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Dental Health Diet and Social Status among Central African Foragers and Farmers

An oral health survey of African pygmies and Bantu revealed significant contrasts that can be explained by differences in diet, social status, and oral hygiene. Pygmy men have fewer carious lesions and less tooth loss than pygmy women. Ethnographic data suggest that this results from sex differences in eating habits and access to cariogenic foods. Pygmy "leaders" have much better dental health than "nonleaders." This status difference appears to be explained by social and dietary variables.

THIS ARTICLE PRESENTS THE RESULTS OF A DENTAL HEALTH SURVEY of pygmy hunter-gatherers and Bantu horticulturalists living in the Central African Republic and Zaire (Figure 1).[1] One goal of the study was to test a series of hypotheses we formulated based on previous ethnographic research concerning correlations between a person's sex, social status, and diet. Another purpose of the survey was to collect information for use by archeologists and physical anthropologists who reconstruct prehistoric behavior patterns using dental evidence. By investigating the sociocultural variables that influence the dental health of ethnographically well-documented groups of hunter-gatherers and agriculturalists, we hoped to strengthen the empirical basis for interpreting variation in the dental health of prehistoric populations.

Ethnographic Background

The Aka, Mbuti, and Efe pygmy groups are mobile, tropical forest foragers who obtain most of their food through hunting and trading. The Aka are primarily net-hunters and reside in the southern forests of the Central African Republic. The Mbuti and Efe forage in the Ituri forest of northeastern Zaire. The Mbuti specialize in net-hunting and occupy the central and southern Ituri. The Efe are bow-hunters of the northern and eastern Ituri (Figure 1). The relative contributions of hunting and gathering to the subsistence of these pygmies fluctuate from season to season. For example, during the drier season (January to May) when they are in the forest, the Aka spend about 67.2% of their day on net hunts. During part of the rainy season (August to September), in contrast, 60% of their day is spent collecting foods, especially caterpillars (Bahuchet 1988). Much of the vegetable food in the pygmy diet is obtained through trading meat to farmers for manioc and other cultigens. Seldom does a day go by without some of this food being eaten. When hunting in the forest, they exchange game for manioc that Bantu farmers bring to their camp.

The ratio of meat to plant foods in the pygmy diet varies on a seasonal basis. The Aka, for example, reside in villages for three or four months each year to help their Bantu "patrons" in clearing fields. At these times, the proportion of agricultural produce in the

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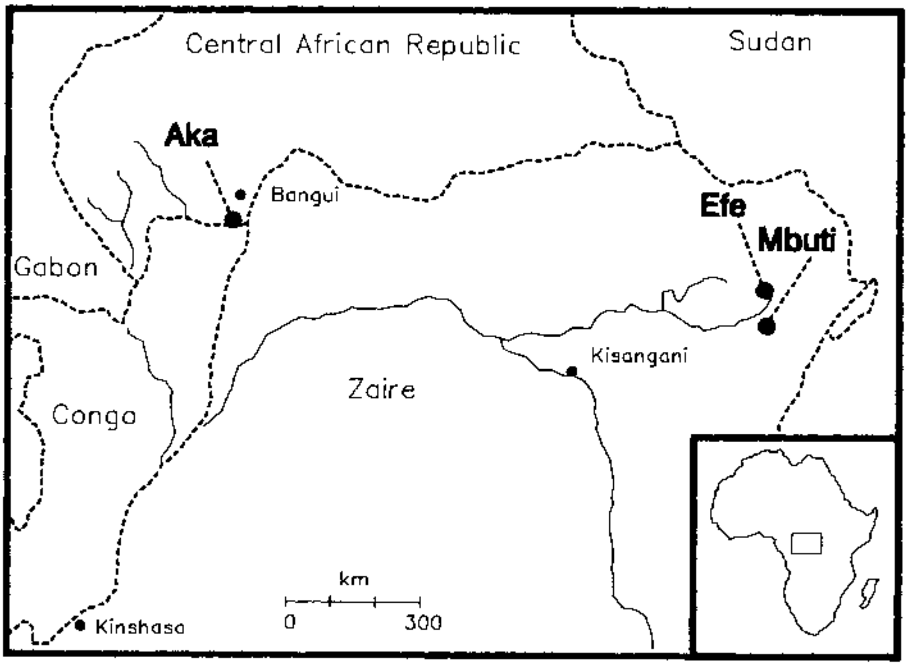

Figure 1
Map of the study area.

diet is often high and meat is seldom consumed. In the forest camps, game is more abundant and meat is often a daily part of the diet.

Some quantitative data are available on the diets of the groups studied. Meat made up 49% of the diet, by weight, of a group of net-hunting Mbuti during the 26-day period they were observed by Hart (1978:340). Since Mbuti depend more heavily on agricultural produce when they are not net-hunting, the year-round percentage of meat in the diet would be lower. Data on a group of Efe show that over a one-year period, about 13.3% of their diet, by weight, consists of meat (Bailey and Peacock 1988). A significant dietary difference between the Mbuti and Efe is suggested by Hill's (1982) cross-cultural survey of meat consumption by foragers. The meat yield of Mbuti net-hunting is among the highest reported for any tropical hunting peoples, while that of the Efe is probably the lowest.

Comparable data on the Aka do not exist. Since they are net-hunters like the Mbuti, it is assumed that their diet is similar to that of the Mbuti. Bahuchet (1988:135) has measured the frequency of different types of foods in the Aka diet and states, "it is evident that products of agricultural origin are always present in equal proportions to wild products." In the tables that he provides, "wild foods" refers primarily to meat. He also reports a relatively high frequency of meat (36%) in the diet. While not directly comparable, his Aka frequency data are consistent with the quantitative data on Mbuti diet.

There is some indication that Aka and Mbuti have less frequent access to horticultural produce than do the Efe. Aka and Mbuti tend to stay in the forest camps seven to eight months a year, while the Efe spend only about five months in the forest (Bailey and Peacock 1988). Efe forest camps also appear to be closer to villages than those of Mbuti and Aka. Bailey and Peacock never had to walk more than eight hours from the village to an Efe camp, while in Hewlett's experience among the Aka, twenty hours of walking were required to reach the most distant hunting camp visited.

Because they lack cash, most pygmies have little or no access to sugar or other highly cariogenic, refined carbohydrates. The only exception to this is the period of about two months each year when honey is collected. The extent to which the groups we surveyed differ in the consumption of this cariogenic food is unclear. Bailey and Peacock (1988) estimate that honey provides 42.7% of the caloric intake of Efe during the honey season (August). Bahuchet (1988) reports that the frequency with which honey is found in the Aka diet never exceeds 25%. Ichikawa (1981) reports that during the Mbuti honey season (June), honey contributes as much as 80% of their caloric intake.

There is some evidence that the diets of pygmy women contain more plant foods than those of the men. Pygmy men, in contrast, appear to consume more meat than pygmy women. Among the net-hunting Mbuti, men are the only ones to eat the head, liver, and heart of the animal, and men regularly eat separately from women (Tanno 1976:120). Men eat in the center of the camp and receive plates from each woman who prepares a meal. The leader of the net hunt is given all the heads of the game captured and then shares them as he wishes with other men. Among the Aka, men and women usually eat together, but after especially successful hunts men will eat together and then join their wives and children with their meal. Aka men also go away for pig or elephant hunts for days or weeks at a time, and eat primarily meat while they are away (Hewlett, van de Koppel, and Cavalli-Sforza 1982). The Aka women collect fruits, nuts, and tubers while the men are gone. Aka men also travel more often and for greater distances than do Aka women. Husbands hunt while traveling. At these times, their wives help relatives with their nets to get some meat. The women get less meat during these periods because their husbands are not there to carry and set up the family net.

The diets of Efe men and women may also differ. Bailey (1985:167) suggests that Efe men and women are oriented to two distinct worlds. "Women are oriented toward the village. The resources women acquire come mostly from the village world and they are as much a part of the production of cultivated foods as are most Lese. . . . In contrast, men are more oriented toward the forest world. Their activities take place mostly in the forest and the resources they acquire come from the forest." If men are spending more time in the forest and women more time in the village, men may be snacking on forest foods (meat and nuts) throughout the day, while the women may be snacking on village foods (carbohydrates) during the day.

It is possible that social distinctions other than gender have an influence on diet in some pygmy groups. Although there is comparatively little status differentiation within pygmy society, a few people are unusually influential and assume the position of "leader." These leaders are called *kombeti* by the Aka and *kapita* by the Mbuti and Efe. They are generally listened to during discussions of proposed subsistence activities and camp movements and also assume a prominent role in negotiating with the Bantu farmers. They do not hold any absolute authority over others and often exert their influence in subtle, modest ways. Among the Aka, men are usually 45 years of age or older when they become *kombeti*. This position is usually occupied by one of the oldest active male members of the dominant clan segment represented in the camp. A new leader emerges when the current leader dies or no longer makes a consistent contribution to the camp through actively hunting, gathering, or serving as a traditional healer. Although the *kombeti* and *kapita* who were examined as part of our research demonstrated influence over camp affairs, in some pygmy groups these titles mean little (Turnbull 1965a:51).

The diet of the Bantu villagers consists primarily of manioc, plantains, maize, rice, and peanuts. Although these people occasionally hunt with snares, much of their meat is obtained from pygmy hunters. Although no quantitative data exist on the diets of the specific "Bantu" populations we surveyed, a recent study of the Boyela, a group of horticultural farmers living near our study area, indicates that as little as 2.5% of their diet consists of meat (Sato 1983).

Access to sugar and other refined carbohydrates is limited by a lack of cash to buy these expensive commercial foods. Bantu men are responsible for growing coffee, the main cash crop. They also occasionally do wage labor for plantation owners, and sometimes prospect for gold and diamonds. This gives them a cash income and, therefore, greater access to refined carbohydrates than the women.

The pygmies and Bantu differ markedly in dental hygiene practices. Many of the pygmies who participated in the survey reported washing their mouth out with water as the only technique they used to clean their teeth. The Bantu, in contrast, consistently reported using chew sticks and toothbrushes to clean their teeth.

The culinary practices of the pygmies and villagers also differ. Pygmies are what has been termed "immediate return" hunter-gatherers (Woodburn 1982). They tend to eat their food as soon after they obtain it as possible and do not like to spend time in food preparation. For example, pygmies do not mind eating the coarse manioc tuber before it has been soaked in water for a few days, something that the villagers would consider "primitive." The flour pygmies prepare from manioc is also often coarser and grittier than that prepared by the villagers. Pygmies do not grind their manioc as long or as carefully as villagers, and dirt is much more likely to get into pygmy manioc because they seldom scrub their cooking pots as villagers do.

These ethnographic data provide a basis for several hypotheses regarding the dental health of the groups surveyed. Clinical, experimental, and archeological evidence clearly links carbohydrate-rich diets to a high frequency of carious lesions. Diets rich in protein and fat, in contrast, tend to result in low caries rates (DePaloa 1982; Nizel 1973; Pedersen 1938; Turner 1979; Walker and Erlandson 1986). Based on the dietary differences discussed above, we predict that the net-hunting pygmies (Mbuti and Aka) with the greatest access to animal protein should have the lowest frequency of carious lesions, the Efe should have an intermediate number, and Bantu with their carbohydrate-rich diet should have the highest prevalence. Since pygmy males appear to have somewhat greater access to animal protein than females, we would expect them to have a comparatively low frequency of carious lesions. Bantu men, in contrast, would be likely to have a higher prevalence of carious lesions than Bantu women because of their greater access to refined carbohydrates.

Data Collection

The observations reported here were made by Hewlett during August 1985 and September 1987. The Mbuti and Efe who participated in the survey live about 10 km east of Mambasa in Zaire. The Mbuti pygmies are associated with the small villages of Mandima, Mambau, Bandisow, Madadudu, and Zungaluka, while the villagers come primarily from Mambau. The Efe participants are associated with small villages near Nduye and the Aka with the Bokoka section of Bagandou village in the Central African Republic (see Figure 1).

Age estimation techniques varied with the different populations. The Bantu knew at least their years of birth, so there was no difficulty establishing their ages. Hewlett had worked with the Aka for over ten years and had established a detailed event chart by which years of birth for the Aka were estimated (Hewlett, van de Koppel, and van de Koppel 1985). Dental eruption and other developmental markers (e.g., pubic hair, menopause) were also considered in estimating Aka ages. The Mbuti and Efe ages are less reliable, as the individuals in these two Zairian populations were less well known to Hewlett. Ages in these populations were estimated from dental eruption, developmental markers, and life-history events (e.g., number of children). These age estimates were made without reference to the extent of dental attrition. Demographic data on the groups surveyed are presented in Table 1.

Observation of the presence, absence, and size of carious lesions was made visually, after wiping the teeth with gauze. The position of each carious lesion, the presence of broken teeth, and missing teeth were recorded by drawing them on data sheets containing diagrams of the dentition's labial, lingual, and occlusal surfaces. These drawings were

Table 1
Demographic data on populations surveyed (*N* = number of individuals examined, % = percent of total).

Group/Sex		Age in years < 20	20–40	40–60	60–80	Total
Aka						
Males	*N*	8	38	13	2	61
	%	13.11	62.30	21.31	3.28	
Females	*N*	8	33	7	1	49
	%	16.33	67.35	14.29	2.04	
Total	*N*	16	71	20	3	110
	%	14.55	64.55	18.18	2.73	
Mbuti						
Males	*N*	3	18	12	1	34
	%	8.82	52.94	35.29	2.94	
Females	*N*	4	14	7	2	27
	%	14.81	51.85	25.93	7.41	
Total	*N*	7	32	19	3	61
	%	11.48	52.46	31.15	4.92	
Efe						
Males	*N*	0	7	3	0	10
	%	0.00	70.00	30.00	0.00	
Females	*N*	0	0	0	0	0
	%	0.00	0.00	0.00	0.00	
Total	*N*	0	7	3	0	10
	%	0.00	70.00	30.00	0.00	
Bantu						
Males	*N*	0	4	5	1	10
	%	0.00	40.00	50.00	10.00	
Females	*N*	1	6	4	0	11
	%	9.09	54.55	36.36	0.00	
Total	*N*	1	10	9	1	21
	%	4.76	47.62	42.86	4.76	

later used to classify each lesion as "small" if it involved less than one-third of the crown or "large" if it involved more than one-third of the crown. During our 1987 fieldwork, oral hygiene and dental attrition were assessed using scales based on those used by Reade (1965:368). Oral hygiene was scored according to the amount of retained food debris and dental calculus using the following scale:

None: No or minimal food debris present in the mouth.
Moderate: Food debris covering the gingival one-third or less of the crowns of the teeth with or without calculus.
Heavy: Food debris covering more than the gingival one-third of the crown associated with considerable calculus.

Each dentition was assigned to one of the following attrition categories based on the condition of the molars:

Slight: Little or no dental wear and no cusp obliteration or exposure of dentin.
Moderate: Cusps worn and dentin exposed.

Heavy: Marked occlusal wear with obliteration of occlusal surface features.
Very heavy: Extensive wear resulting in marked reduction in the height of the crown.

Results

The dental health of the pygmies and villagers differs in several respects. Although the Bantu surveyed had an older average age than the pygmies, they had a lower frequency of missing teeth. The prevalence of carious lesions, on the other hand, was higher among the villagers than the pygmies (Table 2).

No major differences are apparent between the Aka and Mbuti net-hunters. The Mbuti have a somewhat higher frequency of diseased and missing teeth than the Aka, but this can probably be explained by the slightly older average age of the Mbuti in comparison to the Aka (Tables 1 and 2).

Since only adult Efe males between 30 and 40 years of age were surveyed, they were compared with Aka and Mbuti men of the same age. The frequency of diseased and missing teeth among the Efe (20.0%, $n = 10$) is nearly twice that of Aka (11.3%, $n = 24$) and Mbuti (6.6%, $n = 8$) men of comparable ages. This difference is a result of a higher proportion of both carious and missing teeth among the Efe.

Sex Differences

The women in all the groups studied had a higher frequency of diseased and missing teeth than the men (Tables 2 and 3). This sex difference is particularly pronounced for the Mbuti, among whom 23% of the teeth of women and 12% of the teeth of the men are diseased or missing. This difference in large part results from the much lower frequency of missing teeth among Mbuti men than women. Aka men and women do not differ markedly in the proportion of missing teeth. (See Figure 2.)

Among the Aka and Mbuti, the proportion of teeth with carious lesions is higher for women than men. This sex difference is especially pronounced among people 30 years of age or older (Figure 3).

The Bantu resemble the pygmies in their lower frequency of missing teeth among the men than the women. These agriculturalists differ from the pygmies, however, in the higher frequency of carious lesions in men than in women (Tables 2 and 3). The Kruskal-Wallis test, however, shows that this difference is not statistically significant (Table 3).

The higher tooth retention rate of the men in these populations cannot be attributed to age-related differences in dental health. If the women were older than the men, the tendency of people, regardless of their sex, to lose teeth as they grow older might explain the sex difference. The women in all the populations surveyed, however, have a younger average age than the men (Table 2). From this it seems likely that the sex difference in missing teeth would be even larger if the ages of the males and females in these sample populations were the same.

Status Differences

Five *kombeti* and *kapita* who were 38 years of age or older participated in the survey. The dental health of these high-status people was compared to that of the 20 nonleaders in the population of pygmy males who were 38 years of age or older (Table 4).

The average age of the leaders was 48 years and that of the nonleaders was 47 years. The effect of this age difference, if any, would be to contribute to a higher frequency of diseased and missing teeth among the leaders than nonleaders through age-related decay and tooth loss. Comparison of the two samples shows, however, that the leaders have lower frequency of carious lesions and retain more teeth in their jaws than men of comparable age in the general population (Table 4).

Among the leaders, only 12.5% of their teeth were diseased or missing. Among the nonleaders, 31.9% or nearly three times as many of their teeth were diseased or missing. The average number of carious lesions per 100 teeth was 5.73 for the leaders and 7.74 for the nonleaders (Table 4).

Table 2
Dental caries data for Aka, Mbuti, Efe, and Bantu.

		Aka			Mbuti			Efe			Bantu		
		Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total
Number of people		61	49	110	36	28	64	10	0	10	10	11	21
Average age		34	30	32	35	33	34	36	—	36	41	34	37
Non-carious	*N*	1,635	1,301	2,936	995	700	1,667	256	0	256	280	299	579
	%	94.60	94.90	94.74	87.59	76.62	82.81	80.00	—	80.00	88.33	85.67	86.94
Missing teeth	*N*	246	175	421	88	152	240	43	0	43	9	27	36
	%	12.60	11.16	11.96	7.75	17.33	11.92	13.44	—	13.44	2.84	7.74	5.41
Teeth with	*N*	44	66	110	30	20	50	18	0	18	11	12	23
small caries	%	2.57	4.74	3.12	2.64	2.28	2.48	5.62	—	5.62	3.47	3.44	3.45
Teeth with	*N*	27	26	53	23	33	56	3	0	3	17	11	28
large caries	%	1.58	1.87	1.51	2.02	3.76	2.78	0.94	—	0.94	5.36	3.15	4.20
Percent of teeth with caries		4.15	6.60	5.17	5.06	7.31	5.98	5.98	—	5.98	9.09	7.14	8.10
Percent positions diseased or missing		16.24	17.03	16.59	12.41	23.38	17.16	20.00	—	20.00	11.67	14.33	13.06

Table 3
Statistical comparisons of dental conditions using the Kruskal-Wallis test.

Comparison/Trait	Chi-square	Probability[a]
Bantu male to female		
Teeth present	2.40	0.06
Carious teeth	0.90	0.17
Carious or missing	0.32	0.29
Caries to teeth	0.66	0.21
Efe males to Aka and Mbuti males		
Teeth present	0.69	0.20
Carious teeth	2.50	0.06
Carious or missing	2.95	0.04[b]
Caries to teeth	3.06	0.04[b]
Kombeti to non-Kombeti		
Teeth present	4.05	0.02[b]
Carious teeth	0.17	0.34
Carious or missing	4.41	0.02[b]
Caries to teeth	0.73	0.20
Mbuti to Aka		
Teeth present	0.21	0.65
Carious teeth	0.23	0.63
Carious or missing	0.09	0.77
Caries to teeth	0.42	0.52
Pygmy male to female		
Teeth present	1.66	0.10
Carious teeth	2.64	0.05[b]
Carious or missing	3.04	0.04[b]
Caries to teeth	2.88	0.04[b]
Pygmy to Bantu		
Teeth present	3.94	0.04[b]
Carious teeth	5.68	0.02[b]
Carious or missing	0.07	0.80
Caries to teeth	4.18	0.04[b]
Pygmy male to Bantu male		
Teeth present	4.09	0.04[b]
Carious teeth	6.52	0.01[b]
Carious or missing	0.05	0.83
Caries to teeth	4.59	0.03[b]
Pygmy female to Bantu female		
Teeth present	0.84	0.36
Carious teeth	0.44	0.51
Carious or missing	0.08	0.78
Caries to teeth	0.33	0.57

[a]Probabilities are either one-tailed or two-tailed depending on the hypothesis tested.
[b]Significant at the < 0.05 level.

The Kruskal-Wallis test indicates that these differences in dental health are statistically significant. The dentitions of the leaders retain more teeth and also have significantly lower frequency of carious or missing teeth than those of the nonleaders ($p = 0.02$; Table 3).

Attrition Rates

Comparison of attrition scores indicates that the teeth of the Aka and Mbuti wear more rapidly than those of the villagers (Table 5). A difference in attrition rates is particularly

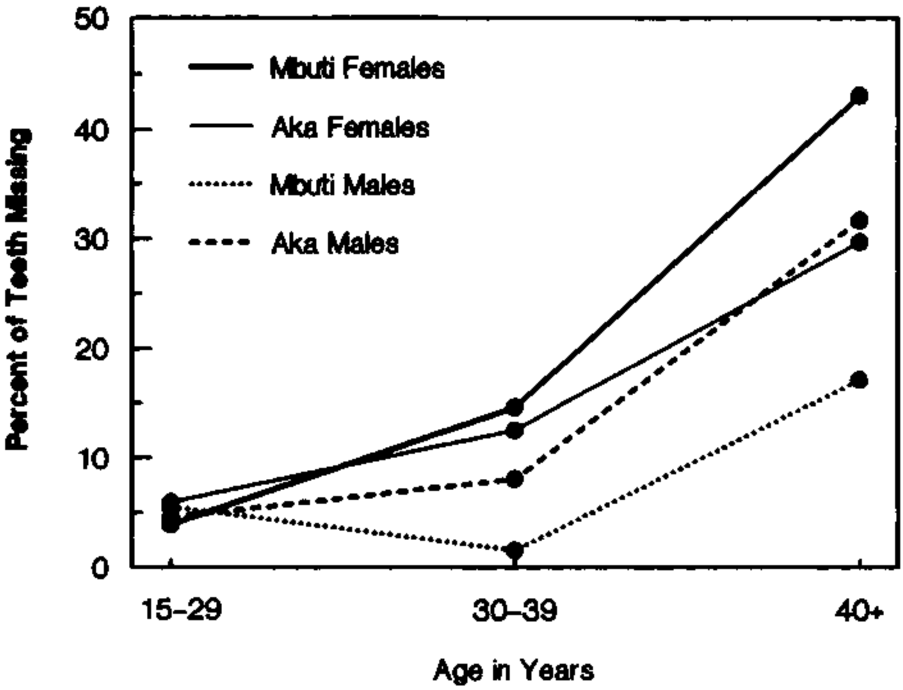

Figure 2
Percent of teeth missing from the dentition plotted against age.

evident among the women. Although the Aka and Mbuti women have a younger average age than the Bantu women, they nevertheless exhibit a higher frequency of the more severe grades of dental attrition than the Bantu women.

The men in each of the groups tend to have heavier dental attrition than the women (Table 5). Since the average age of males in each group is also greater than that of females, this difference may reflect a difference in the length of time the teeth have been exposed to wear instead of a sex difference in dental attrition rate.

The Effects of Artificial Tooth Modification

Some of the difference between the Bantu and pygmies in tooth retention may be a result of the prevalence of artificial incisor modification among the pygmies. This practice involves chipping away the lateral borders of incisors to attain a canine-like profile (Walker and Hewlett 1988). Trauma to the incisors owing to this practice may increase the rate of tooth loss.

Among the Aka, 75.8% of the maxillary and 27.8% of the mandibular incisors were modified. The practice is less common in the other pygmy groups. Among the Mbuti, 37.2%, and the Efe, 16.67%, of the maxillary incisors were modified. These groups do not alter the mandibular incisors. The practice is even less common for the Bantu, among whom only 3.2% of the incisors had been altered.

Among the pygmies, the contribution of incisors to the total number of missing teeth is highest among the Aka, the group with the highest frequency of tooth modification, and lowest among the Efe, the pygmy group with the lowest frequency of tooth modification. The Bantu have a higher proportion of missing incisors than any of the pygmy groups, even though they modify their incisors less often than the pygmies (Figure 4).

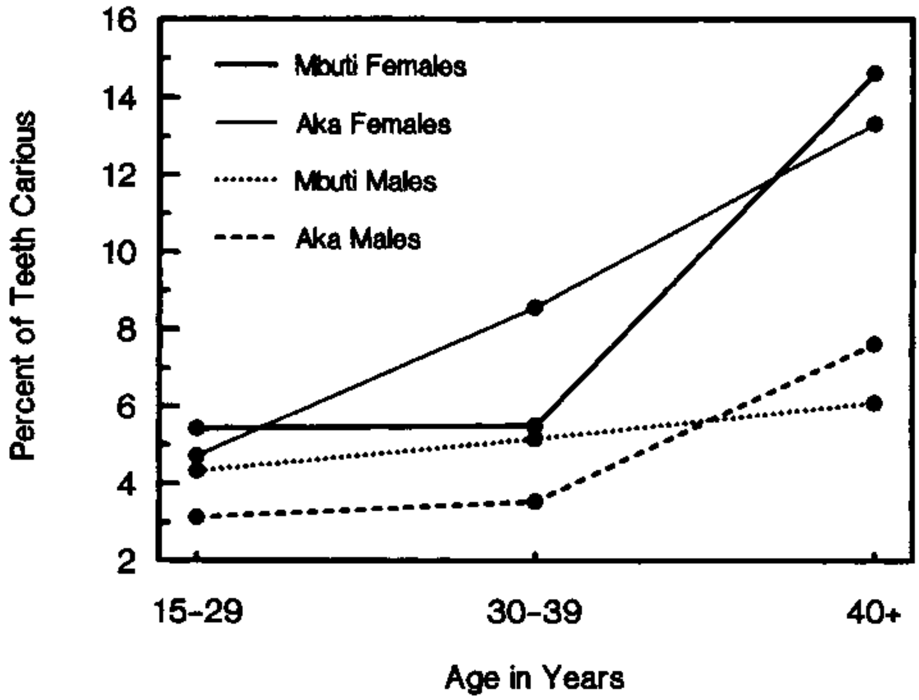

Figure 3
Percent of retained teeth that have carious lesions plotted against age.

Table 4
Dental caries data for pygmy leaders and nonleaders 38 years of age or older.

Condition		Leaders	Nonleaders	% Difference
Missing teeth	*N*	13	243	
	%	6.77	26.18	19.41
Teeth with carious lesions	*N*	11	53	
	%	5.73	7.74	2.01
Diseased or missing teeth	*N*	24	296	
	%	12.50	31.90	19.40
Number of tooth positions		192	928	—
Number of teeth present		179	685	—
Number of men examined		6	29	—
Average age in years		48	47	—

Discussion

Intergroup Differences

Differences in diet provide the most likely explanation for the greater prevalence of carious lesions among the Bantu than among the pygmies. As mentioned earlier, the pygmies have less access to highly cariogenic, refined carbohydrates than do the Bantu. In addition, the pygmy diet tends to be higher in animal protein than that of the Bantu, and this would also contribute to a lower caries rate.

Table 5
Dental attrition data for Aka, Mbuti, Efe, and Bantu.

		Aka			Mbuti			Efe			Bantu		
Attrition		Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total
Slight	*N*	4	11	15	10	12	22	1	0	1	2	7	9
	%	20.00	52.38	36.58	27.78	42.86	34.37	10.00	0.00	10.00	20.00	63.64	42.85
Moderate	*N*	9	6	15	14	8	22	3	0	3	7	2	9
	%	45.00	28.57	36.58	38.89	28.57	34.37	30.00	0.00	30.00	70.00	18.18	42.85
Heavy	*N*	6	4	10	11	5	16	6	0	6	1	2	3
	%	30.00	19.05	24.39	30.56	17.86	25.00	60.00	0.00	60.00	10.00	18.18	14.28
Very heavy	*N*	1	0	1	1	3	4	0	0	0	0	0	0
	%	5.00	0.00	2.43	2.78	10.71	6.25	0.00	0.00	0.00	0.00	0.00	0.00
Average age		34	30	32	35	33	34	36	—	36	41	34	37

Table 6
Oral debris and calculus data for Aka, Mbuti, Efe, and Bantu.

		Aka			Mbuti			Efe			Bantu		
		Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total
None	*N*	15	16	31	29	24	53	5	0	5	10	10	20
	%	75.00	76.19	75.60	80.56	85.71	33.92	50.00	0.00	50.00	100.00	90.91	95.23
Moderate	*N*	5	4	9	7	3	10	5	0	5	0	1	1
	%	25.00	19.05	21.95	19.44	10.71	15.62	50.00	0.00	50.00	0.00	9.09	4.76
Heavy	*N*	0	1	1	0	1	1	0	0	0	0	0	0
	%	0.00	4.76	2.43	0.00	3.57	1.56	0.00	0.00	0.00	0.00	0.00	0.00

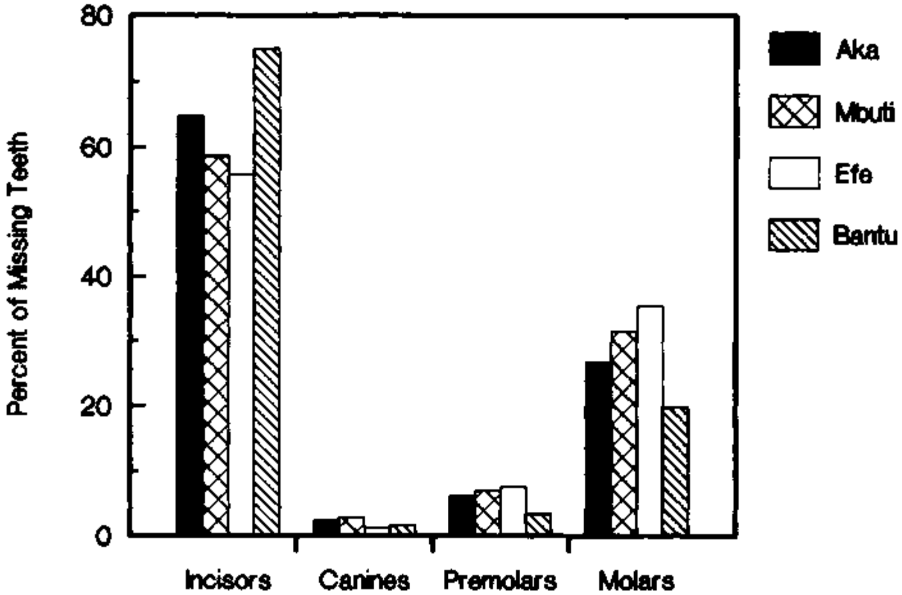

Figure 4
Histogram showing the proportion each tooth type contributes to the total number of missing teeth.

The pygmies surveyed have more missing teeth than the Bantu. This is somewhat surprising, considering the contribution that the high Bantu caries rate is likely to have made to tooth loss among them. Although artificial tooth modification may in part account for the high rate of tooth loss among the Aka, this does not explain the prevalence of missing teeth among the Mbuti and Efe. A larger proportion of the missing teeth of the Bantu are incisors than among the Mbuti and Efe (Figure 4).

Periodontal disease resulting from poor oral hygiene appears to be a much more significant cause of the high rate of pygmy tooth loss than artificial tooth modification (Table 6). The consistent use of chewing sticks by the Bantu, in contrast, is probably an important factor contributing to their high rate of tooth retention. Pharmacological research on West African plant species used for tooth cleaning shows that many of them contain compounds with strong antibiotic and anticariogenic properties that aid in the prevention of tooth loss (Elvin-Lewis 1983; Elvin-Lewis et al. 1980).

The lower rate of dental attrition among the Bantu than the pygmies appears to be in large part a result of differences in culinary practices rather than diet. As we noted earlier, pygmies are much more likely to eat raw or uncooked foods than the villagers. Their diet may also contain more grit than that of the villagers because of a general lack of clean utensils for food processing. These factors may have contributed to rapid tooth wear among the pygmies.

The Efe bow-hunters surveyed had a significantly higher frequency of carious and missing teeth than Mbuti and Aka net-hunters of comparable age and sex ($p = 0.04$; Table 3). It seems likely that this difference is a result of the tendency of the Efe to spend much of their time close to Bantu villages. The Mbuti and Aka, in contrast, spend more time away from the villages in the primary forest where net-hunting is good. There is also some indication that Efe men spend more time in honey collecting than Aka men (Bailey 1985; Bahuchet 1988). As a result of these differences in subsistence, Mbuti and Aka probably have less access than Efe to the cariogenic carbohydrate-rich cultigens produced by the villagers.

Sex Differences

In all the populations, women had a higher proportion of diseased and missing teeth than men. Since the oral hygiene of the men and women we surveyed did not differ significantly (Table 6), it seems unlikely that this variable accounts for the prevalence of diseased and missing teeth among women. Periodontal disease associated with pregnancy provides one possible explanation for the sex difference we observed. Although "pregnancy gingivitis" was for many years considered an important factor predisposing women to tooth loss, studies of pregnant women have failed to demonstrate a significant difference between pregnant and nonpregnant women in the prevalence of gingivitis (Maier and Orban 1949; Jonsson, Howland, and Bowden 1988).

Differences in diet of men and women provide the most likely explanation for this sex difference in oral health (Walker 1988). As we have noted, dental caries are more likely to develop if the diet contains large quantities of carbohydrates. Aka and Mbuti women consume more starchy plant food than the men, and this is undoubtedly in part responsible for their higher caries rate.

The habit many pygmy women have of between-meal eating may also be in part responsible for their high caries rate. Because pygmy men do not carry the basket of collected foods and spend little time collecting, they tend to concentrate their eating in a few large meals consumed when they return home. Pygmy women, in contrast, spend much of their time in the camp or village, taking care of children and cooking. Since food is readily accessible, they snack frequently throughout the day. Clinical studies have shown that people following the eating pattern of pygmy women are much more likely to develop caries than those who, like pygmy men, concentrate their eating in a few meals (Gustafsson et al. 1954; Nizel 1973:234–235).

Among the Bantu, the men have a slightly higher caries rate than the women. Since the Bantu men who participated in the survey had greater access than the women to highly cariogenic foods such as candy, this dietary difference may explain their higher caries rate.

Status Differences

Our data clearly show that the dental health of pygmy leaders is much better than that of their nonleader peers. This excellent dental health could either be a cause or an effect of their high social status.

As is suggested by the emphasis placed on artificial tooth modification, the appearance of the dentition is of considerable social significance to the pygmies. Men with well-preserved dentitions may, therefore, have a better chance of being accepted as group leaders than men with many missing and carious teeth. In this case the good dental health of the leaders may be one of the causes of their high social status.

At the same time, the comparatively good dental health of the leaders may be in part an effect of their high social status. The broad network of social contacts leaders have access to by virtue of their social position makes it likely that they will receive gifts of meat more often than men of lower status, who lack such contacts. If as a result of their social position, leaders consume a diet containing more meat and less high-carbohydrate plant foods that cause caries than men of lower status, this might explain their relatively low frequency of carious and missing teeth.

Conclusions

Our research has several implications for archeologists and physical anthropologists who reconstruct the diets of prehistoric populations using dental evidence. An assumption of many paleodietary studies is that caries frequency is directly correlated with the proportion of carbohydrates in the diet. Our dental caries data are consistent with this assumption. Bantu horticulturalists have higher caries rates than the pygmies, Bantu men have higher caries rates than Bantu women, and pygmy women have higher caries rates than pgymy men. In each case, these differences in caries rate could be predicted based on ethnographic evidence for differences in the ratio of animal protein to carbohydrates in the diet.

Our research indicates that differences in oral hygiene practices and subtle differences in food preparation techniques, such as how often cooking utensils are cleaned, may be just as important as diet in determining rates of tooth loss and attrition. These variables constitute sources of error in paleodietary reconstructions that will be difficult to control for because of the lack of archeological evidence concerning them.

Our data suggest that dietary differences related to a person's sex and social status exist even in so-called "egalitarian" societies, where little emphasis is placed on social distinctions. Even though pygmies are famous for the lack of importance they place on social distinctions, we, nevertheless, found a large difference between the dental health of pygmy "leaders" and "nonleaders." This finding has implications for archeologists who study the relationship between social stratification and health in prehistoric societies. Significant status-related health differences apparently exist in societies that deemphasize the significance of status distinctions.

Our data also have implications for ethnologists who are interested in understanding pygmy subsistence patterns and social organization. For instance, ethnographers who have spent years studying the Ituri pygmies disagree on whether net-hunters or archers are more dependent on village foods. Turnbull (1965b:201) and Putnam (1948:333) see the Efe archers as more dependent on village foods, while Harako (1976:86) indicates the opposite. The high dental caries rate we found among the Efe men supports the contention that they are more heavily dependent on carbohydrate-rich village foods than the Aka. Observations of dental health like those we have made provide an independent source of evidence for testing hypotheses developed through ethnographic fieldwork.

Notes

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[1]We use the terms "Bantu" and "villagers" to refer to the farmers (primarily Bira and Nande) who participated in the research. Some Sudanic Lese were also examined, but for simplicity "Bantu" and "villagers" will be used to refer to all subsistence farmers.

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