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Neolithic Populations of Upper Nubia

A biological assessment of continuity and change

by EMMA MAINES, PASCAL SELLIER

The aim of this paper is to provide a preliminary assessment of the question of biological continuity within Neolithic populations of Upper Nubia. Geographically, Nubia generally refers to the portion of the Nile Valley between the 1st and the 6th cataracts (Fig. 1) and is traditionally understood as a corridor connecting Egypt and sub-Saharan Africa. From a cultural perspective, current research prompts us to broaden and relax this definition. Thus, the notion of “Nubia” today is understood as referring to a much larger area and one that is more permeable to external cultural influences and population movements. In the context of this article the focus is on five sites from a smaller area within this region: the Kadruka¹ concession, located between the 3rd and 4th cataracts of the Nile, contains an important concentration of funerary ensembles. Each of the sites selected for study is situated along an ancient river branch of the Wadi el Khawi (Fig. 2). While Reinold previously excavated four of the five sites between the 1980s and the early 2000s, the fifth site, KDK 23, is part of a new project underway since 2014. From a funerary archaeological, as well as bio-anthropological standpoint, what is so interesting is the density of sites in this area and how closely located each of the sites are to one another. This density represents a truly unique opportunity in terms of research potential. This wealth of data, from such a restrained area and dating to a relatively condensed time period allows for interesting and important comparisons in terms of populations and practice.

While the Kadruka sites all date from the Middle Neolithic, they were not all in use at the same time and their use did not span the same portions of this larger period (Fig. 3). For example, on the basis of ceramic typologies, Reinold identified two phases of use for KDK 21, while the KDK 2 is thought to have a total

¹ When referring to individual sites we will use the abbreviation KDK for Kadruka. KDK23 is being excavated by MaFSaK (Mission archéologique franco-soudanaise à Kadruka) since 2014 (dir. P. Sellier, O. Langlois, P. Chambon).



Fig. 1. Map of geographical context of study. © E. Maines.

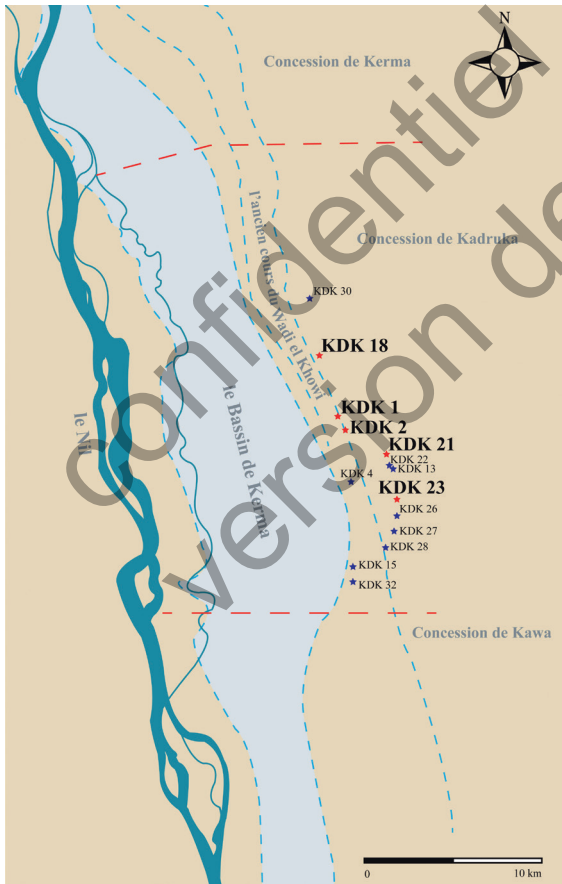


Fig. 2. Map of Kadruka concession. © E. Maines/SFDAS.

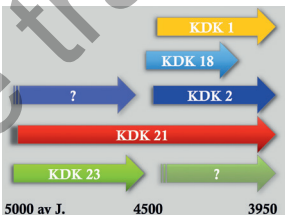


Fig. 3. Chronological attributions for the Kadruka sites. © E. Maines.

of five phases of use, each spanning different intervals.² Analysis of the ceramic typologies for each of the five sites by the Franco-Sudanese mission is ongoing for the Kadruka concession. The reality of disparate chronological attributions and the incomplete nature of the inquiry into these chronologies must be taken into consideration when comparing each ensemble.

MATERIALS AND METHODOLOGY

In terms of the theoretical framework for this paper, one of the goals of this study was to examine data from the vast work of Reinold with a renewed methodology and a different set of goals. Based on an analytical model functioning on multiple levels, this work seeks to provide an improved and in depth understanding of the ways in which each of these funerary ensembles functioned, from the individual and their burial to the ensemble of burials represented by a cemetery, and finally consider these sites from a regional, as well as a diachronic perspective. At each level the goal was to observe the funerary record in order to discern practices and timelines, thus identifying biological and cultural realities and variations. The aim was to assess how biological and archaeological data allows for a more complete understanding of how these sites functioned.

Most of the materials retrieved for study from the excavation of KDK 18, 21 and 2 was stored in a small warehouse in the village of Kadruka. The material and its containers had suffered significant environmental degradation and necessitated an important investment of time and energy into rehabilitating the labeling and storing of the remains. A smaller quantity of materials from KDK 1 and 21 had been stored in Khartoum at the SFDAS and were in better overall condition. Finally, a significant quantity of materials for KDK 1 and a smaller sample from KDK 21 are curated by Université de Genève and were, in the case of KDK 1, in excellent condition and in the case of KDK 21 necessitated only minor improvements to labeling and packaging.

While each site was taken equally into consideration within the theoretical framework, the sites are not equal in terms of the degree to which we can consider that the excavated or studied material is representative of the whole (Fig. 4). Specifically, KDK 2 and 23 are important in terms of the relative reliability of the results. Though by far the largest of the five burial mounds, KDK 2 was not excavated exhaustively by Reinold. In fact, it seems that only a portion of the site was examined with relatively surface test trenches installed. Furthermore, material from a mere 43 of the total 116 burials documented as having been excavated was able to be retrieved for study. Moreover, it was also unfortunately the case that

² REINOLD, *SudNub* 5, 2001, 6-7.

	KDK 1	KDK 2	KDK 18	KDK 21	KDK 23
Total number of estimated burials	± entirely excavated	1000 +	± entirely excavated	Approx. 300	Approx. 300
Total number of excavated burials	124	116	165	288	103
Total number of individuals studied	111	43	147	234	108

Fig. 4. Overview of the Kadruka collection. © E. Maines.

only a very schematic, partial mass plan for the site and no useable individual burial plans were retrieved. Therefore, in the analysis of the burial trends, KDK 2 does not figure in the results. As for KDK 23, the burial mound is still being excavated and we have observed that while there was a very high number of juvenile individuals in the upper strata of the mound, as excavation has continued, not only have fewer juvenile individuals been found, but the material culture has also shifted over time. So, in terms of funerary trends, the results pertaining to KDK 23 should be replaced within the framework of an ongoing excavation, though the biological results do appear to have stabilized.

The present study took into account a total of 386 adults, and 257 juveniles, for a combined total of 643 individuals. From an archaeological standpoint it was possible to study 656 burials. It was possible to calculate an age for 241 juveniles and 142 adults. Though sex estimation was only possible for 78 of those adults, 220 provided post-cranial measurements that allowed for subsequent secondary sex analysis, which added 29 individuals, thus augmenting the total number of sexed individuals to 107. Given the time lapse between excavation and study and the degraded state in which much of the material was retrieved from the 4 sites previously excavated by Reinold, the representativeness is generally satisfactory, and we can consider that this study was particularly fruitful in terms of identifying variability of practice and identity.

A BIOLOGICAL ASSESSMENT OF POPULATION & PRACTICE

Characterizing the population consisted most notably of age estimations for the juvenile segments of each ensemble and sex estimations for the adult portions. In terms of population types, the Kadruka ensemble demonstrates two very distinct variations. The most significant difference between these two types is the contrast between normative representations of the lowest age groups within certain cemeteries compared to their near total absence within the other ensembles

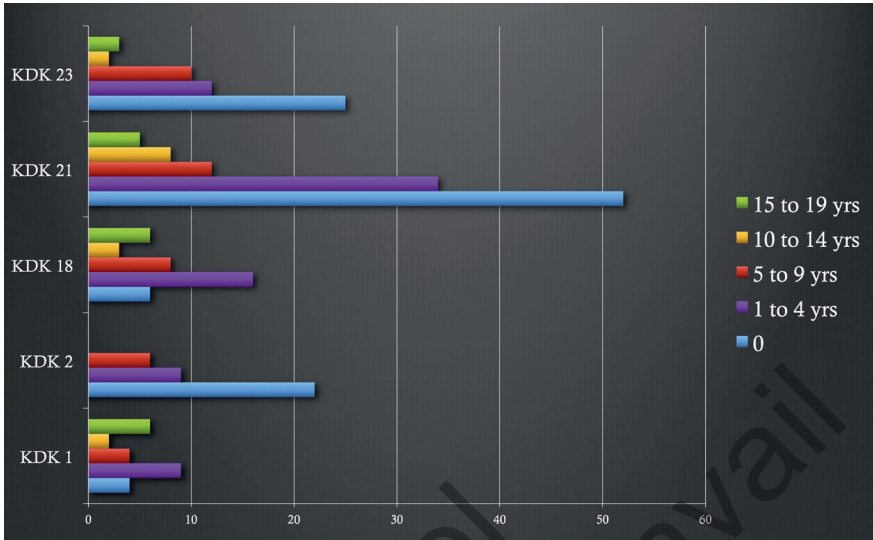


Fig. 5. Overview of the juvenile populations for the Kadruka collection. © E. Maines.

(Fig. 5). While the KDK 2 population cannot be said to be representative of the whole of the cemetery, as so little of its total surface was excavated, we chose to include it for the very precise reason that it demonstrates the presence of these lower age groups, perhaps linking it to funerary trends closer to KDK 21 and 23, as opposed to KDK 1 and 18. These profiles may change for KDK 23, and in the case of KDK 2 are not necessarily representative of the population included in the cemetery as a whole, however, the data from KDK 1, KDK 18 and KDK 21 may be considered as such. The remarkable similarity between KDK 1 and KDK 18 and the marked difference between them and KDK 21 and KDK 23 is intriguing. The mortality profiles calculated for these populations, based on these data utilize a methodology that calculates estimated percentages of mortality for pre-vaccine populations, allowing us to compare the mortality profiles of each cemetery with what would be expected of such a population and assert its normality or deviation from that standard.³ Each ensemble is compared with a “natural” mortality profile and in this case based on a life expectancy at birth of 30 years of age. What is interesting is that in the cases of KDK 1 and 18, while the profiles are coherent with the expectations for this mortality profile starting at the age group of 5 to 9 years of age, the lowest age groups do not fall within the bounds (Fig. 6). This doesn’t mean that those children were not dying, but rather that they were either

³ Sellier’s method (1996) based on LEDERMANN, *Nouvelles tables-types*, 1969.

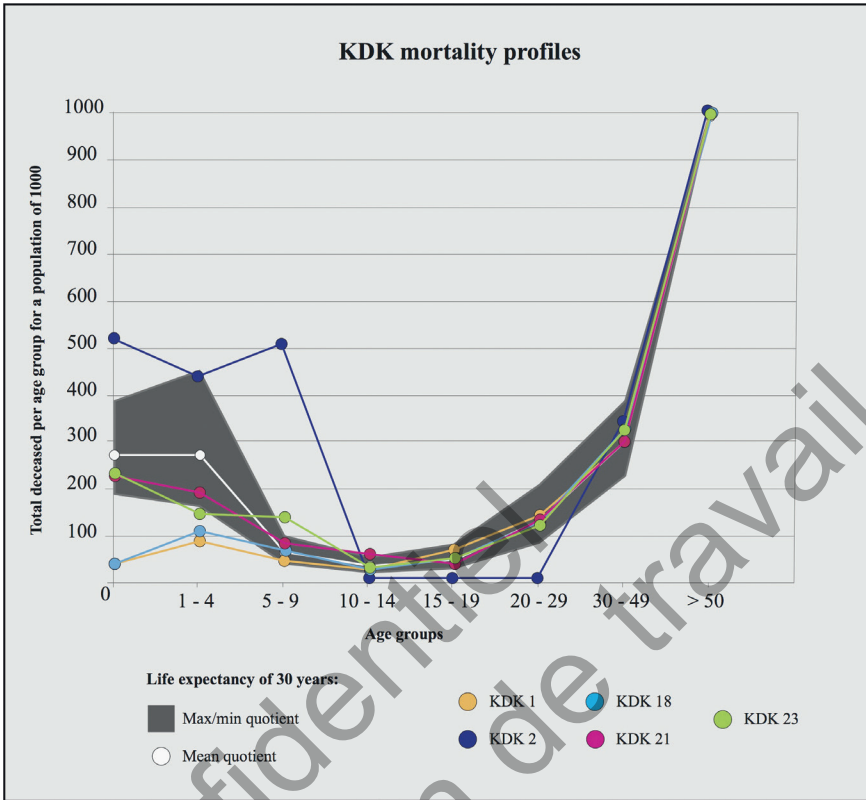


Fig. 6. Kadruka mortality profiles. © E. Maines - P. Sellier.

excluded from the cemetery (potentially receiving another specific treatment) or that those remains were somehow lost. As we can see this is not the case for Kadruka 23 or 21, where what is demonstrated is coherent with an egalitarian access to the cemeteries. Further analyses are needed to identify the exact cut off age for inclusion in each ensemble. Our analyses based on burial placement and general conservation exclude the possibility that erosion or destruction led to this lack of evidence for KDK 1 and KDK 18. Furthermore, our comparisons and research into regional data suggest a diversity of treatment for the youngest segments of the population in general for prehistoric periods in Nubia.

The estimates for differences between inclusion rates of the two sexes demonstrate no significant differences in the case of each site (Fig. 7).⁴ However, analysis

⁴ Chi-squared tests were performed for each site and in all cases the results demonstrate no significant difference in terms of the number of male and female burials.

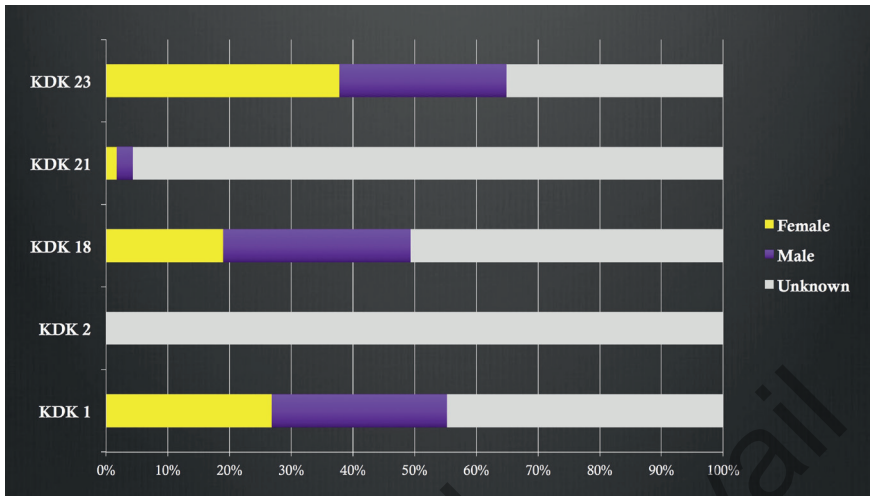


Fig. 7. Sex estimation results for the Kadraka collection. © E. Maines.

of population distances through discrete dental trait analysis suggests that certain populations may be pooled together due to significant similarity and may thus improve our results for secondary sex analysis. In this manner, we may hope to pronounce more definitively on any relevant and significant differences in treatment between male and female individuals within the cemeteries. Indeed, in terms of similarity or diversity from a biological perspective, this discrete trait (specifically dental) analysis, affords us significant insight into relative proximity of populations.⁵ Applying mean measure of divergence calculations⁶ to our observations and assessment of degree of expression of discrete dental traits we were able to compare the five Kadraka populations and assess relative degrees of resemblance or divergence. What was revealed was that the ensemble is not homogenous. Indeed, certain groups are more closely correlated to one another than to others. It remains to be determined to what degree, if any, these groupings correlate with differences and similarities observed in funerary or cultural practices.

The biological data doesn't only allow us to specifically discuss identity, but also provides information concerning lifeways and practice. While poor bone conservation necessarily complicates any definite comparison of pathology and relative health, what can be ascertained is that in each of the Kadraka populations there is evidence for multiple pathologies that allow for discussion of health and

⁵ This work is ongoing and will be the subject of a future publication with Dr. V. Thouzeau.

⁶ SANTOS, *AJPA* 165(1), 2018, 200-205.



Fig. 8. Example of *cribra orbitalia* (KDK 1, ST. 73).
© E. Maines /MaFSaK.



Fig. 9. Example of a healed break of the radius (KDK 1, ST. 73).
© E. Maines /MaFSaK.

lifeways. Indeed, multiple examples of *cribra orbitalia* were identified, which can be linked to anemia (Fig. 8). Several instances of healed fractures or breaks of long bones (Fig. 9) were observed. Perhaps most astonishing were the frequency and severity of periapical lesions, in one case with such gravity that special foodstuffs would have to have been prepared in order to ensure survival (Fig. 10). Finally, a few instances of DISH (diffuse idiopathic skeletal hyperostosis) (Fig. 11) were also observed, a condition which may be linked to lifestyle and can, in some cases, cause debilitation of the individual.⁷ Thus, despite poor bone conservation, the biological data affords substantial insight into episodes of stress, illness and also in some cases, of care and healing. While infections and malnutrition and trauma

⁷ WALDRON, *Paleopathology*, 2009, 115-167.

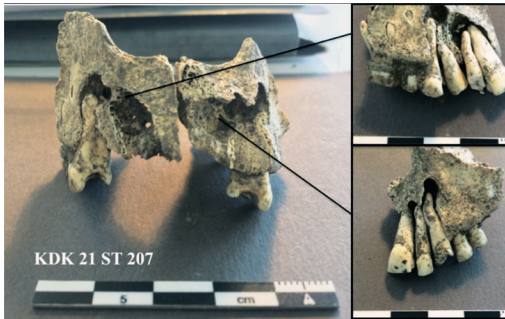


Fig. 10. Example of soft tissue retention of teeth and severe periapical lesions (KDK 21, ST. 207). © E. Maines/MaFSaK.



Fig. 11. Example of DISH in lumbar vertebrae (KDK 1, ST. 131). © E. Maines/MaFSaK.



Fig. 12. Example of linear enamel hypoplasia (KDK 1, ST. 75). © E. Maines/MaFSaK.



Fig. 13. Example of severe dental calculus (KDK 21, ST. 14). © E. Maines/MaFSaK.



Fig. 14. Example of individual with multiple carious lesions (KDK 18, ST. 112). © E. Maines/MaFSaK.

are attested to, so are restored or rehabilitated individuals, or individuals surviving at least some time in fragilized states of existence. A certain number of marks or traces left on teeth and bone also allow us to estimate the relative health of populations, as well as give us insight into certain cultural practices. Linear dental enamel hypoplasia (Fig. 12), calculus (Fig. 13) and caries (Fig. 14) all elucidate not only health, but life experience, with enamel hypoplasia being, at least in part, correlated to periods of stress, illness or malnutrition, and caries and calculus being linked to oral hygiene, diet and therefore by extension, food ways.⁸

The older the individuals, the more likely significant pre-mortem tooth loss, caries and abscesses are in the record. Among other things, this makes eating more difficult, and therein we may find evidence for the preparation of particular foods, for affected individuals, as we mentioned above (in the case of Fig. 10). Tooth loss was not only influenced by poor health and hygiene, but also by cultural practice, likely with the working of fibers or leather, as documented most famously among Alaskan populations.⁹ What is referred to as LSAMAT (or lingual surface attrition of the maxillary anterior teeth), is a well-known by product of this type of activity¹⁰ and is characterized by an unequal pattern of wear between upper and lower teeth, as well as significantly oblique wear of the lingual surfaces of upper teeth (Fig. 15). Other evidence of the use of teeth as tools, include grooving across the lingual and occlusal surfaces (Fig. 16),¹¹ as well as significant fracturing of both anterior and posterior teeth (Fig. 17).¹² The analysis of these practices from a diachronic perspective is part of an ongoing project.

We can also extend our comparisons to the R12 site excavated by Donatella Usai and Sandro Salvatori,¹³ to provide an even more complete picture of the relative diversity or homogeneity of experience between populations of the Sudanese Neolithic. While KDK 18 demonstrates similar rates of caries as the R12 cemetery, KDK 1, 21 and 23 all present much higher rates. Calculus deposits are relatively stable across the KDK populations, but markedly higher than at the R12 cemetery. Finally, the rates of dental enamel hypoplasia, demonstrate a decrease, from KDK 18 to 23 to 21 to 1 (Fig. 18). The data therefore seems to suggest that these populations were perhaps not influenced by the same stressors or pathologies and

⁸ WALDRON, *Paleopathology*, 2009, 236-239, 240-241; GOODMAN, ROSE, *Advances in Dental Anthropology*, 1991, 279-293; GOODMAN, SONG, *Human Growth in the Past*, 1999, 210-239; LANGSJOEN, in *The Cambridge Encyclopedia of Human Pathology*, 1998, 402; HILLSON, *Teeth*, 2005, 290-303.

⁹ TURNER *et al.*, *AJPA* 85(3), 1991.

¹⁰ TURNER AND MACHADO, *AJPA* 6, 1983.

¹¹ LEFÈVRE, *BMSAP* 12(10-3), 1973; FLÉCHIER, VERDÈNE, *BMSAP* 13(1-2), 1974; LUKACS, PASTOR, *AJPA* 76(3), 1988; BONFIGLIO *et al.*, *IJO* 14, 2004.

¹² MOLNAR, *AJPA* 34(2), 1971; BUDINOFF, in *Proceedings Caribbean Archaeology*, 1991; TURNER, MACHADO, *AJPA* 6, 1983.

¹³ JUDD, in *A Neolithic Cemetery*, 2008, 98-104.



Fig. 15. Example of LSAMAT, fracturing and periapical lesions in an adult individual (KDK 23, ST. 124). © E. Maines/MaFSaK.



Fig. 16. Example of occlusal (left, KDK 18, ST. 67) and labial (right, KDK 21, ST 105) grooving). © E. Maines/MaFSaK.



Fig. 17. Example of significant and symmetrical fracturing of anterior and posterior teeth (KDK 18, ST. 64).
© E. Maines/MaFSaK.

KDK 1	Total Present	Total observed	% Presence
Caries	26	57	45.6
Calculus	55	62	88.7
Abscess	17	20	85
DEH	16	51	31.4

KDK 2	Total Present	Total observed	% Presence
Caries	1	3	33.3
Calculus	3	3	100
Abscess	1	1	100
DEH	1	3	33.3

KDK 18	Total Present	Total observed	% Presence
Caries	16	81	19.8
Calculus	59	81	72.8
Abscess	7	13	53.9
DEH	50	80	62.5

KDK 21	Total Present	Total observed	% Presence
Caries	55	84	65.5
Calculus	79	85	92.9
Abscess	26	28	92.9
DEH	46	61	75.4

KDK 23	Total Present	Total observed	% Presence
Caries	22	38	57.9
Calculus	25	38	65.8
Abscess	3	11	27.3
DEH	26	35	75.3

R 12	Total Present	% Presence
Caries	11	14.3
Calculus	19	24.7
Abscess	12	15.6
DEH	2	2.6

Fig. 18. Comparison of rates of markers of oral health, hygiene and subsistence from MAINES, *Diversité biologique et archéologie de la mort*, 2019.

Site	Total P	Observed	% Present
KDK 1	31	37	84
KDK 2	2	2	100
KDK 18	32	56	57
KDK 21	49	63	78
KDK 23	23	30	77
R12	39	47	83

Fig. 19. Comparison of rates of LSAMAT from MAINES, *Diversité biologique et archéologie de la mort*, 2019.

did not exploit the same food ways. There may also be implications for the status of individuals buried in each cemetery.¹⁴ Higher percentages of caries and calculus have been correlated to an increasingly agricultural diet.¹⁵ The comparison of the total number of adult individuals observed and their rates of LSAMAT presence are illustrative of the relative variability of this practice within populations, with percentages as low as 54% for KDK 18 and as high as 84% for KDK 1 (Fig. 19).

AN ARCHAEOLOGICAL ASSESSMENT OF IDENTITY; CULTURAL & PRACTICAL CHOICES

The archaeological record also affords us significant insight into culture and practice. For the Kadruka ensemble, several categories of data were considered: orientation and positioning of the deceased (as opposed to burial orientation as the burial cuts were rarely visible) and grave good inclusion.

Firstly, the orientation of the deceased within the burials appears to point to a variety of codified orientations. The data is simplified here and is based on an axis drawn between the head and hips. What is immediately apparent, is that KDK 1 and 18 present very similar patterns of burial orientation with a majority of orientations with the head to the north and a near absence of burials with the head to the west. In the case of KDK 21 a majority of individuals are buried with their heads to the south, while at KDK 23 there is a remarkable diversity of orientations. In both cases individuals are found with heads to the west, as compared to KDK 1 and KDK 18, however there is a near absence of individuals with their heads to the east in the case of KDK 21 (Fig. 20).

The positioning of the deceased within their burials appears to demonstrate two major trends. While KDK 1 and 21 show an overwhelming majority deposited generally on their left side, with some variation of the position of the torso (85% and 75% respectively), KDK 18 and 23 demonstrate a slightly more equilibrated relationship between left and right-side placement (62% and 56% general left-side placement respectively). While in general the data points to no significant differences based on age groups, at KDK 18 there are slightly more juveniles positioned on the right than there are adults, and at KDK 23 the majority of individuals in a ventral position are juveniles (Fig. 20). Comparisons based on these data and correlated to age, sex and regional patterns will appear in a forthcoming article and demonstrate a variability of practice.

The data gathered relative to the inclusion of different types of grave goods also underscores variability of practice and significant differences between the sites (Fig. 21). While ceramics are heavily present at KDK 21 and KDK 23 (63%

¹⁴ GOODMAN, ROSE, in *Advances in Dental Anthropology*, 1991.

¹⁵ HUMPHREY *et al.*, *PNAS* 111(3), 2014; LANFRANCO, EGGERS, *AJPA* 143(1), 2010.

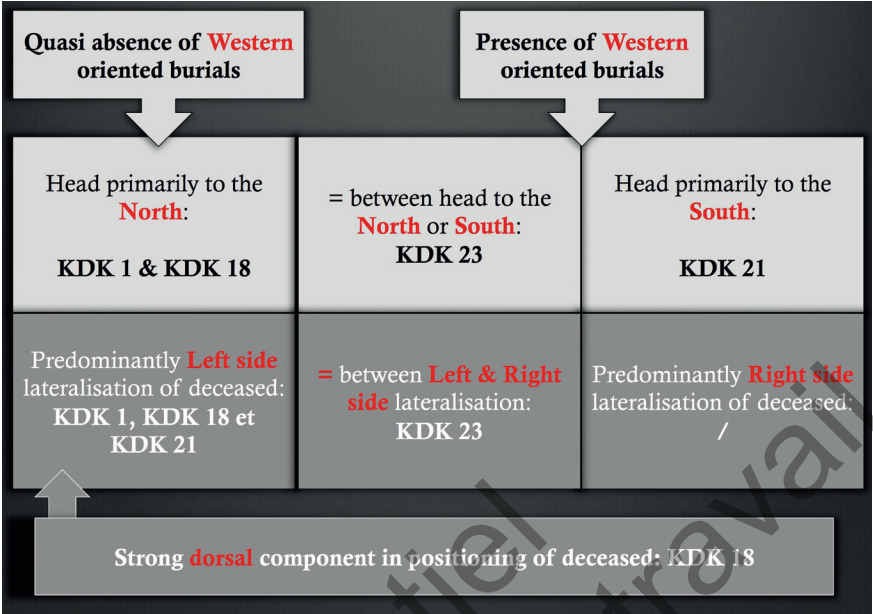


Fig. 20. Overview of funerary trends for the Kadruka ensemble. © E. Maines/MaFSaK.

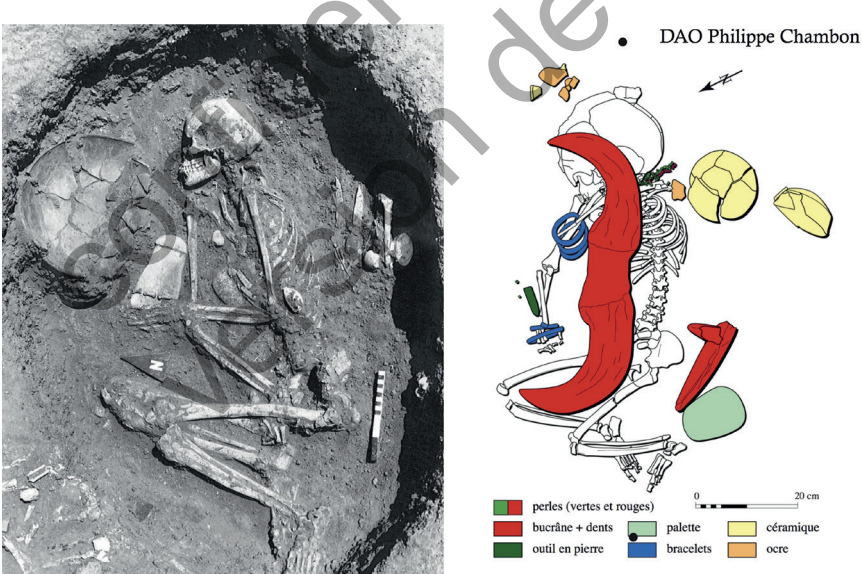


Fig. 21. Illustration of variability of grave good inclusion (left, KDK 18, ST. 64. Photo archives J. Reinold/SFDAS; right, KDK 23, ST. 81. © P. Chambon/MaFSaK)

and 61% respectively), these figures decrease at KDK 1 and KDK 18 (50% and 43% respectively). The opposite is true however of bucrania where we see very low percentages of inclusion for KDK 21 and KDK 23 (7% and 4% respectively) and middle ranges for KDK 18 (28%) and finally extremely high numbers for KDK 1 with over half of the observed burials including bucrania, and oftentimes multiple deposits. Other data is not as clear-cut, as in the case of lithic materials, where the sites of KDK 18, KDK 21 and KDK 23 demonstrate similar rates of inclusion (between 35 and 39%), while KDK 1 presents a slightly higher number (50%). Further analyses based on concentration of deposits and correlation to age and sex are ongoing and will be the subject of future, collaborative publications.

In conclusion, our analysis revealed the existence of a relative diversity beneath the surface of an apparent overarching homogeny. Indeed, the Kadruka sites differ significantly in some ways from one another, as well as from other regional examples such as the R12 site, while in other instances they appear analogous. It remains to be seen whether or not these data can be used to illustrate cultural and biological assemblages in evolution. What are certainly illustrated, are assemblages presenting variations within codified practices, as well as differences in health and access to cemeteries.

BIBLIOGRAPHY

- BONFIGLIO B., MARIOTTI V., FACCHINI F., BELCASTRO M. G., CONDEMI S., "Masticatory and Non-masticatory Dental Modifications in the Epipalaeolithic Necropolis of Taforalt (Morocco)", *IJO* 14, 2004, 448-456.
- BUDINOFF L. C., "An osteological analysis of the human burials recovered from Maisabel: an early ceramic site on the north coast of Puerto Rico" in *Proceedings of the 12th International Congress of the Association for Caribbean Archaeology*, 1991, Martinique, 117-133.
- FLÉCHIER J. P., VERDÈNE J., "Quelques considérations sur la denture des Mésolithiques français", *BMSAP* 13(1-2), 1974, 237-269.
- GOODMAN A. H., ROSE J. C., "Dental Enamel Hypoplasias as Indicators of Nutritional Status" in *Advances in Dental Anthropology*, 1991, 279-293.
- GOODMAN A. H., SONG R. J., "Sources of Variation in Estimated Ages at Formation of Linear Enamel Hypoplasias" in *Human Growth in the Past: Studies from Bones and Teeth*, Hoppa R. D., Fitzgerald C. M. (eds.), Cambridge, 1999, 210-239.
- HILLSON, *Teeth*, 2005.
- HUMPHREY L. T., DE GROOTE I., MORALES J., BARTON N., COLLCUTT S., BRONK RAMSEY C., BOUZOUGGAR A., "Earliest evidence for caries and exploitation of starchy plant foods in Pleistocene hunter-gatherers from Morocco, *PNAS* 111(3), 2014, 954-959.
- JUDD M., "The human skeletal analysis", in *A Neolithic Cemetery*, 2008, 83-104.

- LANFRANCO L. P., EGGERS S. "The Usefulness of Caries Frequency, Depth, and Location in Determining Cariogenicity and Past Subsistence: A Test on Early and Later Agriculturalists from the Peruvian Coast", *AJPA* 143(1), 2010, 75-91.
- LANGSJOEN O., "Diseases of the dentition", in *The Cambridge Encyclopedia of Human Paleopathology*, Aufderheide A. C., Rodríguez-Martín C., Langsjoen O. (eds.), Cambridge, 1998, 393-412.
- LEDERMANN S., *Nouvelles tables-types de mortalité*, Cahiers de l'Institut national d'études démographiques 53, Paris, 1969.
- LEFÈVRE J., "Étude odontologique des hommes de Muge", *BMSAP* 12(10-3), 1973, 301-333.
- LUKACS J. R., PASTOR R. F., "Activity induced patterns of dental abrasion in prehistoric Pakistan: Evidence from Mehrgarh and Harrapa", *AJPA* 76(3), 1988, 377-398.
- MAINES E., *Diversité biologique et archéologie de la mort : une approche populationnelle et culturelle du Néolithique soudanais (Haute-Nubie)*. Doctoral thesis. Université Paris Panthéon-Sorbonne, Paris, 2019. <https://hal.archives-ouvertes.fr/tel-02899987/>
- MOLNAR S., "Human tooth wear, tooth function and cultural variability", *AJPA* 34(2), 1971, 175-190.
- REINOLD, *SudNub* 5, 2001.
- SANTOS, *AJPA* 165(1), 2018.
- TURNER C. G. II, IRISH J. D., MACHADO L. M., "Reply to Robb, Cruwys, and Smith, with additional remarks on LSAMAT", *AJPA* 85(3), 1991, 345-351.
- TURNER C. G., MACHADO L. M. C., "A new dental wear pattern and evidence for high carbohydrate consumption in a Brazilian archaic skeletal population", *AJPA* 61(1), 1983, 125-130.
- WALDRON, *Paleopathology*, 2009.