

1-1-1994

The Human Remains from Carter-Ranch Pueblo,Arizona: Health in Isolation

Marie E. Danforth
University of Southern Mississippi, m.danforth@usm.edu

Della Collins Cook
Indiana University, cook@indiana.edu

Stanley G. Knick III
Pembroke State University

Follow this and additional works at: https://aquila.usm.edu/fac_pubs



Part of the [Anthropology Commons](#)

Recommended Citation

Danforth, M. E., Cook, D. C., Knick, S. G. (1994). The Human Remains from Carter-Ranch Pueblo,Arizona: Health in Isolation. *American Antiquity*, 59(1), 88-101.
Available at: https://aquila.usm.edu/fac_pubs/8294

This Article is brought to you for free and open access by The Aquila Digital Community. It has been accepted for inclusion in Faculty Publications by an authorized administrator of The Aquila Digital Community. For more information, please contact Joshua.Cromwell@usm.edu.

THE HUMAN REMAINS FROM CARTER RANCH PUEBLO, ARIZONA: HEALTH IN ISOLATION

Marie Elaine Danforth, Della Collins Cook, and Stanley G. Knick III

Health patterns in the Pueblo III (A.D. 1100–1225) population from Carter Ranch Pueblo were investigated in skeletal remains from 34 individuals. Childhood health disruptions were assessed using stature, linear enamel hypoplasias, and Harris lines. Periostitis, arthritis, anemia, trauma, and dental pathology were also observed. Although the low juvenile representation is probably an effect of age-biased mortuary practices, results suggest a healthy population compared to larger southwestern sites. Trauma levels at the site are quite high, possibly indicating burial practices differentiated on the ability to work or other health criteria. Additionally, a number of genetic anomalies are present, suggesting an isolated population.

Se presentan unas investigaciones sobre los patrones de salud en 34 esqueletos procedentes del período Pueblo III (1100–1225 D.C.) en el sitio Carter Ranch. Las interrupciones de crecimiento durante la niñez fueron evaluadas según la estatura, las hipoplasias lineares del esmalte y las líneas de Harris. Así mismo, fueron estudiados la periostitis, la artritis, la anemia, el traumatismo y la patología dental. Aunque la población juvenil esté poco representada, pudiendo haber sido afectada por prácticas funerarias de acuerdo a la edad, ya casi todos los indicadores estudiados muestran que el promedio de salud es mejor que el de los pueblos más grandes del suroeste de los E.U. El nivel de traumatismo es alto, posiblemente indicando una población mortuoria diferenciada por la capacidad de trabajo u otros criterios de salud. Además, hay algunas anomalías genéticas que sugieren una población aislada.

The Carter Ranch Pueblo is best known for Longacre's reconstruction of social organization at a prehistoric site, a keystone of the "new archaeology" (Longacre 1964, 1970). Using ceramic-design frequencies, he inferred that at least two social units practicing matrilineal residence were present. While these conclusions have since been rejected by most researchers, Longacre's analysis is still frequently discussed in introductory anthropology and archaeology courses as one of the classic studies that "began pushing at the frontiers of archaeology" (Thomas 1989:469).

Although mortuary practices were included in the analysis, the human remains have never been evaluated, apart from a typological study of crania (Skomp 1965). Hill (1970:47) has suggested that the skeletal material might provide an independent test of the conclusions drawn from the ceramic analysis. Unfortunately, the sample size precluded demonstration of genetic structuring corresponding either to Longacre's model or to a variety of other groupings (Danforth and Cook 1991). However, the Carter Ranch collection can offer valuable insights into the health status of residents of small villages in the prehistoric Southwest.

Analyses of large sites, such as Grasshopper and those at Chaco Canyon, have provided a rich data base from which to reconstruct health and dietary patterns. Recently, several researchers have suggested that conclusions drawn from these communities may not be applicable to all inhabitants of the region (Merbs and Vestergaard 1985; Reinhard 1985; Wade 1981). Large population centers were relatively rare in the prehistoric Southwest. Most people probably lived in settlements of fewer than 100 individuals (Plog 1979; Zubrow 1975, 1976). Unfortunately, the published literature for skeletal series from small southwestern communities is rather limited. Notable exceptions include

MARIE ELAINE DANFORTH • Department of Anthropology and Sociology, University of Southern Mississippi, Hattiesburg, MS 39406-5074

DELLA COLLINS COOK • Department of Anthropology, Indiana University, Bloomington, IN 47405

STANLEY G. KNICK III • Native American Resource Center, Pembroke State University, Pembroke, NC 28372

American Antiquity, 59(1), 1994, pp. 88–101.
Copyright © 1994 by the Society for American Archaeology

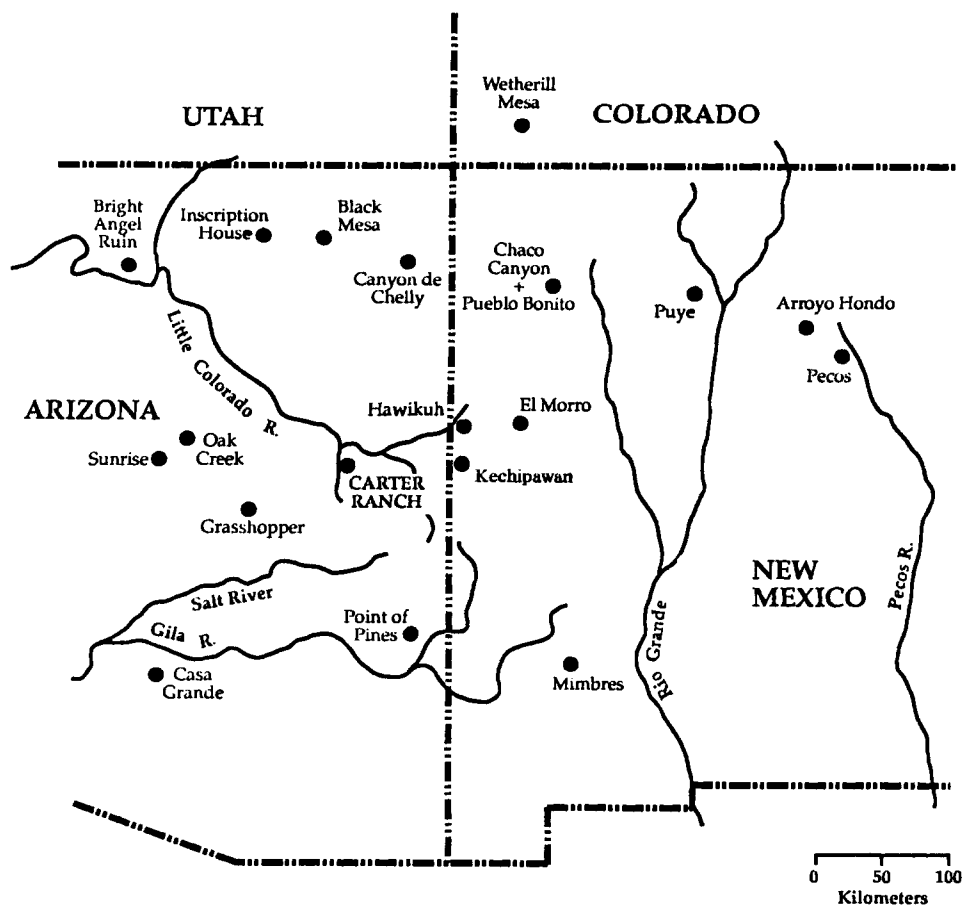


Figure 1. Location of Carter Ranch and other sites referred to in the text.

Bright Angel Ruin (Merbs and Euler 1985), Kechipawan (Lahr and Bowman 1992), Oak Creek Pueblo (Taylor 1985), and Sundown (Merbs and Vestergaard 1985) (Figure 1).

Settlement size is important in reconstructing health because smaller sites may be expected to have generally healthier residents. Density-dependent pathogens, especially respiratory infections, should be less common (Wadsworth 1984). Better sanitation and hygiene might limit the effects of many intestinal parasites and waterborne diseases, a principle that has been applied in paleopathology mainly to the analysis of large sites (Reinhard 1985; Storey 1985). Finally, residents of small sites might be expected to benefit from greater access to wild food resources.

The small community known as Carter Ranch Pueblo was the principal site of its time in the Hay Hollow Valley, a tributary of the Little Colorado River in eastern Arizona (Figure 1). It dates to A.D. 1100–1225, although length of occupation is uncertain (Longacre 1970:26). Our analysis of the health and demographic patterns of the Carter Ranch people adds to the knowledge of the bioarchaeology of village-sized settlements in the Southwest. It also updates Longacre's (1970) findings and completes analysis of one of the best-known sites in North America.

DEMOGRAPHY

The skeletal remains of 34 individuals were recovered at Carter Ranch, 25 in midden and the remainder beneath room floors (Figure 2). Most were single, flexed burials (Martin et al. 1964:60).

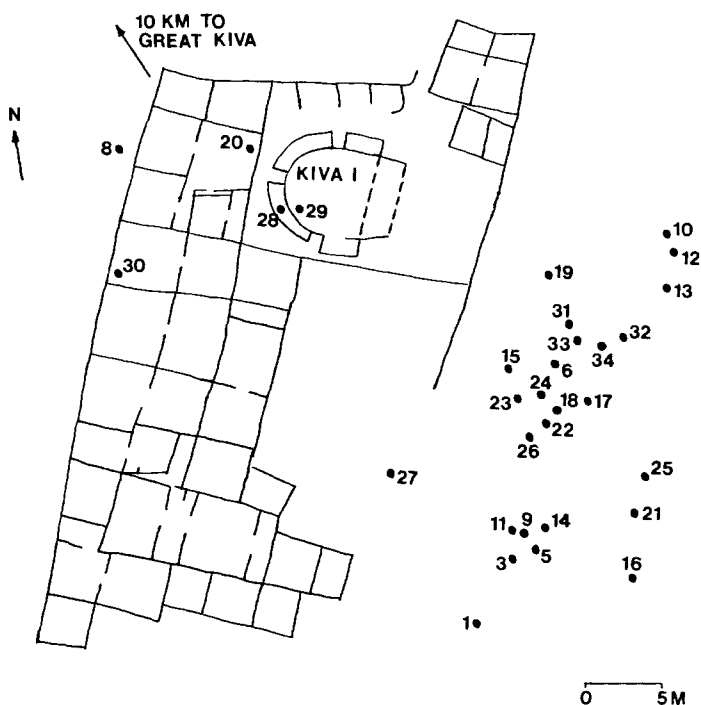


Figure 2. Map of Carter Ranch Pueblo (after Martin et al. [1964:16]).

The only burned skeleton (Burial 20) was found in an unconventional position, and appears to have died in a room collapse from fire (Martin et al. 1964:62). Bone preservation is good, allowing use of most standard age and sex indicators (Stewart 1979).

Seven of nine juveniles died before age two (Table 1). The average age of death among adults was relatively high; over half of the adult sample survived to at least age 35. The sex ratio is approximately equal. The sex and age distributions at Carter Ranch correspond to paleodemographic expectations (Weiss 1973), resembling Point of Pines (Bennett 1973) but lacking excess females seen at Grasshopper or Chaco Canyon (Berry 1985) and excess juveniles seen at Arroyo Hondo (Palkovich 1980), Mimbres (Gilman 1990), and Grasshopper (Hinkes 1983; Paine 1989). Unusual adult sex ratios generally reflect sex-biased mortuary practices, and we see no evidence for these at Carter Ranch. Palkovich (1980) argues that high juvenile mortality at Arroyo Hondo resulted from synergism of malnutrition with other childhood diseases. Hinkes (1983) draws similar conclusions for Grasshopper, although Paine (1989) argues that juveniles are not markedly overrepresented there. The apparent low juvenile mortality at Carter Ranch reflects bias caused by excavation of room blocks rather than the entire site; juveniles are differentially included in the midden, and midden excavations were limited.

For both reasons of sample size and sample bias, the paleodemographic potential of this collection is limited. However, if all burials at the site had been recovered, there is reason to believe that childhood mortality still would appear lower than at larger sites in the region. Juvenile health is frequently considered to be a sensitive indicator of adaptive success, and consequently would be expected to reflect the generally better health enjoyed by inhabitants of smaller communities. To support this tentative inference from paleodemography, we evaluate the health status of juveniles at Carter Ranch.

Table 1. The Carter Ranch Series Sex, Age, Orientation, Burial Goods, and Cluster Assignment.

Burial Number	Sex ^a		Age (in yrs) ^b	Orientation	Associated Burial Goods ^c
	L	C			
Burial Cluster I					
10	-	M	21-34	-	disturbed (medicine cylinder?)
12	M	F	21-34	E-W	2 vessels
13	M	M	35-49	E-W	1 effigy handle
19	M	F	21-34	E-W	3 polychrome vessels, mat, red loin-cloth
31	M	F	35-49	E-W	6 vessels (3 polychrome), sandstone slabs
32	F	F	35+	E-W	no associated goods
33	M	M	35-49	N-S	3 vessels
34	M	M	35-49	E-W	5 vessels (3 polychrome)
Burial Cluster II					
6	M	M?	35-49	E-W	3 vessels, weaving tools, bracelet
15	M	F	18-34	N-S	7 vessels, bracelet, necklace, loin-cloth
17	M	F	21-34	E-W	4 vessels, 2 bracelets, mats, basketry, white cylindrical beads
18a	M	J	5-6 m	E-W	} bracelet, 2 vessels (group of vessels)
18b	F	J	10-11 m	N-S	
22	M	F?	17-18	N-S	6 vessels
23	I	I	2	E-W	2 vessels, (white cylindrical beads, necklace with bone ring pendant)
24	M	F	35-49	N-S	4 vessels, mat
26	M	M	35-49	E-W	3 vessels, 2 grooved bone awls, 10 turquoise pendants, foot of clawed animal (badger)
Burial Cluster III					
3	M	M	35-49	N-S	7 vessels, 1 notched sherd, 1 awl
5	F	F	35-49	N-S	no associated goods
9	M	M	35-49	N-S	4 (7) vessels (jar, pitcher, bowls), bow guard, antler club, territella shell pendants, lump of turquoise
11	F	M	21-34	N-S	1 vessel (pitcher)
16	M	F	21-34	N-S	4 vessels, 1 projectile point
21	F	M	21-34	N-S	hematite plug, chalcedony tablet (possibly used as "tinkler")
25	J	J	1-3 m	N-S	1 large sherd
27	J	M?	35-49	N-S	3 vessels, 1 awl
Additional burials not recovered in cemetery					
2		F	21-35		
4		J	0-2		
7		M	35-49		red paint applied to back before burial
8		J	3		
14		J	neonate		
20		F	35-49		
28		F	50+		
29		J	8-14		
30		M?	18-34		

Note: Table adapted from Danforth and Cook (1991: Table 1) and Longacre (1970). Where Longacre (1970) and the original site report (Martin et al. 1964) disagree on age and sex, our findings generally confirm the site-report data. Burial 1 is not included in Skomp's study (1965), and we found no material with this catalog number.

^a L = assignments listed in Longacre (1970); C = assignments made by Cook in laboratory analysis. M = male, F = female, I = indeterminate, and J = juvenile.

^b For burials 18a, 18b, and 25, m = months.

^c Adapted from Longacre (1970:43); materials in parentheses are additional burial goods discussed in Martin et al. (1964).

Table 2. Mean Long-Bone Length By Sex.

		Males	Females
Maximum humerus length	\bar{x}	314.75	270.25
	S.D.	12.13	14.27
	n	8	8
Maximum radius length	\bar{x}	245.56	206.63
	S.D.	7.92	8.70
	n	9	8
Maximum ulna length	\bar{x}	262.00	221.13
	S.D.	10.10	9.30
	n	9	8
Maximum femur length	\bar{x}	426.22	387.11
	S.D.	20.16	22.77
	n	9	9
Maximum tibia length	\bar{x}	369.89	323.91
	S.D.	11.46	18.94
	n	9	11
Maximum fibula length	\bar{x}	359.17	309.00
	S.D.	14.74	22.98
	n	6	6

Note: All measurements in mm.

STATURE

Adult stature may be considered an indicator of cumulative stress throughout childhood, and students of modern human biology in the living commonly use it as an overall health index (Falkner and Tanner 1986). Several studies of prehistoric populations have linked depressed stature to limited access to food resources, particularly protein (e.g., Falkner and Tanner 1986; Haviland 1967; Huss-Ashmore et al. 1982). At Carter Ranch, we calculated stature using tibiae and femora lengths (Table 2) with Genoves's (1967) formulas. Mean male stature was 162.2 cm, and mean female stature was 147.7 cm (Figure 3). One female (Burial 12) had been previously identified as a proportionate dwarf (Neumann ca. 1965). However, her stature of 154.1 cm is within the range of stature for the series as a whole.

Compared to other southwestern populations, males at Carter Ranch are rather tall. Mean male stature ranged from 157.2 to 161.4 cm at other prehistoric sites (Bennett 1973; Corruccini 1972; Hooton 1930; Palkovich 1980) when recalculated using Genoves's (1967) formulas. In contrast, females at Carter Ranch are rather short compared to the same series, which ranged from 146.8 to 153.7 cm. Stature estimates for Carter Ranch are within the range reported for males from modern Pueblo groups in Hrdlička's 1935 survey, but shorter than his modern Athapascans (1935). Unfortunately, too few adults in the series can be sexed using definitive pelvic indicators to analyze for dimorphism.

LINEAR ENAMEL HYPOPLASIAS

Linear enamel hypoplasias are developmental disturbances of enamel formation that appear as transverse depressions in the surface of the tooth. These lesions are linked to nutritional status and infectious diseases (Goodman and Rose 1990; Pindborg 1982). The age of the individual when the disruption occurred can be estimated.

Enamel hypoplasias were evaluated macroscopically on the buccal surface of the central incisors and canines. These teeth record most disruptions (Goodman and Armelagos 1985), and at Carter Ranch wear and caries preclude scoring of postcanine teeth. Episodes were classified as slight (visible only in low incidence lighting), moderate (visible in ordinary room lighting, ca. .5 to 1.25 mm in occluso-cervical width), or severe (> 1.5 mm in occluso-cervical width).

In all 21 adults scored, both teeth had at least one slight hypoplasia episode, and all but one

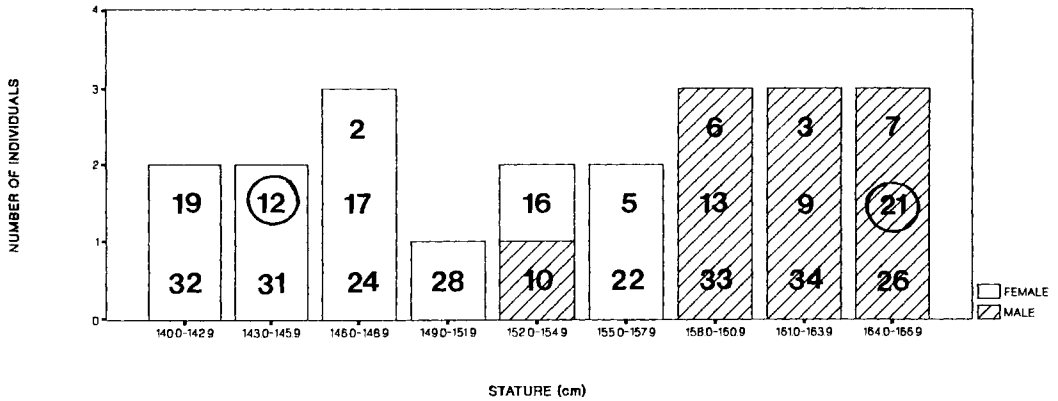


Figure 3. Distribution of adult stature. Numbers within histograms correspond to burial numbers. Unusually dolichocephalic individuals are circled.

(Burial 26) had at least one moderate episode. No severe episodes were seen. The most commonly affected enamel unit was the cervical third of the canine; 70 percent of individuals had such lesions (Figure 4). This area of enamel develops between ages four and six (Gustafson and Koch 1974). No other enamel unit yielded frequencies of moderate hypoplasias exceeding 50 percent. There were no differences by age or sex in either defect frequencies or ages at formation.

While enamel hypoplasia frequencies are not particularly low, the lack of any severe episodes reinforces the pattern of generally good health during childhood. The peak between ages four and six is similar to that found at Black Mesa (Martin et al. 1985). Palkovich (1980) and others have interpreted the peak as indicating late weaning, but it is more plausible that this region of the canine is more sensitive to metabolic disturbances than are others (Goodman and Rose 1990).

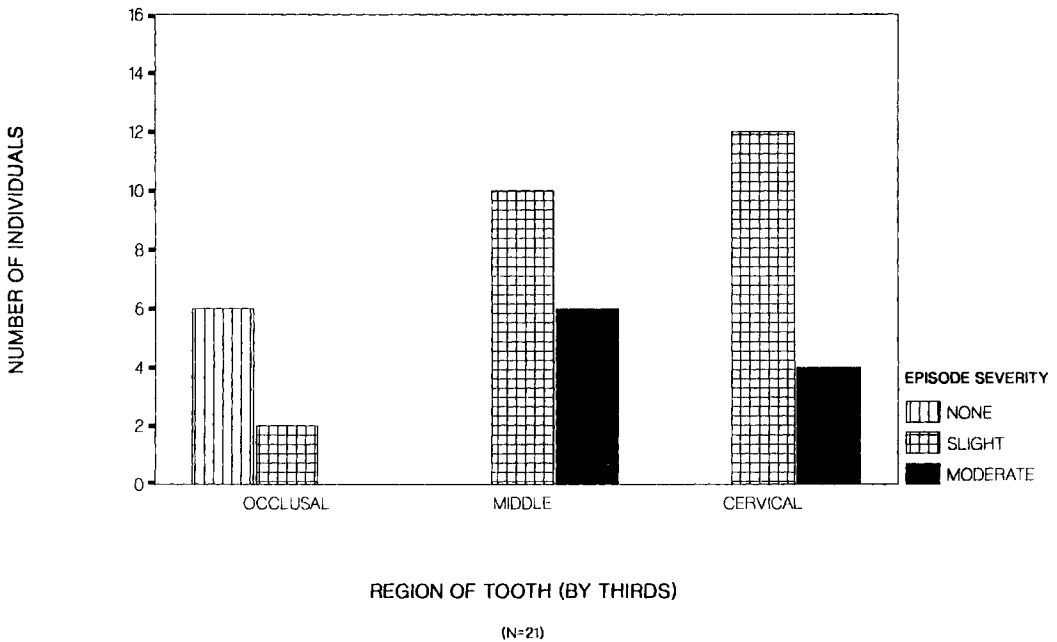


Figure 4. Linear enamel hypoplasia frequencies in adults in the canine. The occlusal third roughly corresponds to ages four months to two years, the middle third to ages two to four years, and the cervical third to ages four to six years (Gustafson and Koch 1974).

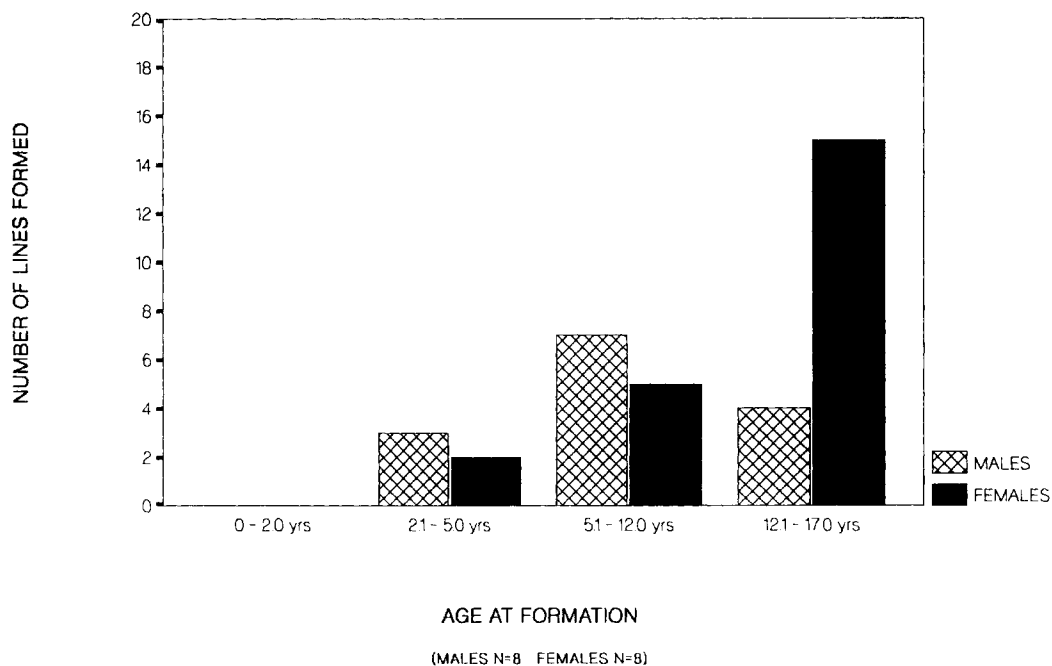


Figure 5. Age at Harris line formation among adults in the tibia.

HARRIS LINES

Harris lines, a marker of recovery from acute disruptions of growth during childhood, are lattice-like plates of bone that form at long-bone metaphyses when growth resumes (cf. Garn et al. 1968). Lines on a-p radiographs of distal femora and tibiae were scored as present if they spanned at least two-thirds of the bone diameter of the distal half of the bone. Age at line formation was estimated (Hunt and Hatch 1981). These data must be interpreted carefully since lines in older individuals may have been resorbed. While 80 percent of adults had Harris lines present in at least one bone, frequencies were very low. Mean number of Harris lines in the femur was 2.0, whereas the tibia averaged 2.5 lines per bone. Although the average number of lines was similar in males and females, age at formation did vary by sex. In both tibiae and femora, males showed a fairly even distribution of growth disruptions throughout childhood, whereas females had more frequent disruptions during later adolescence (Figure 5). This pattern does not suggest a regularly recurring stress, such as seasonal food shortages (e.g., Buikstra 1976; McHenry 1968). Lines are most likely to occur during periods of rapid growth and in relatively well-nourished individuals (Cook 1979; Dreizen et al. 1964; Garn et al. 1968; Magennis 1990). The peak in line formation between ages 12 and 17 is related to the fact that these lines have had less time to be resorbed than those formed earlier. Long-bone bowing in two adult females (Burials 3 and 19) suggests childhood rickets, and several individuals have prominent bowing of the tibiae. Plastic deformation and resultant remodeling erase previously formed Harris lines.

ANEMIA

Cribriform orbitalia is diploic thickening and porosities of the orbital roof, and porotic hyperostosis refers to similar lesions on the vault (Stuart-Macadam 1987). These lesions are attributed to anemia from a variety of causes. Anemia is among the most frequently discussed health conditions in the prehistoric Southwest. Increased frequencies of these markers have been linked to maize agriculture,

sedentism, high infectious-disease loads, and parasitism (El-Najjar et al. 1976; Kent 1987; Palkovich 1984; Walker 1985).

Four of five individuals dying before age two had active or remodeled cribra orbitalia, and two had porotic hyperostosis. The only older child with scorable orbits (Burial 29) did not display anemia lesions. This health indicator is the only one we surveyed in which Carter Ranch and other small communities resemble larger southwestern sites (El-Najjar et al. 1976; Merbs and Vestergaard 1985; Palkovich 1980; Taylor 1985; Wheeler 1985). Interobserver comparability leaves much to be desired, and we compare these studies with caution. Reinhard (1985) points out the role of population density, water supplies, and sanitation in anemia due to parasitism.

High levels of anemia at Carter Ranch and other small sites may reflect any or all of these factors. Three of 10 adults who died at 35 or younger had both healed cribra orbitalia and porotic hyperostosis. Stuart-Macadam (1987) has argued that these lesions in adults reflect childhood anemia. None of the adults over age 35 at death displayed either condition, this difference being statistically significant (Fisher's Exact Test; $p = .05$). All anemia lesions were seen in females. This sex difference was statistically significant (Fisher's Exact Test; $p = .05$). Levels of anemia among adults are similar to those at Arroyo Hondo (Palkovich 1980) and Sundown (Merbs and Vestergaard 1985), but are much lower than those for Canyon de Chelly, Chaco Canyon sites, and Inscription House (El-Najjar et al. 1976)¹. This may be a consequence of the advanced age of the Carter Ranch adults as compared with the latter groups.

ORAL PATHOLOGIES

Dental lesions were among the most common health conditions in the series (Table 3). Of 20 adults scored, two had no lesions, one was edentulous, and 12 had abscesses secondary to heavy dental wear. Only 3 percent of 451 adult teeth are carious, and the majority are wear-related associated with abscesses. This is well below the level in any maize-dependent group in Turner's study (1979), but is largely a reflection of the advanced age of the sample and the high rate of antemortem tooth loss. Of 21 scorable adults, all but three had lost teeth, averaging 5.8 teeth per person. This high level of dental disease is not unexpected in a population that had a large proportion of older people and used sandstone *metates*, as was true at Carter Ranch (Rinaldo 1964b:65-67). Merbs (personal communication 1970) has suggested that the raw material in *metates* is a factor in differences in dental wear among Southwestern populations.

Two cases of dental abscesses were potentially life-threatening. One middle-aged adult male (Burial 9) had apical abscesses associated with an active infection in the bone surrounding the inner ear with numerous drainage canals exiting through the occipital and temporal bones. A young adult male (Burial 11) had a healed, dense-walled lesion that destroyed all the anterior maxillary alveolar bone to the level of the lower border of the nasal aperture. All four upper-incisor roots are exposed in the lesion. The crown of one lateral incisor has been destroyed by caries, and the remainder show pulp exposure due to deep transverse wear grooves of the kind that Larsen (1985) has attributed to basket-making. While a very atypical periodontitis following pulp exposure is likely here, a midline maxillary tumor or cyst, or noma, a syndrome of periodontal destruction secondary to malnutrition, are possible causes.

PERIOSTEAL LESIONS

Periosteal lesions were common in the series (Table 3). These may reflect a number of infectious agents, both systemic and local, as well as trauma and noninfectious processes. All long-bone surfaces were scored for thickenings or elevations and increased vascularity. Among juveniles, levels of periostitis were surprisingly low: only one infant (Burial 23) had lesions on facial bones.

Thirteen of 24 scorable adults show periostitis, most commonly on the tibiae. No significant differences are seen with age or sex, but a higher percentage of males had vault lesions. In comparison with other southwestern sites, levels of adult periosteal lesions are moderate. They are higher than those reported for Arroyo Hondo (Palkovich 1980) and Sundown (Merbs and Vestergaard 1985), but lower than those reported for Pecos (Hooton 1930).

Table 3. Frequencies of Pathologies by Sex and Age.

	By Sex		By Age (in years)			
	M	F	0-2	3-18	18-34	35+
Maximum n	13	13	6	2	11	15
Cranial periosteal lesions	.58*	.23*	.25	.00	.50	.40
Postcranial periosteal lesions	.55	.62	.25	.00	.60	.57
Cribra orbitalia/porotic hyperostosis	.00**	.31**	.80	.00	.30**	.00**
Dental lesions (except caries)	.83	.69	.00	.00	.67	.80
Arthritis	.75	.38	.00	.00	.30**	.73**
Trauma	.33	.23	.80	.00	.27	.29
Treponematosi	.08	.15	.00	.00	.27*	.00*
Osteoporosis	.08	.23	.00	.00	.07	.27
Harris lines (tibia)	.89	.73	-	-	.75	.83
Linear enamel hypoplasias (≥ 1 moderate episode present)	.72	.85	-	.00	.70	.90

* = .05 < p < .10.

** = p < .05.

As at Black Mesa (Martin et al. 1985), lesions at Carter Ranch are not localized, suggesting a systemic etiology. The lack of periosteal lesions in children here and at other southwestern sites suggests that endemic treponematosi was not common, especially compared to high frequencies in the Southeast or Midwest (Cook 1976; Powell 1988). In three young adults, lesions were distributed in a pattern suggesting treponemal disease. The most convincing case is a female (Burial 16) who had lesions on the humerus and stellate scars on the cranial vault.

The absence of patterning suggestive of treponematosi among older adults is perhaps surprising because we expect to see lesions increase in frequency with age. Overall, these findings suggest a more bejel like, or less yaws like, pathogen in the Southwest. Lahr and Bowman (1992) have recently argued for the presence of venereal syphilis at Kechipawan, but we find their evidence more consistent with endemic treponematosi.

DEGENERATIVE CONDITIONS

Considering the advanced age of many individuals in the series, it is not surprising that many degenerative conditions were present (Table 3). Arthritis levels were significantly higher in individuals over 35 compared to those dying before that age (Fisher's Exact Test; $p = .02$). Twice as many males as females showed arthritis, but this difference was not statistically significant in this very small sample. Burial 26 may have had an inherited arthritis syndrome: ankylosing spondylitis. The superior half of the right sacroiliac joint is fused, but there is no loss of joint space. Exostoses of the posterior aspects of the distal fibulae and marginal lipping of all appendicular joints support the diagnosis.

TRAUMA

Trauma is very common (Table 3). One-quarter of 24 scorable adults had healed fractures. There are two nasal fractures, one associated with a broken mandible and the other with a broken humerus, two radius fractures, a clavicle fracture, and a femur fracture. Four of the six cases can be interpreted as the result of blows. Two individuals (Burials 11 and 34) show spondylolysis. These injuries and a crush fracture of the pelvis (Burial 34) may be linked to falls. A pseudoarthrosis of a fractured clavicle in an adult male (Burial 33) would have imposed a significant disability. Bone density in the population is generally low, contributing to compression fractures of vertebrae in four males and one female, all 35-50 years of age (Burials 3, 5, 6, 33, and 34). These frequencies of trauma are much higher than those reported for Pecos (Hooton 1930) or Kechipawan (Lahr and Bowman 1992), but are similar to those seen in crania from the protohistoric populations at Hawikuh and

San Cristobal (Stodder 1990). These findings may suggest a disability-related access to burial at Carter Ranch Pueblo (cf. Buikstra 1981).

GENETIC SYNDROMES

Several individuals in the series have atypically short femora with very short necks that are sharply angled perpendicular to the shaft. In these individuals, the femoral head often overrides the neck, producing a deep sulcus on the inferomedial margin. The associated acetabulum is quite shallow as well. In one juvenile (Burial 25), there is a small reactive sulcus in the proximal femur diaphysis that resembles the neck morphology of the abnormal adult femora. This dysplasia of the proximal femur appears to match very well the self-limiting hip dysplasia syndrome in modern Navajo. Rabin et al. (1965) argue that this is a genetically caused condition that corrects itself in part because cradleboards function like orthopedic braces.

Evidence for Klippel-Feil syndrome, an inherited dysmorphology, is present in a young adult male (Burial 11). There is congenital fusion of the second and third cervical vertebrae, spondylolysis and premature suture closure. The syndrome has been reported in other southwestern samples (Merbs and Euler 1985; Miles 1975; Wade 1981).

The Carter Ranch series is unusual in the degree of premature suture closure present. The sphenotemporal suture of most adults had begun fusion, and one individual (Burial 19) with premature coronal closure is somewhat more brachycephalic than one would expect given the cranial deformation characteristic of the series. Another female skull (Burial 12) stands out as being of different shape from the remainder in that it is very small but quite long and narrow. The cranial index is 68: dolichocranic in an otherwise meso- to brachyranic series. This shape is a consequence of premature sagittal closure with platybasia. This individual was the one previously identified as a proportional dwarf by Holm Neumann. While the individual is not technically a dwarf in stature, these features point to one of the short stature/cranial anomaly syndromes. A young adult male (Burial 21) also showed the same cranial shape and suture closure pattern, but is at the upper end of the stature range (Figure 3). These skulls were singled out by Skomp (1965) as showing a different deformation pattern, with occipital rather than lambdoidal flattening. We find that this difference is attributable to premature suture closure rather than cultural practices.

ARCHAEOLOGICAL CONSIDERATIONS

Our tables include several age and sex assignments that differ from Longacre's (1970:42). Sex discrepancies affect a portion of his social analysis. Longacre (1970) suggested that one burial area represents a religious sodality because of preponderance of males and ceremonial goods in these burials. He lists four males, one female, and one infant. We found the opposite: two males, four females, and two infants. Grave goods support our assessment. Longacre lists Burials 15 and 19 as having red "loincloths." In the site report, Rinaldo (1964a) discusses red "aprons" being found with two female burials, noting that similar items have been excavated with female burials at other sites. He concludes, "Apparently they were not an item of men's clothing" (Rinaldo 1964a:107). We find no reason to distinguish this group on demographic grounds.

LIFE IN A SMALL PREHISTORIC SOUTHWESTERN COMMUNITY

Although our conclusions are tenuous in light of the small sample sizes and probable mortuary practice biases, analysis of the skeletal remains from Carter Ranch suggests a relatively well-adapted population. Thus, our data conform to health expectations in a small village in the prehistoric Southwest.²

Juveniles experienced some health disruptions as evidenced by linear enamel hypoplasias, Harris lines, and anemia. Stature suggests reasonably good access to resources. Childhood diseases linked to malnutrition and crowding are less evident than at larger sites. Adults at Carter Ranch also appear to have coped quite successfully with challenges posed by their environment. Half the sample survived to at least age 35. Accompanying this longevity were increased levels of age-related health conditions, such as arthritis and oral pathologies.

There also appear to be certain health consequences associated with living a small community. The Carter Ranch people had a relatively high concentration of genetic anomalies. Femoral dysplasia, Klippel-Feil syndrome, ankylosing spondylitis, and short stature/cranial anomaly syndrome all represent genetically inherited conditions. Rates of trauma were also unusually high. Thus, the question must be raised as to whether other small Pueblo communities were similarly burdened. It may be that these high frequencies of pathologies speak to mortuary practices differentiated by ability to work or other factors. The relative genetic isolation of this small population may be reflected here as well.

Longacre's analysis of social organization at Carter Ranch is oddly missing from recent discussions of cultural explanation in southwestern prehistory (Minnis and Redman 1990; Spielmann 1991). It has moved from being required reading for every graduate student in archaeology to that peculiar void that separates science from history of science. Longacre's (1968) summation of his work may offer some clues to this eclipse.

The Carter Ranch Site stands as a turning point in the prehistory of this particular region of the Southwest. The occupation of the site by two residence units ushers in an era of population aggregation in the area. . . . The process of aggregation coincides with the onset of a period of environmental stress and would seem to be an adaptive response on the part of these extinct societies. The initial set of adaptive changes documented at the Carter Ranch Site are a prelude to the even greater changes that appear in the region by 1300 (cf. Hill 1966) [Longacre 1968:101].

Explanation in southwestern prehistory has shifted from the ecological focus of the new archaeology to more complex social causes (e.g., Wilcox 1991). We find no evidence for health consequences of environmental deterioration, as the ecological model might lead us to expect. On the other hand, our evidence for isolation contradicts the newer models of regional integration and hierarchy within which we might view Carter Ranch. The series is too small to fulfill the potential it once offered in providing a test of Longacre's hypotheses about social organization, but it is able to document health patterns at the small sites in which most prehistoric inhabitants of the Southwest resided.

Acknowledgments. We would like to thank William A. Longacre, J. Jefferson Reid, and several anonymous reviewers for their valuable comments while preparing this manuscript. We would also like to thank the Field Museum of Natural History for access to the material.

REFERENCES CITED

- Bennett, K. E.
1973 *The Indians of Point of Pines, Arizona: A Comparative Study of Their Physical Characteristics*. Anthropological Papers No. 23. University of Arizona, Tucson.
- Berry, D. R.
1985 Aspects of Paleodemography at Grasshopper Pueblo, Arizona. In *Health and Disease in the Prehistoric Southwest*, edited by C. F. Merbs and R. J. Miller, pp. 43–64. Anthropological Research Papers No. 34. Arizona State University, Tempe.
- Buikstra, J. E.
1976 The Caribou Eskimo: General and Specific Disease. *American Journal of Physical Anthropology* 45: 351–368.
1981 Mortuary Practices, Palaeodemography and Palaeopathology: A Case Study from the Koster Site (Illinois). In *The Archaeology of Death*, edited by R. Chapman, I. Kinnes, and K. Randsborg, pp. 123–132. Cambridge University Press, Cambridge.
- Cook, D. C.
1976 *Pathological States and Disease Process in Five Illinois Woodland Populations: An Epidemiological Model*. Unpublished Ph.D. dissertation, Department of Anthropology, University of Chicago, Chicago.
1979 Subsistence Base and Health in Prehistoric Illinois Valley. *Medical Anthropology* 12:111–125.
- Corruccini, R. J.
1972 The Biological Relationship of Some Prehistoric and Historic Pueblo Populations. *American Journal of Physical Anthropology* 37:373–388.
- Danforth, M. E., and D. C. Cook
1991 An Osteological Analysis of Social Organization at Carter Ranch Pueblo, Arizona. *Proceedings of the Indiana Academy of Sciences* 101:101–110.
- Dreizen, S., C. N. Spirakis, and R. E. Stone
1964 The Influence of Age and Nutritional Status on "Bone Scar" Formation in the Distal End of the Growing Radius. *American Journal of Physical Anthropology* 22:295–306.

- El-Najjar, M. Y., D. J. Ryan, C. G. Turner, and B. Lozoff
1976 The Etiology of Porotic Hyperostosis Among the Prehistoric and Historic Anasazi Indians of Southwestern United States. *American Journal of Physical Anthropology* 44:477-488.
- Falkner, F. T., and J. M. Tanner (editors)
1986 *Human Growth: A Comprehensive Treatise*. Plenum, New York.
- Garn, S. M., F. N. Silverman, K. P. Hertzog, and C. G. Rohmann
1968 Lines and Bands of Increased Density: Their Implications to Growth and Development. *Medical Radiography and Photography* 44:58-88.
- Genoves, S.
1967 Proportionality of the Long Bones and Their Relation to Stature Among Mesoamericans. *American Journal of Physical Anthropology* 26:67-77.
- Gilman, P. A.
1990 Social Organization and Classic Mimbres Period Burials in the SW United States. *Journal of Field Archaeology* 17:457-471.
- Goodman, A. H., and G. J. Armelagos
1985 Factors Affecting the Distribution of Enamel Hypoplasias Within the Human Permanent Dentition. *American Journal of Physical Anthropology* 68:479-494.
- Goodman, A. H., and J. C. Rose
1990 Assessment of Systematic Physiological Perturbations from Dental Enamel Hypoplasias and Associated Histological Structures. *Yearbook of Physical Anthropology* 33:59-110.
- Gustafson, B. E., and G. Koch
1974 Age Estimation Up to 16 Years of Age Based on Dental Development. *Odontologisk Revy* 25:297-306.
- Haviland, W. A.
1967 Stature at Tikal, Guatemala: Implications for Ancient Maya Demography and Social Organization. *American Antiquity* 32:316-325.
- Hill, J. N.
1970 Prehistoric Social Organization in the American Southwest. In *Reconstructing Prehistoric Pueblo Society*, edited by W. A. Longacre, pp. 11-58. University of New Mexico Press, Albuquerque.
- Hinkes, M. J.
1983 *Skeletal Evidence of Stress in Subadults: Trying to Come of Age at Grasshopper Pueblo*. Unpublished Ph.D. dissertation, Department of Anthropology, University of Arizona, Tucson.
- Hooton, E. A.
1930 *The Indians of Pecos Pueblo*. Yale University Press, New Haven.
- Hrdlička, A.
1935 The Pueblos; With Comparative Data in the Builds of the Tribes of the Southwest and Northern Mexico. *American Journal of Physical Anthropology* 20:235-460.
- Hunt, E. E., and J. W. Hatch
1981 The Estimation of Age at Death and Ages of Formation of Transverse Lines from Measurements of Human Long Bones. *American Journal of Physical Anthropology* 54:461-469.
- Huss-Ashmore, R., A. H. Goodman, and G. J. Armelagos
1982 Nutritional Inference from Paleopathology. In *Advances in Archaeological Method and Theory*, vol. 5, edited by M. B. Schiffer, pp. 395-474. Academic Press, New York.
- Kent, S.
1987 The Influence of Sedentism and Aggregation on Porotic Hyperostosis and Anemia: A Case Study. *Man* (n.s.) 21:605-636.
- Lahr, M. M., and J. E. Bowman
1992 Paleopathology of the Kechipawan Site: Health and Disease in a Southwestern Pueblo. *Journal of Archaeological Science* 19:639-654.
- Larsen, C. S.
1985 Dental Modifications and Tool Use in the Western Great Basin. *American Journal of Physical Anthropology* 67:393-402.
- Longacre, W. A.
1964 Archaeology as Anthropology: A Case Study. *Science* 144:1454-1455.
1968 Some Aspects of Prehistoric Society in East-Central Arizona. In *New Perspectives in Archaeology*, edited by S. R. Binford and L. R. Binford, pp. 89-102. Aldine, Chicago.
1970 *Archaeology as Anthropology: A Case Study*. Anthropological Papers No 17. University of Arizona, Tucson.
- McHenry, H. M.
1968 Transverse Lines in Long Bones in Prehistoric California Indians. *American Journal of Physical Anthropology* 29:1-17.
- Magennis, A. L.
1990 *Growth and Transverse Line Formation in Contemporary Children*. Unpublished Ph.D. dissertation, Department of Anthropology, University of Massachusetts, Amherst.

- Martin, D. L., C. Piacentini, and G. J. Armelagos
1985 Paleopathology of the Black Mesa Anasazi: A Biocultural Approach. In *Health and Disease in the Prehistoric Southwest*, edited by C. F. Merbs and R. J. Miller, pp. 104–112. Anthropological Research Papers No. 34. Arizona State University, Tempe.
- Martin, P. S., J. B. Rinaldo, W. A. Longacre, L. G. Freeman, J. A. Brown, R. H. Hevly, and M. E. Cooley
1964 *On the Prehistory of Eastern Arizona, II*. Fieldiana: Anthropology Vol. 55. Field Museum of Natural History, Chicago.
- Merbs, C. F., and R. C. Euler
1985 Atlanto-occipital Fusion and Spondylolisthesis in an Anasazi Skeleton from Bright Angel Ruin, Grand Canyon National Park, Arizona. *American Journal of Physical Anthropology* 67:381–392.
- Merbs, C. F., and E. M. Vestergaard
1985 The Paleopathology of Sundown, a Prehistoric Site Near Prescott, Arizona. In *Health and Disease in the Prehistoric Southwest*, edited by C. F. Merbs and R. J. Miller, pp. 85–103. Anthropological Research Papers No. 34. Arizona State University, Tempe.
- Miles, J. S.
1975 *Orthopedic Problems of the Wetherill Mesa Populations*. Publications in Archeology No. 7G. Wetherill Mesa Studies, National Park Service, Washington, D.C.
- Minnis, P. E., and C. L. Redman (editors)
1990 *Perspectives on Southwestern Prehistory*. Westview Press, Boulder, Colorado.
- Neumann, H.
ca. 1965 Notes on file, Department of Anthropology, Indiana University, Bloomington.
- Paine, R. R.
1989 Model Life Tables as a Measure of Bias in the Grasshopper Pueblo Skeletal Series. *American Antiquity* 54:820–824.
- Palkovich, A. M.
1980 *The Arroyo Hondo Skeletal and Mortuary Remains*. Arroyo Hondo Archaeological Series, vol. 3. School of American Research Press, Santa Fe.
1984 Agriculture, Marginal Environments, and Nutritional Stress in the Prehistoric Southwest. In *Paleopathology at the Origins of Agriculture*, edited by M. N. Cohen and G. J. Armelagos, pp. 425–438. Academic Press, New York.
- Pindborg, J. J.
1982 Aetiology of Developmental Enamel Defects Not Related to Fluorosis. *International Dental Journal* 32:123–134.
- Plog, F.
1979 Prehistory: Western Anasazi. In *Southwest*, edited by A. Ortiz, pp. 108–130. *Handbook of North American Indians*, vol. 9, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Powell, M. L.
1988 *Status, Health and Prehistory: A Case Study of the Moundville Chiefdom*. Smithsonian Institution, Washington, D.C.
- Rabin, D. L., C. R. Barnett, W. D. Arnold, R. H. Freiberger, and G. Brooks
1965 Untreated Congenital Hip Disease: A Study of the Epidemiology, Natural History and Social Aspects of the Disease in a Navajo Population. *American Journal of Public Health* 55 (supplement to February): 1–44.
- Reinhard, K. J.
1985 Parasitism at Antelope House: A Puebloan Village in Canyon de Chelly, Arizona. In *Health and Disease in the Prehistoric Southwest*, edited by C. F. Merbs and R. J. Miller, pp. 220–233. Anthropological Research Papers No. 34. Arizona State University, Tempe.
- Rinaldo, J. B.
1964a Artifacts. In *Chapters in the Prehistory of Eastern Arizona, II*, by P. S. Martin, J. B. Rinaldo, W. A. Longacre, L. G. Freeman, J. A. Brown, R. H. Hevly, and M. E. Cooley, pp. 63–109. Fieldiana: Anthropology Vol. 55. Field Museum of Natural History, Chicago.
1964b Burials and Mortuary Customs. In *Chapters in the Prehistory of Eastern Arizona, II*, by P. S. Martin, J. B. Rinaldo, W. A. Longacre, L. G. Freeman, J. A. Brown, R. H. Hevly, and M. E. Cooley, pp. 59–62. Fieldiana: Anthropology Vol. 55. Field Museum of Natural History, Chicago.
- Skomp, D.
1965 *Racial Continuity in the American Southwest: An Example of Carter Ranch Pueblo Physical Relationships*. Unpublished Master's thesis. Department of Anthropology, Indiana University, Bloomington.
- Spielmann, K. A. (editor)
1991 *Farmers, Hunters and Colonists: Interaction Between the Southwest and the Southern Plains*. University of Arizona Press, Tucson.
- Stewart, T. D.
1979 *Essentials of Forensic Anthropology*. C. C. Thomas, Springfield, Illinois.
- Stodder, A. L. W.
1990 *Paleoepidemiology of Eastern and Western Pueblo Communities in Protohistoric New Mexico*. Unpublished Ph.D. dissertation, Department of Anthropology, University of Colorado, Boulder.

- Storey, R.
1985 An Estimate of Mortality in a Pre-Columbian Urban Population. *American Anthropologist* 87:519–535.
- Stuart-Macadam, P.
1987 A Radiographic Study of Porotic Hyperostosis. *American Journal of Physical Anthropology* 74:511–520.
- Taylor, M. G.
1985 The Paleopathology of a Southern Sinagua Population from Oak Creek Pueblo, Arizona. In *Health and Disease in the Prehistoric Southwest*, edited by C. F. Merbs and R. J. Miller, pp. 115–118. Anthropological Research Papers No. 34. Arizona State University, Tempe.
- Thomas, D. H.
1989 *Archaeology*. 2nd ed. Holt, Rinehart and Winston, Fort Worth.
- Turner, C. G. III
1979 Dental Anthropological Indications of Agriculture Among the Jomon People of Central Japan. *American Journal of Physical Anthropology* 51:619–648.
- Wade, W. D.
1981 Klippel-Feil Syndrome in a Prehistoric Population of Northern Arizona. *Mercury Series Paper* 106: 115–126. National Museum of Man, Archeological Survey of Canada, Ottawa.
- Wadsworth, G.
1984 *The Diet and Health of Isolated Populations*. CRC Press, Boca Raton, Florida.
- Walker, P. L.
1985 Anemia Among Prehistoric Indians of the American Southwest. In *Health and Disease in the Prehistoric Southwest*, edited by C. F. Merbs and R. J. Miller, pp. 139–164. Anthropological Research Papers No. 34. Arizona State University, Tempe.
- Weiss, K.
1973 *Demographic Models for Anthropology*. Memoirs No. 27. Society for American Archaeology, Washington, D.C.
- Wheeler, R. L.
1985 Pathology in Late Thirteenth Century Zuni from the El Morro Valley, New Mexico. In *Health and Disease in the Prehistoric Southwest*, edited by C. F. Merbs and R. J. Miller, pp. 79–84. Anthropological Research Papers No. 34. Arizona State University, Tempe.
- Wilcox, D. R.
1991 Changing Contexts of Pueblo Adaptation, A.D. 1250–1600. In *Farmers, Hunters, and Colonists: Interaction Between the Southwest and the Southern Plains*, edited by K. A. Spielmann, pp. 128–154. University of Arizona Press, Tucson.
- Zubrow, E. B. W.
1975 *Prehistoric Carrying Capacity: A Model*. Cummings, Menlow Park, California.
1976 Stability and Instability: A Problem in Long-Term Regional Growth. In *Demographic Anthropology: Quantitative Approaches*, edited by E. B. W. Zubrow, pp. 245–274. University of New Mexico, Albuquerque.

NOTES

¹ These data are difficult to compare with frequencies at other sites (e.g., Kechipawan), which have not been broken down by age and sex.

² The role of diet in the health of the inhabitants of Carter Ranch is difficult to assess because the results of the floral and faunal analyses have not been published. Flotation was not practiced in Field Museum excavations in Arizona until 1969.

Received February 4, 1991; accepted May 3, 1993