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Diet and Post Mesolithic Craniofacial And Dental Evolution In Sudanese Nubia.

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SUMMARY

Posterior and anterior teeth reduce in size between the Mesolithic (9,000-6,000 B. C.) and Christian (550-1300 A.D.) periods from lower Nubia. Concurrent changes in crania include: 1) a reduction in the maxillo-mandibular region, 2) rotation of the lower face to a more inferior and posterior position, and 3) rotation of the crania, resulting in a higher and more spheroid morphology. Traditionally, this suite of changes have been thought to result from population replacement, with an increase in Caucasian admixture. We suggest that changes in both craniofacial and dental elements are interrelated and explained by in situ evolution, fuelded by dietary changes. Two hypotheses are presented to explain the process by which dietary change might lead to changes in craniofacial and dental phenotypes: a "masticatory function" and a caries resistance-dental reduction" hypothesis. The co-reduction of the maxillo-mandibular skeleton and tooth size suggests that reduced masticatory function may have been a primary mechanism for dental and craniofacial changes synchronic with the origin of agriculture. After the origin of agriculture, anterior tooth dimensions stabilize, while posterior tooth sizes and maxillo-mandibular elements continue to reduce, although t a slower rate. These post-agricultural changes may be best explained by selection for caries resistant (smaller and less complex) teeth and compensatory reduction of skeletal and muscular elements.

INTRODUCTION

The interpretation of morphological changes in prehistoric Nubian skeletal remains has generated considerable controversy. Earlier researchers, interested in understanding the history of ancient Egypt, assumed that an analysis of Nubian populations would provide important information on the origins of Egyptian populations and civilizations. These researchers realized that Nubia, extending from the first Cataract at Aswan and southward to the fourth Cataract in Sudan, was the principal corridor through which people and ideas were transmitted between interior Africa and the Mediterranean Basin.

Given Nubia's juxtapositon between these two geographical regions, determination of the time, circumstances, and consequences of population movement was a logical first step in the analysis of ancient Nubian skeletal remains. It was hoped that such a determination would shed light on both biological and cultural developments in the Nile valley.

Based on materials unearthed by the First Archaeological Survey of Nubia (1907-1911), Elliot-Smith, Douglas Derry, and F. Wood Jones initiated the study of Nubian skeletal remains (Derry, 1909, Elliot-Smith and Jones, 1910). They argued in favor of major "racial" changes in Nubian populations through prehistoric and historic times. These differences were further interpreted to be the result of differing degrees of Negroid and Caucasoid admixture, with implications which extended far beyond the realm of human biology. Periods of cultural advance in both Nubia and Egypt were thought to correspond to times when Caucasian populations predominated, while "dark ages" were thought to correspond to periods during which Negroid populations predominated.

This approach to skeletal analysis, along with its cultural interpretations, did not go unchallenged. As early as 1905, C. S. Myers cited major faults with the statistical handling of these data. Later in the century, Batrawi (1946) studied collections from the Second Archaeological Survey of Nubia (1929-1934) and found no basis for an association between race and cultural achievement. While Batrawi's rejection of racial determinism found wide acceptance among subsequent researchers, a typological approach aimed at determination of race from skeletal materials continues to dominate the concerns of many physical anthropologists working in this region. For physical anthropology, the central features of this typological approach are: 1) an orientation towards a static and idealized description of human races, and 2) a commitment to migration, population replacement and admixture (genetic flow) as major mechanisms of evolution.

The preeminence of migration and population replacement as agents of change in the Nubian corridor is difficult to maintain in light of recent archaeological evidence. Adams (1967), in summarizing the results of the UNESCO campaign (1959-1969), argues that "So far as population is concerned, we have, notwithstanding earlier theories, no reliable evidence of any major or complete changes during the major historic period ... we must now adopt as a working hypothesis the idea that the Nubian population has remained basically the same since Neolithic times" (Adams, 1967:). The implications of the archaeological data for physical anthropology are clear. While population movement along the Nubian corridor has undoubtedly contributed to the genetic diversity of Nubian populations, in both time and space, such diversity has ultimately been shaped by <u>in situ</u> evolution.

Purpose

In this paper we examine Post-Mesolithic changes in Nubian cranial morphology that have traditionally been interpreted in terms of Caucasoid-Negroid migration and admixture. This traditional view, by focusing on idealized racial types and their subsequent mixing, has incorrectly minimized human variability and ignored selective forces which ultimately affect crania form. It is our view that post-Mesolithic changes in ancient Nubian crania are best explained by <u>in situ</u> evolution, fueled by dietary changes. Two hypotheses are presented to explain the process by which dietary change might lead to changes in craniofacial phenotypes. Our final purpose is to evaluate the explanatory power of these hypotheses and present an integrative model of the relationship between diet and dental-craniofacial change in Nubia.

MATERIALS AND METHODS

The cranial material used in this study was excavated by the University of Colorado Nubian Expedition and the Scandanavian Joint Nubian Expedition. The skeletal remains were recovered from the Wadi Halfa area of the Republic of Sudan, near the second cataract and just below the Egyptian border. These remains span a 10,000 year period from the Mesolithic through the Christian period.

The Mesolithic (9,000-6,000 B.C.) was a period of intensive gathering and hunting with a major focus on seeds and large bovids. The following A-Group (3400-2400 B.C.) and C-Group (2400-1200 B.C.) periods witnessed an increase in agricultural subsistence with some herding. These populations heavily relied on the cultivation of barley, millet and sorghum. It appears that between 1000 B.C. and A.D. 100, the period known as the Nubian hiatus, Lower Nubia was abandoned. This abandonment was likely to have been the result of the lowering of the Nile, which prevented agriculture with the <u>shaduf</u>. The introduction of the <u>sagia</u> (water wheel) during the Meroitic period (350 B.C. to A.D. 350) led to a reoccupation of the area. During this period of revitalized agriculture, Lower Nubia was part of the Meroitic Kingdom, which controlled much of the Nile Valley. The break-up of the Meroitic Kingdom initiated a 200 year period of local autonomy known as the X-Group period (A.D. 350-550). With the conversion of Nubia to Christianity, the area was again reunited. This eight hundred year period of reunification and centralization of power (A.D. 550-1300) is known as the Christian period. In summary, subsistence in Nubia develops from a hunting-gathering economy during the Mesolithic period to an initial agricultural phase during the succeeding A-Group and C-Group periods, followed by intensified agriculture during the Meroitic, X-Group and Christian periods.

Two methods have been used to analyze changes in Nubian craniofacial form. The Scandinavian material, studied by Carlson (1976) was radiographed, with measurements derived from the x-ray image using Cartesian coordinates. The Colorado material was measured (Van Gerven et al., 1976) and independently studied. Carlson and Van Gerven (1977) subsequently combined data from the Scandinavian and Colorado material and analyzed sixteen measurements from twelve

Mesolithic, 87 combined A and C group (agricultural sample) and 153 combined Meroitic, X-Group and Christian crania (intensive agriculture sample). The following discussion is based on these data.

RESULTS AND DISCUSSION

Craniofacial changes

Means and standard deviations for the sixteen craniofacial measurements reported by Carlson and Van Gerven (1977) are presented by cultural periods in Table 1. Percent change in mean values through time are presented in Table 2. Diachronic changes in these cranial measurements fit into three clusters (Fig. 1). Variables in cluster I slightly increase through time, variables in cluster II show little change through time and variables in cluster III sharply decrease through time. Variables in cluster I (diachronic increase) include facial height, cranial height and parietal and frontal chord. Variables in cluster II (little diachronic change) include facial length, cranial length, symphyseal height and mandibular ramus height. Variables in cluster III (diachronic decrease) include the length of the masseter origin, mandibular ramal width, width of the mandibular corpus and the thickness of the symphysis (Table 2).

TABLE 1. Means and standard deviations for craniofacial variables in three Nubian populations (in cm).

Variables	Mesolithic mean	Mesolithic s.d.	A-C Group mean	A-C Group s.d.	MXCh Group mean	MXCh Group s.d.
1. Cranial length	18.58	0.32	18.18	0.64	18.27	0.82
2. Cranial height	12.75	0.56	13.91	0.66	13.64	0.64
3. Frontal chord	10.57	0.29	11.70	0.45	11.47	0.55
4. Parietal chord	11.32	0.35	12.48	0.49	12.35	0.70
5. Facial length	10.36	0.35	10.00	0.47	10.28	0.57
6. Upper face height	6.63	0.33	6.68	0.40	6.66	0.43
7. Cheek height	2.57	0.23	2.42	0.26	2.37	0.27
8. Masseter origin length	4.31	0.52	3.38	0.34	3.18	0.32
9. Ramus height	4.75	0.62	4.51	0.42	4.55	0.45
10. Corpus length	9.25	0.41	7.37	0.57	7.20	0.50
11. Symphysis height	3.35	0.22	3.19	0.38	3.28	0.37
12. Symphysis thickness	1.69	0.17	1.48	0.14	1.44	0.18
13. Ramal width	4.29	0.37	3.70	0.38	3.73	0.30
14. Sigmoid notch height	4.67	0.64	4.40	0.40	4.28	0.37
15. Coronoid process height	6.14	0.54	5.98	0.53	5.95	0.53
16. Total face height	10.92	0.60	11.55	0.60	11.46	0.65

MXCh = combined Meroitic, X and Christian samples. Modified from Carlson and Van Gerven (1977:497).

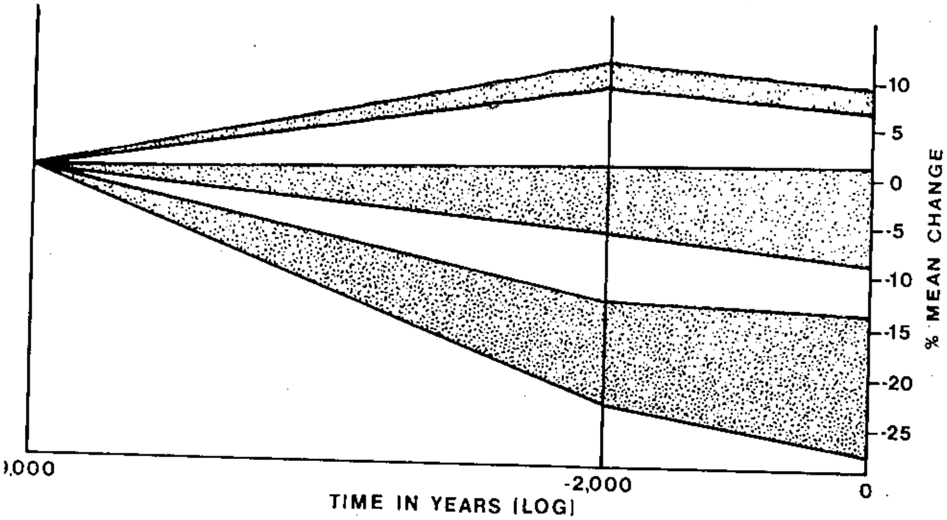
TABLE 2. Temporal changes in craniofacial measurements.

Variables	Mesolithic to A-C Group	A-C Group to MXCH Group	Mesolithic to MXCH Group
1. Cranial length	-2.2	0.5	-1.7
2. Cranial height	8.4	-2.0	6.4
3. Frontal chord	9.7	-2.0	-7.9
4. Parietal chord	9.3	-1.1	8.4
5. Facial length	-3.5	2.8	-0.8
6. Upper face height	0.8	-0.3	0.5
7. Cheek height	-5.9	-2.1	-7.8
8. Masseter origin length	-21.6	-6.0	-26.3
9. Ramus height	-3.8	-0.5	-4.3
10. Corpus length	-20.4	-2.4	-22.8
11. Symphyseal height	-4.8	2.8	-2.1
12. Symphyseal thickness	-12.5	-2.8	-15.3
13. Ramal width	-13.8	0.9	-13.1
14. Sigmoid notch height	-5.8	-2.8	-8.4
15. Coronoid process height	-2.7	-0.6	-3.1
16. Total face height	5.5	-0.8	4.8

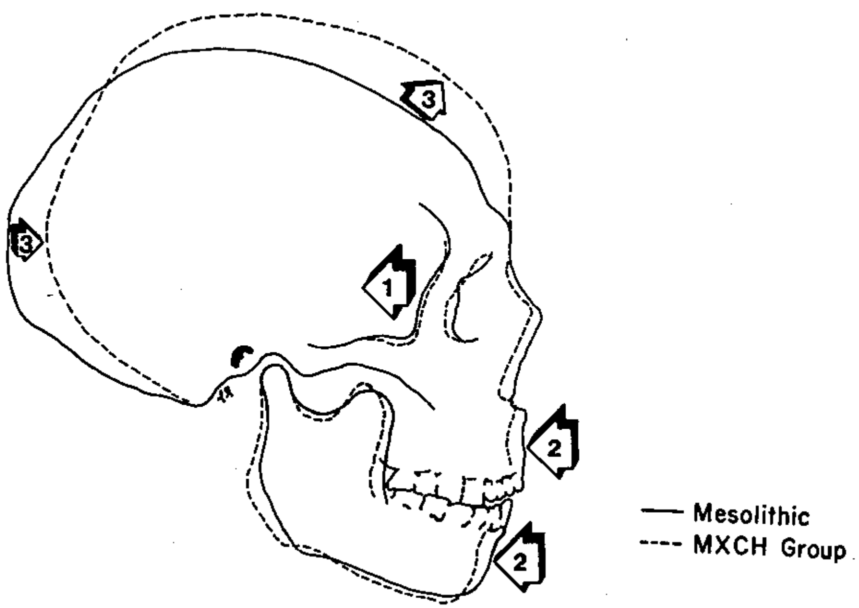
Changes are in percents. MXCh = combined Meroitic, X-Group and Christian samples. Modified from Carlson and Van Gerven (1977:500).

The pattern of cranial change is more clearly visualized when viewed diagramatically (FIG. 2). Mean values for the Mesolithic crania are linked by the solid line while the mean values for the combined Meroitic, X-Group and Christian crania are linked by the broken line. Arrows indicate the major directions of change. There is a substantial reduction in the areas of attachment of the masticatory muscles and a reduction in development of the maxillo-mandibular region. Cranial length decreases while cranial height increases.

What may initially appear to be a complex suite of changes may be explained by the reduction and rotation of the masticatory apparatus. A reducion in the masticatory musculature and its bony elements results in a "rotation" of the skull so that the now smaller face is placed in a more inferior and posterior position. As a result, compensatory rotation occur in the crania, resulting in a higher and more spheroid morphology.



'IG 1. Mean changes in craniofacial measurements from the Mesolithic -9,000 years) to the combined A-C Group (-2,000 years) and the ombined Meroitic, X-Group and Christian samples. Percent changes are lotted on a log scale (from Carlson and Van Gerve, 1977:501). ctual values and precent changes are presented in Tables 1 and 2.



G 2. Diagramatic representation of mean Nubian crania for the solithic (solid line) and combined Meroitic, X-Group and Christian ashed line). Arrows represent major directions of change (from rlson and Van Gerven, 1977:502).

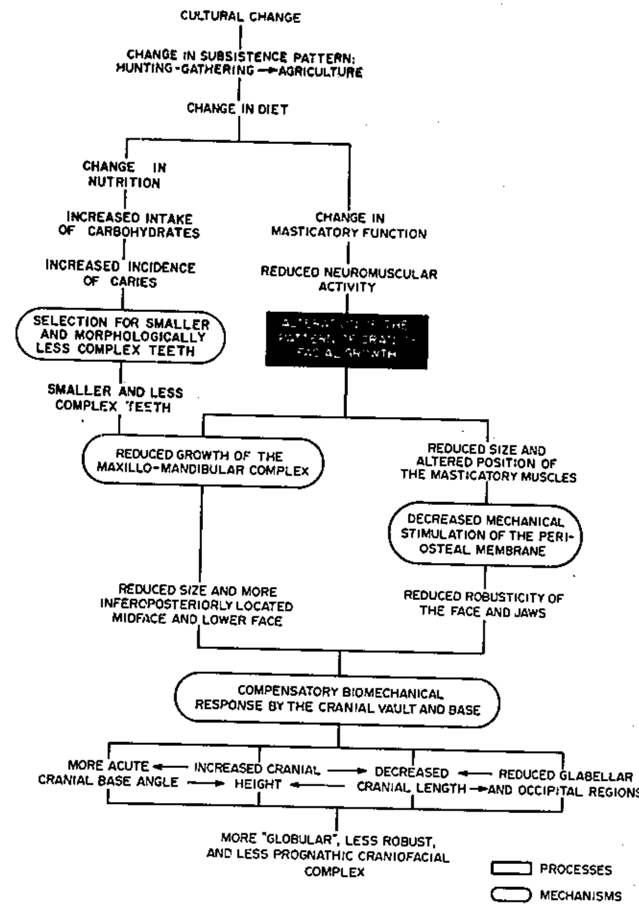


FIG 3. Model of mechanisms and processes by which dietary change may lead to changes in dentition and the craniofacial complex.

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