et al., 2024; Smith, 2020). Osteological evidence suggests the population was relatively healthy, with limited indicators of physiological stress present on skeletal remains. Additionally, rates of interpersonal violence seem to be particularly low, when compared to earlier Nubian communities, suggesting a relatively peaceful environment (Buzon and Richman, 2007; Schrader and Buzon, 2017).

Building off of these interpretations and robust archaeological context, Schrader (2012) examined enthesal changes at Tombos. This

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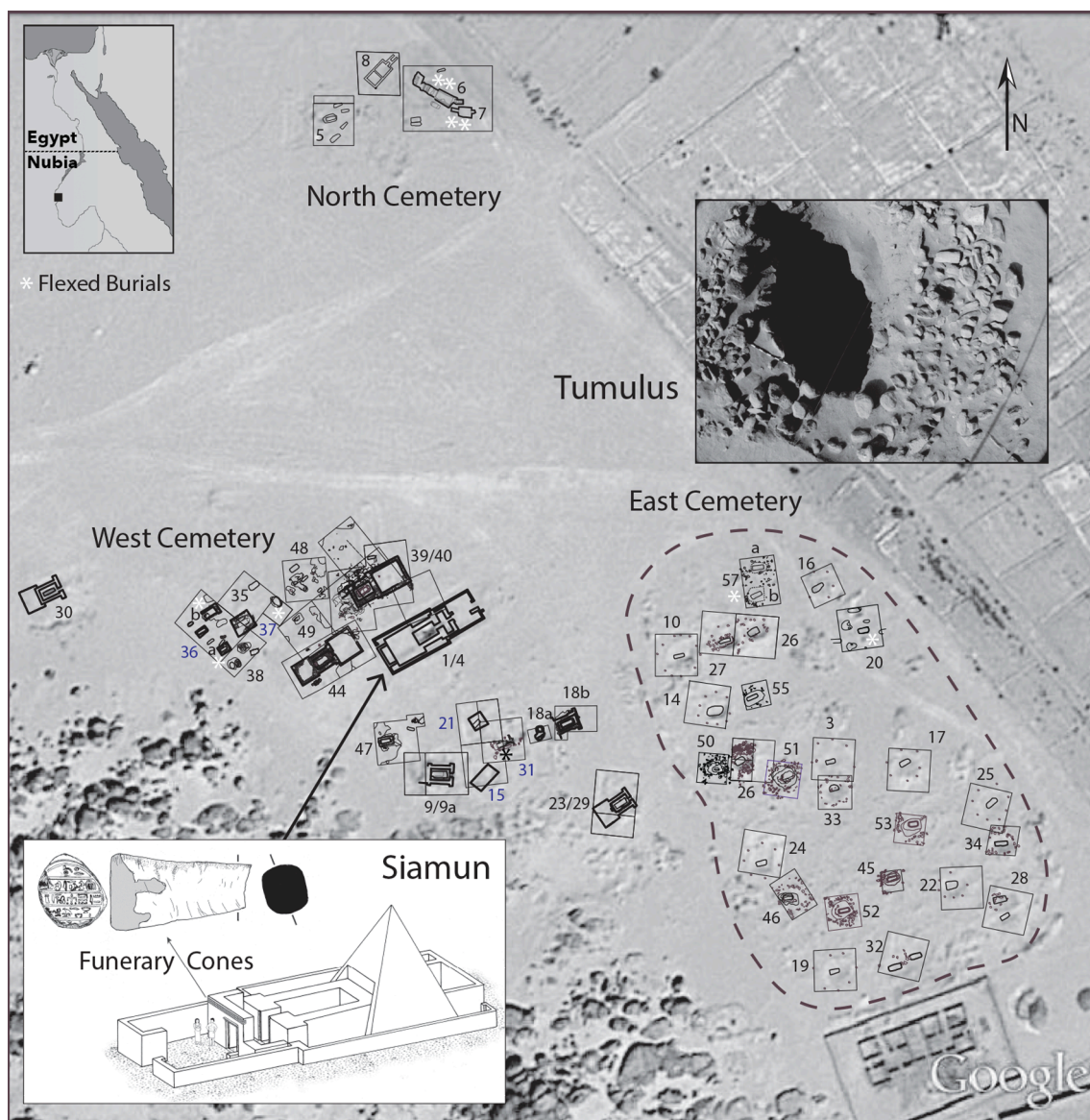
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study found particularly low enthesal changes scores, suggesting a quotidian life that was not particularly physically demanding. Schrader suggested that the population of Tombos may have been composed of minor officials, professionals, craftspeople, and scribes. This study shed new light on the lived experience of Egyptians, Nubians, and Egypto-Nubians that inhabited Tombos and was seemingly congruent with the Egyptian co-existence strategy during the New Kingdom. However, after a decade of continued excavation, analysis, and additional refinement of the chronology at Tombos, the inclusion of more recently excavated remains and a reanalysis of the earlier skeletal material can provide new insights into the social dynamics of the community during the colonial and subsequent periods.

The greater representation of tomb types and areas within the cemetery from expanded excavation allows for a more robust examination of status and identity. More specifically, we compare Egyptian-style elite pyramid complex burials (including the pyramid itself, as well as the chapel and shaft), with less elite chamber and pit tombs; Nubian-style tumulus burials are also examined. Tumuli are mounded structures, often with a irregular stone circles superstructure, and a burial shaft with chamber niche substructure. Social status might be indicated by

association with tomb type, but also burial practice, in particular the provision of grave goods and burial containers in the form of wooden or ceramic coffins, reed mat work, or wrapping in linen with no container. The presence of several flexed burials of women suggests a different social status and/or identity for these individuals. Although flexed burials are common in Egypt through the First Intermediate Period (c. 2040 BCE), they largely disappear afterwards in New Kingdom contexts. For example, none are attested from the large New Kingdom cemetery at Gurob and only two were uncovered in recent excavations at Amarna in the extensive areas excavated (Stevens, 2018; Brunton and Englebach, 1927; Dolling, 2007; Stevens, et al., 2013; Grajetzki, 2022). The presence of this burial position at Tombos thus points towards a deliberate signaling of a Kushite ethnic identity, which of course could also have implications for status (Smith, 2003). With this broader analysis of a more representative set of enthesal data, we aim to assess variation in labor and lived experience at Tombos. Who was buried in the various tomb types/cemetery areas and are they segregated by social group? Are migrants, identified by strontium isotope analysis, subject to increase workload? Did individuals who potentially identified as Nubian, indicated by a traditional Kushite-style flexed burial position (Edwards,



**Fig. 1.** Plan of Tombos Cemetery (Highlighting the three main cemetery areas: North, West, and East; Illustrating examples of tumulus and pyramid burial structures).



2004; Geus, 1991; Kendall, 1997; Reisner, 1923), engage in more physically strenuous activities than individuals buried according to Egyptian traditions? Through an integrated contextual analysis of enthesal data and mortuary practices, the goal of this study is to more fully explore variability in status and community composition.

## 2. Materials and methods

### 2.1. Materials

All skeletal remains analyzed originate from Tombos and are categorized into different types, including chamber, pyramid/chapel/shaft, pit, and tumulus graves. These different tomb types at Tombos, along with grave goods, such as burial containers, artifacts, and body position, can provide important data about individuals' social position in the community (Fig. 1). The cemetery can be divided into three components, Northern, Western, and Eastern.

In the Northern cemetery area, there are underground chamber tombs consisting of large mudbrick vaulted chambers with no evidence of superstructures (Fig. 2). They are similar to tombs found in Egypt and Nubia (Brunton and Engelbach, 1927; Säve-Soderbergh and Troy, 1991). In line with ancient Egyptian burial practice, they were used as

large communal structures designed for multiple individuals (Smith, 2003). These structures would have been used, reopened, and reused as necessary, until full. Artifactual evidence suggest these tombs were used during the 18th, 19th, and 20th Egyptian Dynasties (Buzon et al., 2016). Drawing on correlates from Egypt, Smith and Buzon, while acknowledging the complexity of inferring status in archaeological remains, have argued that these chamber tombs would have been used by a middle-class, defined here as consisting of lower-level officials, scribes, functionaries, and perhaps members of their households (Smith, 2003; Buzon et al., 2016). There were also a few pit tombs, small single individual inhumations measuring less than 1x2m.

The Western area of the cemetery is a field of pyramids, chapel tombs, shafts without surviving superstructures, and simple pits. These mud brick monuments are associated with the Egyptian elite, titled officials with important portfolios. The largest pyramid complex (Unit 1/4) belonged to Siamun, the Scribe Reckoner of the Gold of Kush, an important official below the viceroy and military commander of the colony (Smith and Buzon, 2017). This pyramid included a large chapel courtyard and was decorated with funerary cones, an unusual treatment associated with the southern Egyptian political and religious center at Thebes (Ryan, 1988; Smith, 2003; Buzon et al., 2016). Several communal tombs in this area of the cemetery were chapel, shaft, or

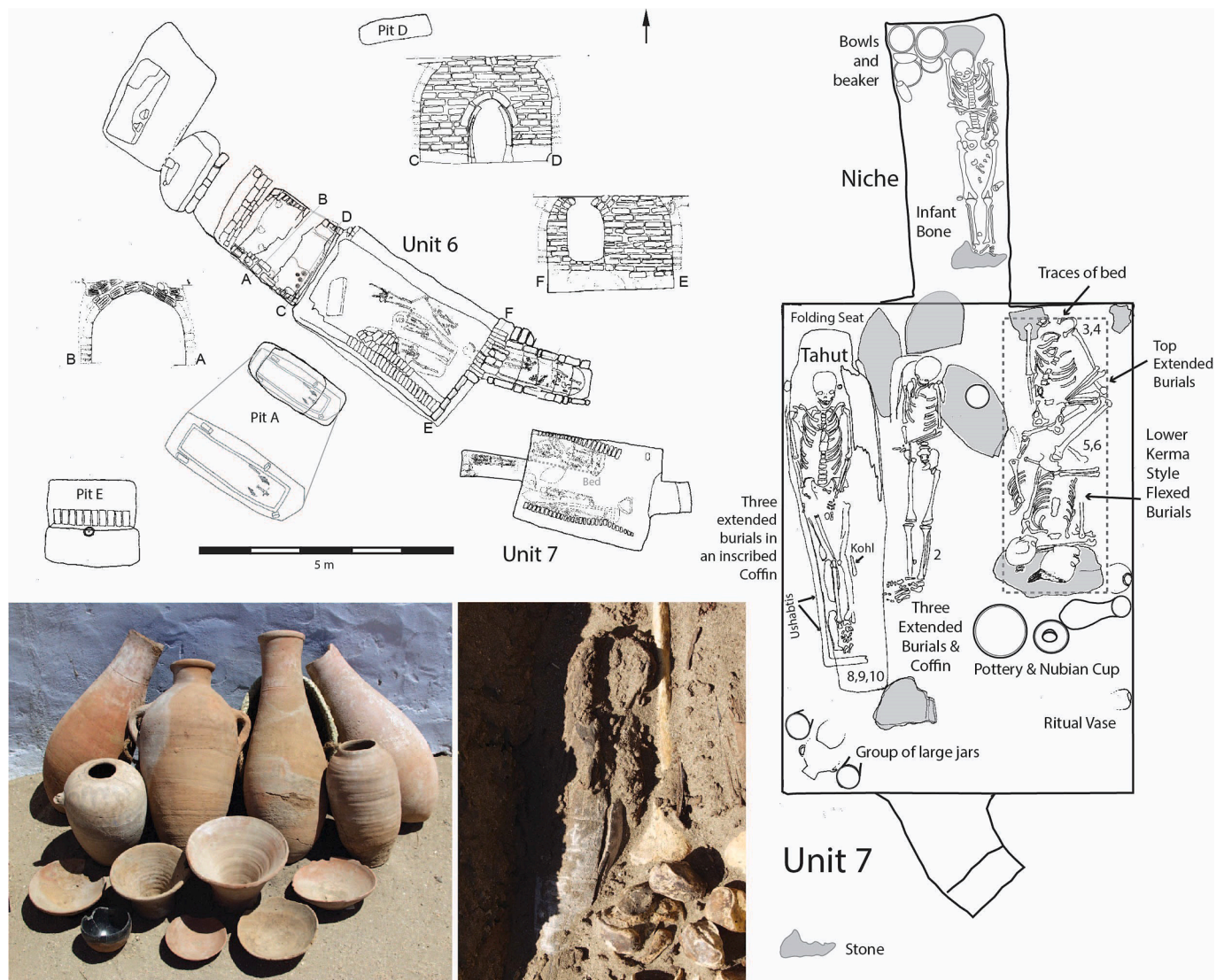
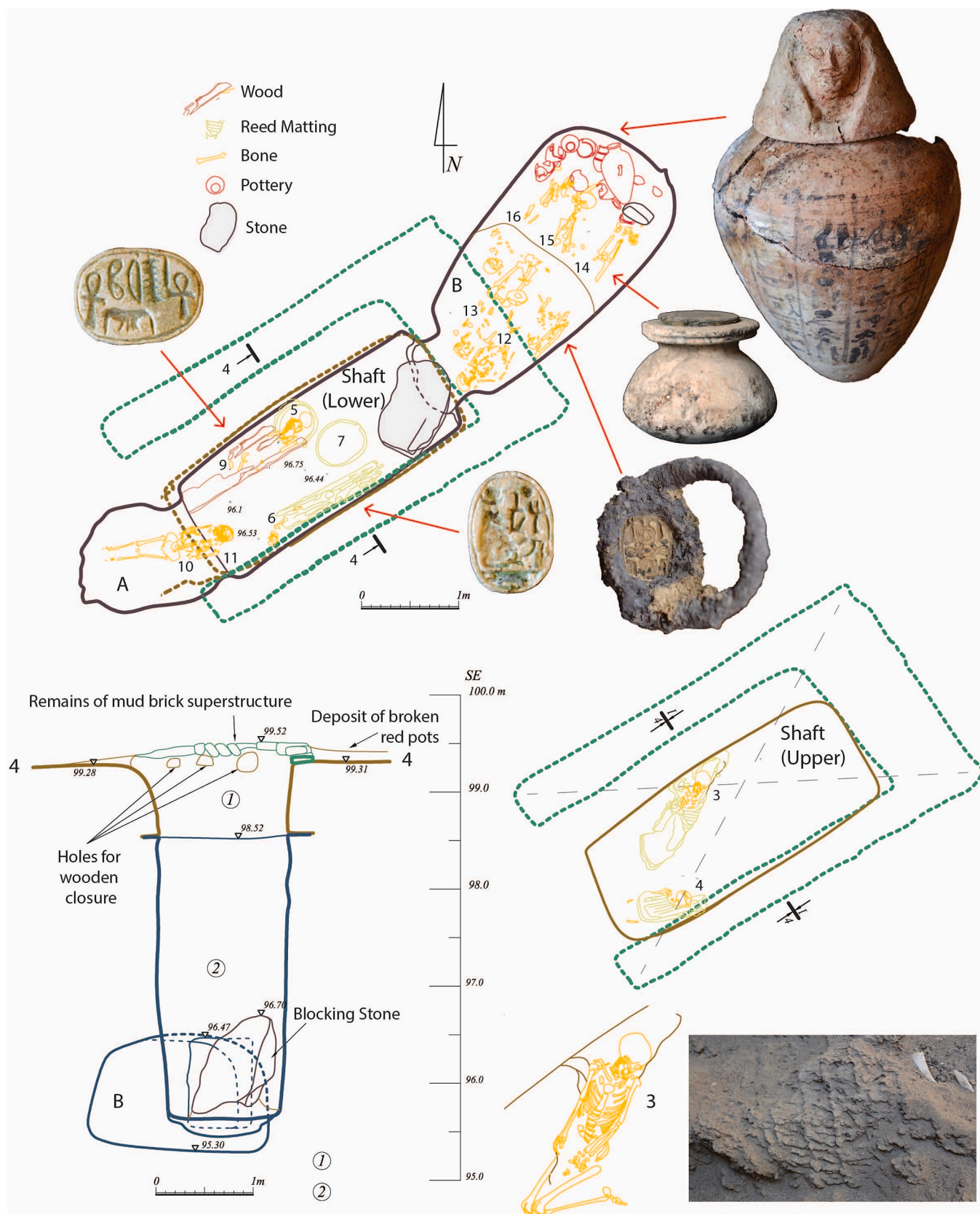
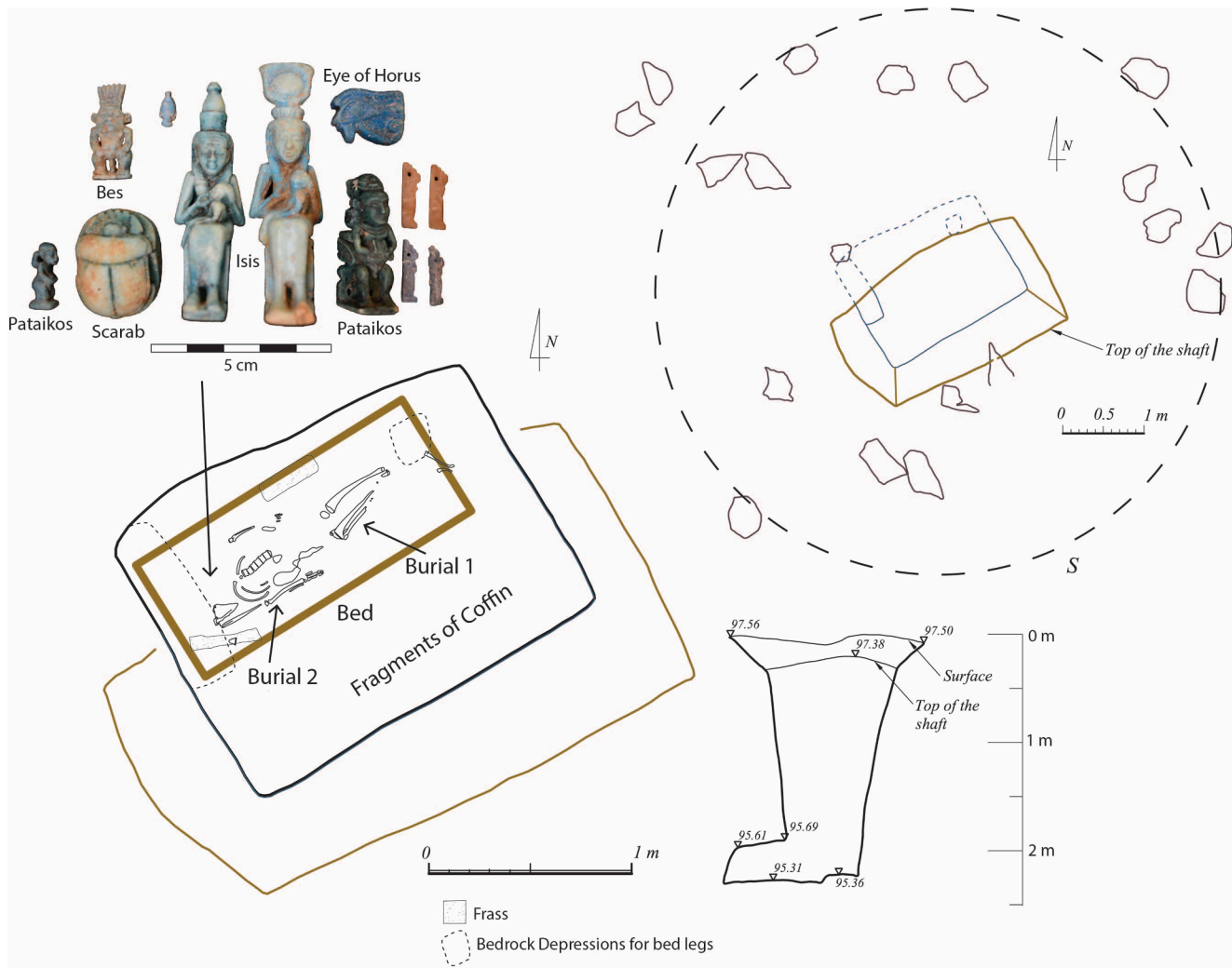


Fig. 2. Units 6 and 7 in the Northern Cemetery, with detail of burials in the Unit 7 tomb. Photos of pottery from the tomb, including a Nubian style blacktopped redware bowl and the Ushabti of Tahut *in situ* (prepared by Smith).





**Fig. 3.** Unit 36, shaft 2 in the Western Cemetery showing burials in the shaft and main chamber. Photos of scarabs from modest burials and one of four canopic jars dedicated to the Lector Priest Hapi, an Egyptian alabaster cosmetic vessel, and silver mounted scarab ring from the main burial chamber (prepared by Smith).



**Fig. 4.** Unit 27 in the Eastern Cemetery showing the scattered remains of the tumulus and its shaft and side chamber burials. Photo of amulets of Egyptian deities from the tomb, including smaller amulets of the Eye of Horus, Bes, and Pataikos likely associated with Burial 2, and a four high quality amulets likely associated with Burial 1, including a large scarab, two different versions of Isis, and an elaborate Pataikos with a goddess behind him (prepared by Smith).

chamber tombs that were fully excavated representing a range of preservation; the largest tombs had shafts leading to underground complexes that were quite deep (7 m) and suffered due to moisture and chamber collapse (Fig. 3). The burials in the pits arrayed around these larger tombs were comparatively very well preserved and usually undisturbed. Most contained just one individual. These tombs were constructed in both the New Kingdom and into the Late period (1069–650 BCE). Burials in the New Kingdom began in the 18th dynasty, but in some cases, there is also evidence within the same tomb of continuing or re-use extending into the early Late period.

The use of wooden coffins was widespread in both the northern and western cemeteries along with a small number of ceramic coffins in a distinctive local style mimicking a wooden coffin, contrasting with the “slipper” type found in contemporary Egypt and the Levant (Cotelle-Michel, 2004). In the New Kingdom, coffins were common from the elite through those of more modest social position. However, they remained somewhat costly, particularly when decorated, and can thus be used as an indicator of status, in particular contrasting with the poorest individuals (Smith, 1992). At least five examples of burials bundled in reed matting, a less expensive alternative to coffins, were found in two tombs in the western cemetery, though disturbance and the generally poor preservation of organic materials raises the likelihood that more once existed. Previous research has suggested that these burials in coarse reed containers were associated with lower socioeconomic status individuals,

who could not afford a coffin, although the use of finer reed matting is attested in more prosperous burials (Smith, 1992; Stevens, 2018). Better preserved tombs included a variety of grave goods, including elite items such as canopic jars (evidence of evisceration in the mummification process), elaborately decorated coffins, ushabtis (specialized funerary figurines), and jewelry. Some burials have no associated grave goods; however, interpretation of a lack of grave goods is complicated by looting and reburial events, although this is not an issue for the many burials that were found intact.

The Eastern area of the cemetery at Tombos contains Nubian style tumuli (Fig. 4). These tombs contained 1–3 individuals. Evidence of both burial beds and coffins is present along with jewelry, including a few graves with many items, such as ceramic vessels, and jewelry, including amulets (Buzon and Smith, 2023). Most tumuli date to the early Late period and are thought to reflect a thriving post-colonial segment of the former colonial community that signaled a Nubian identity through the use of a localized version of the traditional indigenous tomb superstructure.

## 2.2. Methods

Enthesal changes are points of muscle or ligament attachment to bone. As the body is used more frequently and more intensively, the muscles and ligaments require a stronger mode of attachment. This can

**Table 1**  
List of enthesal changes analyzed.

Enthesis	Attachment	Biomechanical Function
M. supraspinatus/ M. infraspinatus	Greater tubercle of humerus	Arm abduction and rotation
M. subscapularis	Lesser tubercle of humerus	Arm rotation
M. teres minor	Greater tubercle of humerus	Arm rotation, adduction, extension
Common extensors origin	Lateral epicondyle of humerus	Wrist and finger abduction, adduction, extension
Common flexors origin	Medial epicondyle of humerus	Forearm pronation; wrist flexion and abduction; finger flexion
M. triceps brachii	Olecranon process of ulna	Forearm extension
M. brachialis	Coronoid process of ulna	Elbow flexion
M. biceps brachii	Radial tuberosity	Elbow flexion and forearm supination
M. brachioradialis	Radial styloid process	Elbow flexion
M. semimembranosus/ M. semitendinosus/ M. biceps femoris	Ischial tuberosity of os coxae	Hip extension; knee flexion and lateral rotation
M. gluteus medius	Greater trochanter of femur (anterior aspect)	Hip abduction and medial rotation
M. gluteus minimus	Greater trochanter of femur (lateral aspect)	Hip abduction and medial rotation
M. iliopsoas	Lesser trochanter of femur	Hip flexion
M. gastrocnemius	Femoral condyles	Foot and knee flexion
M. quadratus femoris	Intertrochanteric crest of femur	Lateral rotation and adduction of thigh
Patellar ligament	Tibial tuberosity	Leg flexion and extension
M. popliteus	Medial surface of proximal tibia	Knee rotation and flexion

result in distinct crests and ridges on the bone at the point of attachment (Villotte and Knüsel, 2013). It is important to note that enthesal changes cannot address or recreate specific activities, but rather, speak to broad levels of physical activity and strain. Enthesal changes have been thoroughly studied in the Nile Valley as a tool to address levels of activity in the past (e.g., Carballo-Pérez and Schrader, 2023; Schrader, 2012; 2015; 2019; Zabecki et al., 2016).

There are two categories of enthesal changes, fibrous and fibrocartilaginous. The former attaches the tendon or ligament directly to the bone, whereas the latter has a transition zone of cartilage in between (Benjamin et al., 2006; Shaw and Benjamin, 2007). Previous research has shown that fibrocartilaginous entheses are less prone to injury and may therefore more reliably speak to activity rather than acute trauma (Villotte and Knüsel, 2013).

A total of 17 fibrocartilaginous enthesal changes, including both upper and lower body (Table 1) were analyzed per individual using a 1–6 ordinal severity scale (Hawkey and Merbs, 1995; see also Schrader, 2019). These specific entheses were selected for study because they have been previously researched, both in the region as well as in other worldwide archaeological contexts. Sex and age were estimated using standard and accepted bioarchaeological methods involving cranial and pelvic morphology (Buikstra and Ubelaker, 1994). Due to the fact age is frequently significantly positively correlated with enthesal changes, we have only included individual burials (i.e., no commingled material) for which age-at-death could be estimated. For the individual included in this study, preservation good to excellent.

To statistically examine differences in enthesal changes between tomb types, ANCOVA tests were employed. ANCOVA, or analysis of covariance, examines the relationship between categorical variables and a dependent variable, while controlling for a variable. While the dependent variable is traditionally continuous, recent research has also indicated that ANCOVA can be applied to ordinal variables and are notably useful for age-related conditions, such as enthesal changes (Cheverko and Hubbe, 2017; Schrader and Carballo Pérez 2023). Additionally, the covariate, which is statistically controlled for, can be defined as age, thereby holding age as a constant. In bioarchaeological research, ANCOVA has been used on numerous occasions (Albee, 2023; Cheverko et al., 2023; Schrader and Buzon, 2017).

In addition to ANCOVA, we also took a more qualitative approach to assessing enthesal changes examining average scores for the upper and lower body. Based on these data, four groups, Very High (VH), High (H), Low (L), and Very Low (VL), were created (Table 2). While this approach is not common in enthesal studies, it is a useful way to visually identify those individuals who had enthesal changes that were markedly high or

low and examine their context in greater detail. These categories were used to not only examine variation in enthesal changes by cemetery area (Western, Northern, Eastern), but equally burial position (flexed, extended.).

Ethical considerations were taken into account throughout this research. All authors have worked closely with the local communities of Tombos and the National Corporation for Antiquities and Museums (NCAM) in Sudan, who support this research. With permission from NCAM, the remains are currently curated at Purdue University. The methods used in this study are all non-destructive, therefore, promoting the longevity and care of these skeletal remains. Throughout this research, authors abided by the guidelines set out by British Association for Biological Anthropology and Osteoarchaeology and regional bioarchaeological ethical guidelines (BABAO Code of Ethics; BABAO Code of Practice; Mitchell and Brickley, 2017; Schrader et al., 2024).

### 3. Results

The age and sex distribution of the sample is presented in Table 3. Enthesal changes scores in the Pyramid/Chapel/Shaft (PCS) category are frequently higher than chamber or tumulus burials (Table 4). Eleven comparisons between entheses and burial structure type (age-controlled) were significantly different (Table 4). Broadly speaking, these entheses reflect both upper and lower body tendons and ligaments that facilitate shoulder, arm, hip, knee, and ankle movement. If we take a closer look at the post-hoc tests (Supplementary Table 1), for many entheses the Western cemetery burials have the highest enthesal changes, followed by Northern burials and Eastern burials, which are notably similar.

As detailed above, individuals were placed into categories based on average enthesal score level in order to explore variability in data in relation to other factors such as age, sex, time period, and mortuary practices (see Figs. 5–6 and Supplementary Tables 2–3, 6). Individuals in the Very Low level are primarily represented by young adults and females from the Eastern graves and Northern tombs. The Low level contains a small group of individuals from all tomb types, ages, and sexes. The High level is mostly composed of older adults, both males and females from Eastern and Western tombs. The Very High level includes a variable mix of individuals, including males and females, adults of all age categories, and all cemetery areas.

Additionally, Very High, High, Low, and Very Low categories were used to examine variation in enthesal scores between burial position and locality. Enthesal changes from the flexed burials are not as marked as those from the extended burials (Figs. 7–8 and Supplementary



**Table 2**  
Qualitative assessment of enthesal changes.

	Mean Enthesal Changes Score
Very High	+2
High	1.5–2
Low	1–1.5
Very Low	<1

**Table 3**  
Demographic distribution of tombos sample.

	Western Female	Male	Northern Female	Male	Eastern Female	Male	Total
Young	9	7	8	11	11	6	52
Middle	7	7	2	2	6	4	27
Old	4	10	6	3	6	1	26
Total	44		32		34		110

Tables 4–5). There is no difference in activity levels between locals versus non-locals (Supplementary Table 6–7).

**4. Discussion**

This analysis of Tombos enthesal changes data across cemetery areas and tomb types suggests a complex landscape of physically active and less-physically active people, which contrasts with earlier interpretations that concluded that the enthesal changes for the Tombos population were not pronounced. This was counterintuitive to typical conceptualizations of indigenous lifeways in the wake of colonization; however, given that Tombos was an Egyptian administrative center, there was reason to believe that the site may have been an exception, consistent with the notion that the Egyptian colonial sites were occupied by privileged colonists from Egypt. However, if we further interrogate these data, it is important to note that all skeletal material included in Schrader (2012) originate from the middle-class chamber tomb component of the cemetery (excavated 2000–2008). Beginning in 2010, co-directors Dr. Stuart Tyson Smith and Dr. Michele Buzon began excavating the tumulus tombs in the eastern cemetery and additional pyramid/chapel/shaft tombs in the western cemetery. With over a decade of continued excavation, the sample size has increased for Tombos facilitating this re-examination.

**Table 4**  
Enthesal changes mean scores.

	Left Western	Northern	Eastern	p-value	F	Right Western	Northern	Eastern	p-value	F
M. supraspinatus/ M. infraspinatus	1.280	0.580	0.930	0.481	0.742	1.570	0.730	1.270	0.609	0.501
M. subscapularis	2.000	0.800	1.040	<b>0.059</b>	3.003	1.430	1.360	1.480	0.792	0.234
M. teres minor	1.440	0.750	0.700	0.327	1.141	1.150	1.880	0.940	<b>0.073</b>	2.761
Common extensors origin	2.090	1.330	1.800	0.378	0.988	1.610	2.000	1.740	0.297	1.239
Common flexors origin	1.360	0.600	0.830	<b>0.089</b>	2.507	1.000	0.790	1.110	0.232	1.502
M. triceps brachii	1.500	0.770	1.090	<b>0.083</b>	2.567	2.000	1.250	1.000	<b>0.003</b>	6.144
M. brachialis	2.140	1.410	1.330	<b>0.017</b>	3.582	1.630	1.450	1.180	0.405	0.915
M. biceps brachii	1.620	2.000	1.030	<b>0.010</b>	4.943	1.720	1.890	1.260	0.152	1.934
M. brachioradialis	1.700	1.210	0.960	0.131	2.103	1.730	1.330	1.190	0.758	0.279
M. semimembranosus/ M. semitendinosus/ M. biceps femoris	2.740	2.180	2.260	0.848	0.165	2.910	1.940	2.030	0.453	0.800
M. gluteus medius	1.800	1.110	1.270	0.454	0.801	1.570	1.160	1.600	0.498	0.705
M. gluteus minimus	1.820	1.120	1.460	0.362	0.525	2.260	1.220	1.190	<b>0.027</b>	3.824
M. iliopsoas	1.170	1.000	1.030	0.979	0.021	1.300	0.890	1.070	0.847	0.166
M. gastrocnemius	1.430	1.070	1.280	0.869	0.140	1.200	0.790	1.160	0.646	0.441
M. quadratus femoris	1.470	0.780	1.130	0.271	1.334	1.960	0.830	1.110	<b>0.002</b>	6.915
Patellar ligament	1.940	0.700	1.520	<b>0.040</b>	3.450	1.950	1.000	1.540	0.124	2.161
M. popliteus	0.940	0.330	0.540	<b>0.045</b>	3.317	0.920	0.500	0.560	0.156	1.916

\*Bold: p-value ≤ 0.10 coupled with an F-value > 2.50.

**4.1. Western cemetery**

Supported by robust Egyptological evidence, it is assumed that elite individuals were less likely to participate in physical labor. The data presented here suggest some people of Tombos, particularly those buried in the Western cemetery were engaging in repetitive strenuous labor. This evidence implies that these more elaborate tombs were not exclusively for the interment of high-status low-labor administrators, such as Siamun, but included low-status high-labor staff. During the New Kingdom Egyptian colonial period in Nubia (1500–1050 BCE), towns that served as centers of administration were built. The associated cemeteries are often considered to be elite, based on tomb architecture and grave goods (Lemos and Budka, 2021). Much of the archaeology in the Nile Valley has focused on the primary burials in monumental grave structures, a bias that has resulted in masking the lower class or less “important” members of society who might be buried within them or nearby (e.g., Richards, 2005; Érika et al., 2018). This unbalanced approach has ultimately penetrated popular culture and public captivation, resulting in little attention to the variable socioeconomic groups that existed in these ancient communities. The contextual analysis of skeletal remains from these colonial settings provides an opportunity to more fully illuminate the social roles of underrepresented groups.

While the social status of an individual may be estimated through the examination of mortuary practices such as grave goods and containers, location of burial within the tomb, other treatments, and disturbance can complicate the assessment. Collective tombs and reuse of these tombs appear to have been an important phenomenon in New Kingdom Nubia (Figs. 2 and 3). Lemos sees this practice as a reaction to impoverishment under colonial rule, allowing for the colonized to share the religious benefits of restricted specialized grave goods like heart scarabs and ushabtis (Lemos, 2024). However, collective burial representing a range of social statuses in a single tomb, as well as the reuse of older tombs, is something that is also a common feature of Egyptian mortuary practice (e.g., Carter and Carnarvon, 1912; Hayes, 1935; Lilyquist, 2020; Polz, 2005; see Grajetzki, 2022; Smith, 1992 for discussion). Similarly, objects that Lemos argues as restricted under imperial control were in fact rare even in Egypt, part of a larger social pattern of social stratification in Egypt that was replicated in Nubian colonies like Tombos. These communal burial practices result in the mixing of different sets of grave goods (Spence 2019); subsequent reuse and disturbance exacerbates this issue in both Nubia and Egypt.

Here, evidence of these activities through indications on the skeleton

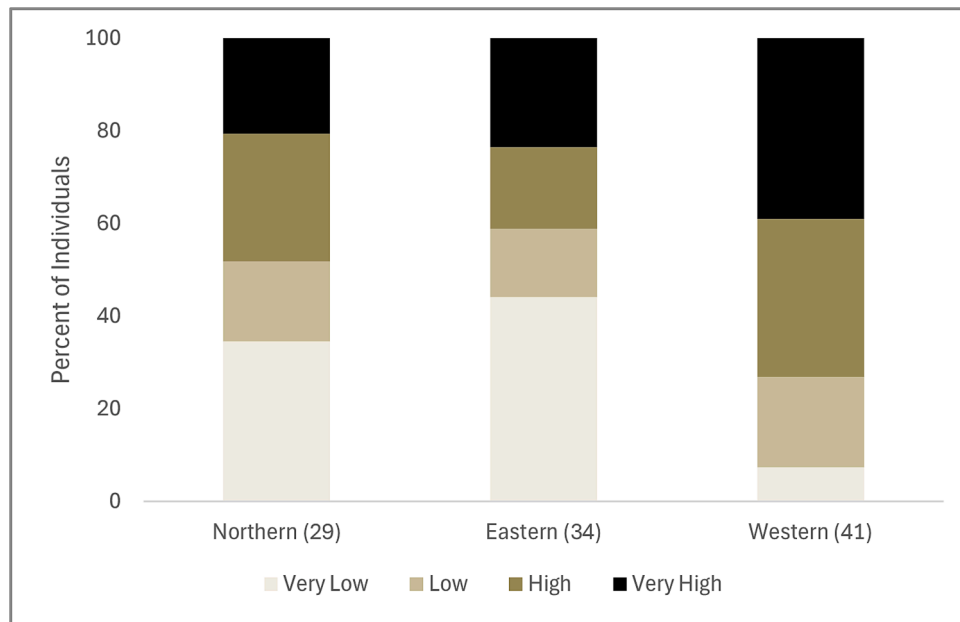


Fig. 5. Upper body average score categories by cemetery area.

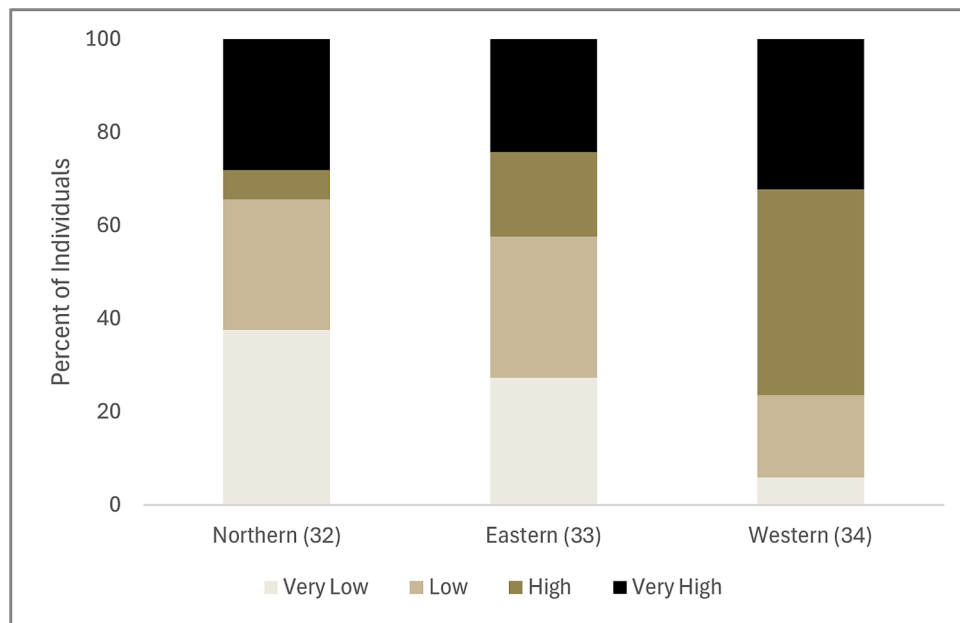


Fig. 6. Lower body average score categories by cemetery area.

allow for a more detailed analysis. The majority of individuals (both local and nonlocal as determined from previous strontium isotope analysis, see [Buzon et al., 2016](#)) from the Western cemetery have markedly high levels and are young or middle-aged adults and male, suggestive of heavier physical labor from a younger age. It is impossible to say what specific activities Western cemetery individuals were participating in, but, according to the enthesal changes data presented here, it involved complex upper and lower body movements. Possible explanations include construction, agropastoral, and production activities. This, in addition to sparse grave goods and inexpensive coffins/reed wrapping, seems to suggest that some Western cemetery individuals may have belonged to a lower socioeconomic class.

It is important to specifically state that higher enthesal changes and inferred manual labor does not inherently indicate lower status or vice

versa. However, given the robust written documentation from Egypt, we have reason to suppose that people of the lower classes were engaging in more physically demanding tasks than the upper classes who were more likely to be involved in bureaucracy, trade, and leisure activities ([Meskell, 1999](#)). If these hard-working individuals are indeed of lower socioeconomic status, this counters the traditional narrative that the elite were exclusively buried in monumental tombs like those in the Western cemetery, a long-standing assumption in the field of Egyptology. We are not suggesting that these tombs were designed, built, and funded by these high-labor individuals—rather, we argue that people of high socioeconomic status and with formal titles, such as Siamun, commissioned these pyramids for themselves, close family members, and servants/functionaries. In the case of Siamun, hieroglyphic inscriptions indicate that Siamun's mother was also entombed in his

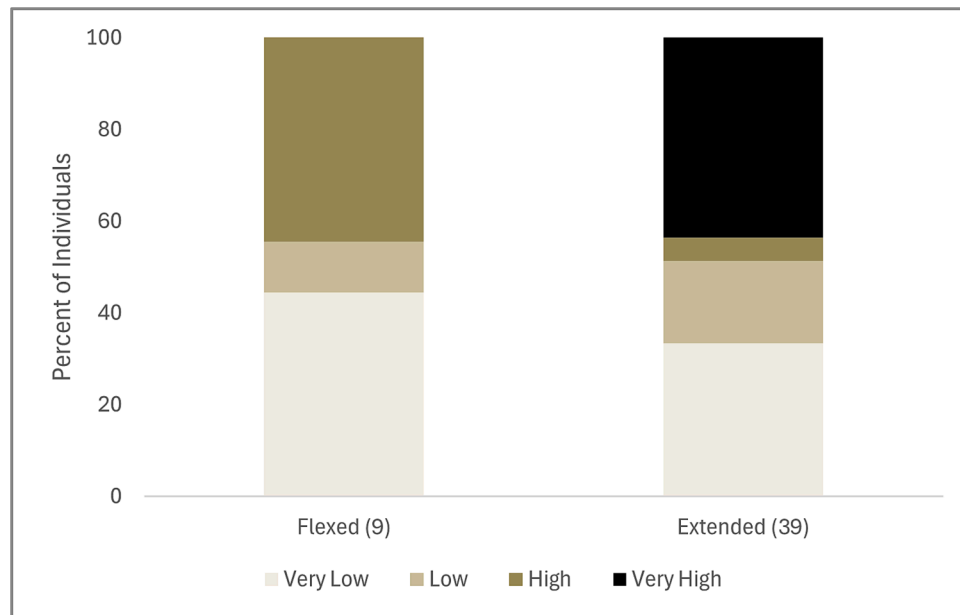


Fig. 7. Upper body average enthesal score by body position.

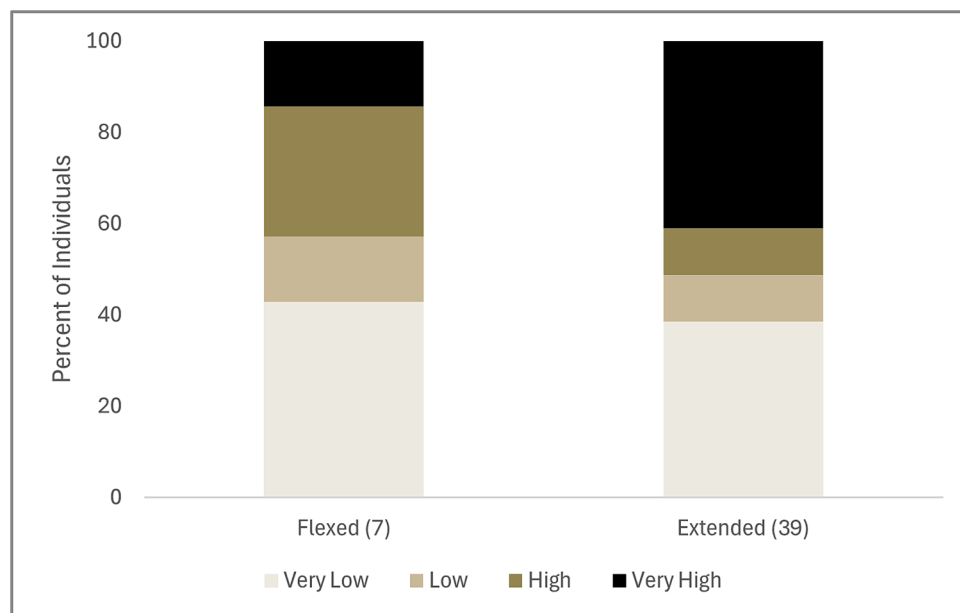


Fig. 8. Lower body average enthesal score by body position.

pyramid. However, there are frequently an additional 10 to 20 individuals buried in and around these funerary complexes. We hypothesize that these additional burials would have included staff of the elite tomb owner and, later, expedient tomb reuse by lower status individuals. In this model, Western cemetery contexts could contain both the highest and lowest socioeconomic segments of a given community.

For example, Unit 36 Tomb 2 is rectilinear mud brick chapel atop a wide shaft cut into alluvium with underground chambers extending to the east and west (Fig. 3). In the shaft of this tomb, more than two dozen intact burials were recovered, including several preadults. Five burials with preservation allowing for demographic and enthesal data collection were included in this study. Two individuals, Burials 1 (young adult male) and 6 (nonlocal middle adult female) in this tomb show Very High upper and lower body average scores; they were both wrapped in reed matting. These burials in reed matting, among others in the Western

cemetery, with higher enthesal remodeling scores may represent household workers or laborers brought to Tombos with the elite family of the Lector Priest Hapy, who was buried in the main chamber. It is notable that three of four burials in reed matting also had higher scores. Other burials examined in this tomb include Burial 4 (old adult male) with High upper body scores, Burial 9 (middle adult male) with Low upper and Very High lower body average scores, and Burial 3 (young adult female) with Very Low upper body and low lower body average scores. Overall, there is a range of scores, including some which represent some of the highest at the site, especially from young and middle adult individuals.

It is important to note that there is an inherent bias in the skeletal data from the Western cemetery given that looting in antiquity was common and frequently contributed to commingling of skeletal remains. Tomb robbers would have targeted the most elite, given that they were



likely buried with a larger quantity of more expensive grave goods. As mentioned above, commingled remains were not included in this study, so it is possible that the commingled individuals in this area are the remains of tomb owners and other elites. Additionally, due to the moisture and chamber collapse discussed above, many of the main underground chambers (such as Siamun's pyramid complex which was too dangerous to excavate) were so damaged by the conditions their remains were unanalyzable, like Hapy, whose elite status is reflected in the provision of canopic jars, and the five others, presumably family members, buried with him. Notably, the skeletons of the six individuals in the primary chamber of Unit 36, Shaft 2, were almost completely destroyed by damp and salts, including Hapy. This has resulted in a sample biased towards the less elite individuals. It is also conceivable that the remains in Western cemetery are those that were interred after the primary tomb owner. In fact, some instances of tomb re-use extend for hundreds of years after the construction of the tomb and is likely associated with memory, space, and ancestor veneration (Smith and Buzon, 2014). However, many intact burials found in Unit 36, Tomb 2 are roughly contemporary.

Within the Western cemetery we also have some examples of more elite individuals from shallower and better-preserved tomb contexts. Unit 35, Tomb 2, Burial 3 contained the and old adult female in a sealed niche dating to the New Kingdom using traditionally Egyptian practices. This individual was buried within a coffin decorated with inlaid eyes along with a blue-green glazed plaque amulet with the Bat-Hathor on one side and Tawaret on the other side. Additionally, she was buried with a finely carved serpentine heart scarab with a human head that provided her name, Weret, and a spell from the book of the dead. A bowl filled with juniper berries and several ceramic containers were included. She displayed High upper and lower body average scores, not uncommon in older individuals.

In Unit 9, the tomb of a possible soldier (young adult male) dating to the Late period (700 BCE), was found in a small, vaulted chamber tomb in a coffin placed onto a bed. This combination of traditionally Egyptian (coffin) and Nubian (bed) practices is also seen in pottery that combines styles. Additionally, this burial included a stack of iron weaponry, amulets, beads, scrabs, copper-allow bowls and an elaborately decorated wooden cosmetic box containing faience vessels of extraordinary quality (Smith, 2022). This individual displayed High upper body and Very High lower body scores, which may be indicative of his hard labor military occupation. The inclusion of these remarkable set of grave goods also suggests high rank/socioeconomic status.

#### 4.2. Northern cemetery

Northern cemetery chamber tomb burials exhibit higher *Teres minor* (right) and *Biceps brachii* (left and right) enthesal changes, which suggest more intensive arm rotation (at shoulder), supination, and flexion (at elbow). As originally proposed in Schrader (2012), this is congruent with minor officials and professionals, such as craftspeople and scribes. Based on archaeological evidence, Smith and Buzon (2017) have proposed that the chamber burials may reflect a New Kingdom middle-class component of the society. This research, in addition to previous analysis, supports that argument.

In this cemetery area, Unit 7 was remarkably intact underground chamber tomb made of mud brick (Fig. 2). The tomb included a mummiform coffin with some preserved decoration along with a scarab and two ushabti figurines, including the name of the deceased, the Scribe Tahut, and a spell from the Book of the Dead that activated the figurine to perform work in the afterlife on the deceased's behalf. This individual (young adult male) had Very High upper body scores and Low lower body scores. Two additional individuals were buried in this coffin, one young adult and one old adult, both females with all very low average scores. Two flexed burials were also found in this tomb, both female, one young adult and one old adult also with Very Low average scores with the exception of Low scores for the old adult upper body. Two other

burials (young adult male, young adult female) display Very Low scores. Very High scores are found in an old adult female and a young adult male shows a mix of High upper body and Low lower body scores.

The Unit 7 burials appear roughly contemporary while Unit 6 in this Northern Cemetery reveals a 400-year period of more or less continuous use, based on ceramic and radiocarbon dates. The first burials were placed in the back chamber around 1400 BCE and the last individuals interred in the staircase leading to the outer chamber around 1000 BCE (Fig. 2; Buzon et al., 2016; Smith, 2003). Individuals from these Northern cemetery chamber tombs who score in the Very High Category are generally older adults, with the exception of Unit 7 Chamber 2. This burial comes from a smaller niche off the main larger chamber described above (Fig. 2). In this niche, an intact pot was found in the doorway along with pottery sherds, fragments of wood, likely from a coffin, and scattered infant bones. One semi-intact burial was recovered, a young adult male with Very High upper and lower body scores. One arm had been pushed out of place, perhaps to get at a valuable ring. Strontium isotope analysis indicates a local value. A group of New Kingdom Egyptian style pottery vessels were found near the head including four flowerpots, two bowls and one beaker. Given the grave inclusions, this individual may have had higher socioeconomic status while participating in more strenuous activities.

#### 4.3. Eastern cemetery

The tumulus burials in the Eastern Cemetery exhibit higher enthesal scores for the patellar ligament (left), which reflects more intensive leg extension (at knee). This is also congruent with the archaeological evidence for granite quarrying during this period (see Harrell, 1999; Schrader and Buzon, 2017; Schrader, 2019). Individuals in the higher levels tend to be older; few young adults from the Tumulus burials have High or Very High average scores, which points to a relatively prosperous professional labor force of adults. Unit 27 contains two burials (Fig. 4; Burial 1 – old adult female and Burial 2 – young adult female). Burial 1 has Very Low average scores for both upper and lower body. In contrast, the younger individual, who was interred first, has High scores for both upper and lower body. Due to disturbance from ancient looting neither set of skeletal remains were fully articulated. Burial 2 was partly articulated and had been wrapped in linen (likely mummified) and placed upon a bed in the bottom of the side-niche, which had been prepared with depressions to receive the legs of the bed, a common feature at Tombos and elsewhere in Nubia. Only the lower legs remained articulated for Burial 1, who was associated with remains of a wooden container, likely a coffin, that had been broken apart. The tomb also contained a variety of pottery, handles that had dropped off of at least two valuable copper alloy bowls, assorted jewelry, and amulets (Buzon and Smith, 2023). Although they had been scattered by ancient looters, most of the smaller amulets and other beads, which included faience and Red Sea shell, were clearly associated with the younger woman (Fig. 4). However, the owner of the larger amulets was more likely the older woman, who was placed above the (already disturbed?) younger woman's burial after some time had elapsed. The Very Low scores for the older female perhaps suggest higher economic status in conjunction with the finer grave goods potentially associated with her, including a coffin, copper vessels, and high quality faience amulets of Isis, Pataikos, and a large scarab. The younger individual may have had lower status and an earlier entry into the physical workforce. Nevertheless, she was not poor, provided with a bed, linen wrapping, and an impressive array of jewelry around her neck, including very likely a valuable metal amulet, bead(s), and/or pendant targeted by ancient looters.

#### 4.4. Flexed burials

While most of the burials at Tombos in all cemetery areas were found in an extended body position that is associated with Egyptian practices, a small percentage were found in a flexed body position linked with local

traditions. In this study, nine flexed burials were examined for enthesal remodeling. All are female. Tumulus graves in the Eastern cemetery have two individuals, one middle adult with Very Low upper body and Low lower body and one old adult with High upper and lower body. Chamber tomb burials in the Northern cemetery contained two young adults with Very Low upper and lower body, one middle with Very Low upper body and Very High lower body, and one old adult with Low upper body and Very Low lower body. From the pyramid/chapel graves in the Western cemetery, there is one young adult with High upper body, one middle adult with High upper body and an old adult with High upper and lower body.

Individuals buried in the local flexed burial style are found from the earliest burials in the New Kingdom to the early Late period. The enthesal data provide a glimpse into how these individuals were incorporated into the community. In general, the lower scores do not indicate that all individuals using this local style were servants doing physical labor. The low scores are evident in the Eastern and Northern cemeteries, suggestive of socioeconomic privilege in this multicultural community. Similar to what was found in the Western cemetery on the whole, the individuals with higher scores, including one young and one middle adult are found in this area who may have been harder working community members, possibly associated with elite households.

#### 4.5. Locals/non-locals

There appears to be no difference in activity patterns between the locals and non-locals with even distributions of categorical enthesal scores between each group (Supplementary Table X). From this, we might deduce that occupations and/or physical activity expectations did not differ between individuals who grew up at Tombos and individuals who later migrated to Tombos. However, this data should be used with caution as we only have six non-local individuals in this data set and, therefore, cannot take sex and age into consideration.

### 5. Conclusions

While enthesal changes and labor cannot be equated with socioeconomic status, there is a large body of archaeological and Egyptological data that suggest there may have been some strict elite/non-elite categories and that these would have had very real consequences for bodies, occupations, and labor patterns. This contextual analysis of enthesal changes data suggests there was an interesting mortuary landscape at New Kingdom colonial Tombos, likely governed by socioeconomic status, sociocultural norms, and agentic practice.

The most elaborate tomb at Tombos was dedicated to the Scribe Accountant of the Gold of Kush Siamun, a title that suggests an important role in assembling the Kushite contribution to the annual Presentation ceremony given the site's proximity to the former Kushite capital at Kerma. The combination of burial practice and enthesal changes suggests that he brought with him an entourage who were engaged in various activities that supported his mission, likely a combination of diplomacy, surveillance, and the periodic assembly and transshipment of goods to the north. Skilled staff would include scribes like Tahut, priests like Hapy, and various supervisors to manage the colonial workforce, weigh gold, etc., perhaps reflected in the individuals with light enthesal wear. Laborers would be required for constructing and maintaining the mud brick buildings of the settlement and cemetery, as well as the large fortified enclosure that surrounded it (Smith and Buzon, 2018). If Tombos served as a transshipment point, then workers would be required to move goods from place to place and load caravans and/or ships for the trip to Egypt. Presumably there was at least a small contingent of soldiers, although the rarity of evidence for interpersonal violence and lack of weaponry suggests that security was not a central concern. It is likely that at least some members of the community were involved in agriculture and pastoralism, although as an administrative center the colony could have been supplied from outside. Wealthier

members of the community would require servants to keep house, who might be required to prepare food (in particular the strenuous activity of grinding grain into flour), clean, and carry heavy objects as a part their duties, again leading to more enthesal wear.

These data suggest that social classes were not segregated, but instead that a hard laboring non-elite were buried alongside an elite who avoided tasks that led to enthesal wear. To the extent that some older tombs were used for later interments, their reuse was seemingly accessible to all segments of society. Importantly, these data indicate that Tombos, and likely other Egyptian colonial New Kingdom towns in Nubia, were more socioeconomically diverse than once thought. The argument that New Kingdom towns were enclaves for the colonial elite is thus flawed. Additionally, the low enthesal remodeling scores for some local women who were buried in local flexed burial styles implies that not all were brought in as servants or slaves, but were among the more privileged members of the community, suggesting a role as social brokers between colonists and the local population through intermarriage rather than an exploitation of local labor to serve the colonists.

We can no longer assume that individuals buried in grandiose pyramids tombs are the elite. Indeed, the hardest working members of the communities are associated with the most visible monuments. Colonial administrators could have encouraged this practice in order to inscribe a hierarchical social order on the sacred landscape of the cemetery. In contrast, the northern cemetery by and large reflects a group of people who led a relatively leisurely lifestyle consistent with family groups. The presence of four flexed burials also highlights the area's multiethnic social context. As we move beyond the colonial era, the generally low enthesal remodeling scores individuals buried in Nubian style tumuli suggests a process of cultural entanglement by prosperous members of the community. The argument that colonial towns are more socioeconomically diverse equally provides a potential explanation for why other contemporaneous non-elite cemeteries have not been found—in fact, the data presented here suggests they were in and around the “elite” tombs the entire time. These results also illustrate the importance of reevaluating interpretations, expanded skeletal collections, and research questions. With years of additional excavation, the content of the skeletal collection was completely transformed since 2012. As biological anthropologists and archaeologists, we must constantly reflect upon data collected and previous assumptions.

#### CRediT authorship contribution statement

**Sarah Schrader:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Michele Buzon:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Emma Maggart:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Anna Jenkins:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Stuart Tyson Smith:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jaa.2025.101668>.

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