Original Research Paper

Volume - 14 | Issue - 10 | October - 2024 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anatomy

EFFECT OF DIET AND DIETARY HABITS ON THE DENTAL TISSUES OF ANCIENT AND CURRENT POPULATION IN SUDAN

Razaz M.S. Abdallah	Department of Anatomy, Dentistry College, Alfajr college for Science and Technology, Khartoum, Sudan
Abbas Gareeb*	Department of Anatomy, University of Khartoum*Corresponding Author
Syed Nazar Imam	Department of Anatomy, College of Medicine, Taibah University, Madinah, Saudi Arabia
Yasir Hassan Elhassan	Department of Anatomy, College of Medicine, Taibah University, Madinah, Saudi Arabia

ABSTRACT **Introduction:** The impact of diet and dietary habits on oral health is a significant area of research that explores how different foods and eating patterns influence the health of teeth and gums. Poor dietary choices can lead to dental problems such as dental caries, gum disease, and enamel erosion, while a balanced diet rich in essential nutrients can promote oral health. Understanding these relationships is crucial for developing effective strategies to prevent oral diseases and improve overall health. The transition in dietary habits from ancient to modern times in Sudan reveals significant changes influenced by cultural, economic, and environmental factors. Ancient Sudanese diets primarily consisted of locally sourced grains, fruits, vegetables, and occasional meat, reflecting an agricultural lifestyle. In contrast, contemporary Sudanese diets have become more varied and often include processed foods, imported items, and increased sugar consumption, which has implications for both general and oral health. This shift underscores the importance of understanding historical dietary patterns to address current nutritional challenges and health outcomes. **Aim** This study aims to: Investigate the food type and variations in dietary habits from ancient to contemporary Sudanese populations, and examine the impact of these dietary changes on oral health, particularly the prevalence of dental problems. **Methodology:** Across sectional study was done in Khartoum state, comparing ancient from Marawi (albejrawya) and current population in Khartoum state. 44 sample, 22 jaws of ancient and 22 similar current populations participate. The 22 ancient remains were examined and measured directly, while the 22 modern participants filled the diet and dietary habits questioner then examined intra orally and the findings recorded on the examination sheet which includes Occlusion, caries, tooth wears. Calculus and staining. **Result:** According to the result of overall the percentage of calculus in ancient was 36.3% and current population was 22.7% and the staining of ancient was 36.6% and 27.2% incurrent population. The percentage of malocclusion in ancient is less than current populatio, ideal alignment of teeth in ancient was 90.9% and 59% in current population. Ancient tooth rotation about 4.5% from total number but 18.1% in current population. The spacing (diastema) was 4.5% in ancient and 36.3% in current population. There was no impaction in ancient, but it was 22.7% in modern population. **Conclusion** The study reveals significant insights into how diet changes over time impact oral health. The shift from traditional, nutrient-rich diets of ancient civilizations like the Kushites to more varied and often processed modern diets has led to a noticeable increase in dental problems, such as caries and gum disease. These findings highlight the critical role of diet in maintaining dental health and underscore the importance of promoting healthy eating habits to mitigate oral health issues in contemporary populations.

KEYWORDS : diet, ancient, current population, malocclusion, calculus, tooth wear and caries

BACKGROUND

Food preferences and consumption patterns vary significantly across cultures, influenced by factors such as geography, history, socioeconomic status, and cultural traditions (1).

Variations in dietary habits are observed among individuals and across different nations, with continuous evolution over time from ancient to current civilizations (2,3).

The teeth are prone to injury by diet, and as well diet control and causes dental tissues diseases (4).

In regard to ancient Sudanese food some excavations uncovered evidence for broomcorn millets, evidence for cucurbits, and legumes were found, as well as peas and lentils in the Wadi Halfa area (5).

Dates are one of the most available fruits along Sudan's Nile Valley in addition to Lalop (coated by sugary fibers envelop) potentially consumed in the region of Kush(6).

Kushites cultivate fruits orange tamarind graprfruits and they consumed a range of animal-based products meats fats blood milk, cheese and fish, all are documented by Roman geographer (7).

Modern diets are high processed foods, refined sugars, and fats, with increased consumption of meat, dairy, convenience food sand industrial agriculture technologies (8).

Various dietary components affect dental diseases and emphasizes the connection between diet, dental health, and systemic health conditions (9).

Consumed raw, unprocessed foods like meat, fruits, nuts, and tubers cause high degree of dental wear due to fibrous, abrasion and lower incidence of caries because natural diet low in sugars(10).

DENTAL PROBLEMS

A. OCCLUSION

Studies have shown that breastfeeding is associated with a reduced risk of developing malocclusions such as open bite and crossbite. Bottle-feeding, on the other hand, can lead to improper jaw and tongue movements, increasing the risk of malocclusions (11).

Diets that require more chewing, such as those high in fibrous foods raw vegetables and meats, promote better jaw development and alignment. Chewing stimulates the growth of the jawbone and surrounding muscles, which is crucial for proper occlusion (12).

Physical anthropologists attributed these changes in dental occlusion greatly to the transition of modern diet differences in agricultural and hunter-gatherer that related to mastication or chewing habits which have a long-term effect on dentofacial growth and development (13).

Some environmental factors that have been associated with malocclusions include diet, mastication forces, extra-oral habits, nonnutritive sucking, habitual mouth breathing, and early loss of primary teeth (14).

The introduction of carbohydrate-rich foods, particularly grains, increased the prevalence of dental caries (cavities). The softer diet reduced the wear on teeth but led to more dental crowding and malocclusion (15).

B. TOOTH IMPACTION

Some studies of evidence suggest that changes in diet and food processing technology contribute to variations in facial size and shape. The human diets since the Middle Paleolithic have changed substantially in content(16). Food processing improves digestibility, but soft food and smaller in particle size, needless occlusal force per chew, and less chewing time per unit of food(17) So, softer and more processed foods are widely hypothesized to lead to decreased facial growth, especially in the lower face and the alveolar crests (18).

This theory compared eight minipigs raised for eight months on nutritionally identical soft and hard diets; the four pigs raised on soft food had serious malocclusions and differed significantly in facial shape with shorter mandibular rami and narrower mid faces than pigs raised on hard food (19).

C. TOOTH WEAR:

Heavy wear patterns due to the consumption of unprocessed foods and the presence of grit and sand from stone tools used in food preparation (20).

Tooth wear studies based on skull material from archaeological excavations have mainly been attributed to factors related to the diet (21).

The general view is that, in pre-industrialized populations, the intensive wear of molars and premolars results mainly from the use of a coarser diet, and from the more vigorous masticatory activity required by the diet (22).

An increase in the level of fluoride in the water would increase the hardness of the enamel and so affect wear patterns between various archaeological populations. Ante-mortem tooth loss would intensify stress on the remaining teeth, thereby increasing tooth wear (23).

D. DENTAL CARIES

Four things are required for caries formation: a tooth surface (enamel or dentin), caries-causing bacteria, fermentable carbohydrates (such as sucrose), and time, this involves adherence of food to the teeth and acid creation by the bacteria that makes up the dental plaque (24).

Studies have shown that individuals who consume fewer meals with no snacks tend to have a lower incidence of dental caries compared to those who snack frequently (25).

E. DENTAL CALCULUS:

Less calculus compared to agricultural societies, but still present due to a lack of oral hygiene practices.

Calculus formation increased due to higher carbohydrate diets and less fibrous foods that naturally clean the teeth (26).

Heavy calculus production is associated with relatively high levels of dietary protein, which increases the alkalinity of the oral cavity (27). Dental calculus preserves over time and has even been found on the teeth of humans among primates, the oldest known calculus to date was reported on the dentition of a Miocene orangutan ancestor and dates to roughly twelve million years ago (28).

F. DENTAL STAIN

Tooth staining may result from natural plant pigments and local habits such as betel nut chewing and tabacoo which cause significant staining (29).

Extrinsic discolorations are common. can be due to food, drinks, smoking, neglected dental plaque, and calculus, or Tabaco use (30).

Coffee, Tea, and Red Wine: These beverages are common in modern diets and contain chromogens and tannins that can adhere to tooth enamel, causing stains these are widely spreading among current populations (31).

Causes of intrinsic discoloration generally fall into those that occur during tooth development and those acquired later in life, these causes include trauma, fluorosis, dental caries, dental filling pulp necrosis, and tetracycline. (32).

OBJECTIVES

The objectives of this study are to:

1. Investigate the variations in diet types from ancient to contemporary Sudanese populations.
2. Examine the impact of these dietary changes on Dental tissues.
3. Understand the evolution of diet and dietary patterns over time and their implications for modern diet changes and oral health outcomes in Sudan.

RESEARCH METHODOLOGY

1 STUDY DESIGN

Comparative cross-sectional study.

2 STUDY AREA

The study was conducted in Khartoum state (the capital of Sudan).

3 STUDY POPULATION

Skull& jaws remains from Marwi (Albejrawya) for an ancient and Current patients from Khartoum Teaching Dental Hospital.

The study group includes subjects of both genders and different ages (children, adolescents, and adults).

INCLUSION CRITERIA

1. Totals converge of available sample
2. Matching the number of patients attending Khartoum Teaching Dental Hospital and did radiographs.

EXCLUSION CRITERIA

1. People with destructive disease or oral swelling
2. People with jaw fractures.

4 METHODOLOGY

4-1. DATA COLLECTION TOOLS:

a- Oral examination instruments: mirrors, probes, explorer, tweezers, dental chair, face masks and gloves
b- Data collection sheets: Oral examination sheets and measurement sheets
c- Examinable subjects: Patient, Radiographs, and jaws and teeth of remains.

4.2 LIST OF VARIABLES:

a. Dependent variables
Occlusion
Tooth impaction
Tooth wear (abrasion, erosion& attrition)
Dental caries.
Dental calculus
Dental stain
Periodontal disease, diastema and.

The measurement ancient was measured by caliper and in modern population was measured by Romexis Viewer.

b. independent variables
Age
Gender
Education
Gender
Occupation

d- Dental Examination
The skulls and the remains teeth which were preserved in cotton roles were examined directly on a clean flat table under electrical light using the examination tools for malocclusion, tooth wear, dental caries, calculus, and stains present or not present.

For the current patients after agreeing on the informed consent the patient was interviewed for diet and dietary habits and then examined on a dental chair by examination tools for malocclusion, tooth wear, dental caries, calculus, and stain.

5 SAMPLE SIZE

Total coverage of the number of ancient skulls and jaws present in the museum of the faculty of Dentistry University of Khartoum collected from Marwi and an equivalent number of patients attended with radiographs in Khartoum Teaching Dental Hospital, which was 44 and who fulfilled the inclusion criteria.

A simple random technique was used to select the modern population.

5 DATA ANALYSIS:

The descriptive analysis was used to determine the frequency of diet intake and to determine the frequency, means, and standard deviation for each parameter (MXW, MXL, MW, and ML) for the two groups and the compression between the two groups. Another descriptive statistic was used to determine the percentage of (tooth wear, carious teeth, periodontal disease, and malocclusion).

Data were analyzed using the statistical package of the SPSS version 20. T-test was used to compare differences between the values set at 0.05 and 0.01 confidence intervals 95% and 99%. P values >0.05 and 0.01 were considered significant.

The benchmark range values of the parameters were determined by choosing the lowest value of the frequency distribution curve in the modern population and the highest value of the frequency distribution curve in the ancient.

TABLES AND FIGURES:

Table 1: Protrusion of mandible in study participants (n=16):

Variable (n=8)	Number	%
Protrusion of ancient mandible Yes No	3 5	37.5 62.5
Protrusion of modern population mandible Yes No	1 7	12.5 87.5

Table 2: malocclusion of ancient and modern population in study participants (n=44):

Variable (n=22)	number	%
Teeth alignment of ancient(n=22)		
Normal	20	90.9
Crowding	1	4.5
Spacing	1	4.5
Teeth alignment of modern population(n=22)		
Normal	13	59.1
Crowding	5	22.7
Spacing	4	18.1
Teeth Rotation in ancient (n=22)		
Yes	1	4.5
No	21	95.4
Teeth Rotation in modern population(n=22)		
Yes	4	18.1
No	18	81.8
Tooth deviation of ancient(n=22)		
Yes	2	9.1
No	20	90.9
Tooth deviation of modern population(n=22)		
Yes	8	36.3
No	14	63.6
Diastema of ancient(n=22)		
Yes	1	4.5
No	21	95.4
Diastema of modern population(n=22)		
Yes	8	36.3
No	14	63.6
Impaction of ancient(n=22)		
No	22	100
Impaction of modern population(n=22)		
Yes	5	22.7
No	17	77.2

Table 3: Periodontal disease (calculus& stain) in study participants (n=44):

Variable (n=22)	number	%
Ancient calculus	8	36.3
Modern population calculus	5	22.7
Ancient staining	14	63.6
Modern population staining	6	27.2

Table 4: teeth Wear in study participants (n=44):

Variable (n=22)	number	%
Attrition Ancient		
Yes	22	100
Attrition Modern		
Yes	3	13.6
No	19	86.4
Erosion Ancient		
Yes	1	4.5
No	21	95.5
Erosion Modern		
Yes	6	27.3
No	16	72.7
Abrasion Ancient		
Yes	1	4.5
No	21	95.5
Abrasion Modern		
Yes	3	13.6
No	19	86.4

Table 5: Carious lesions in study participants (n=44):

Variables (n=22)	number	%
Caries Ancient		
yes	10	45.5
no	12	54.5
Caries Modern		
yes	18	81.8
no	4	18.2
Cavitated Ancient		
no	22	100
Cavitated Modern		
yes	13	59.1
no	9	40.9

Figure 1:

DISCUSSION

OCCLUSION & IMPACTION

Table (1) for the mandible protrusion of the 8 ancient 3 protruded and 5 are not protrude while for the 8 current jaws, 1 protruded 7 not.

Table (2) its results of the occlusion variable showed the following: for the 22 ancient 20 of normally aligned teeth, 1 showed spacing and 1 showed crowding, for teeth rotation 1 of rotated teeth, 21 were of no rotation, for tooth deviation 2 of deviated teeth and 22 were not and for diastema 1 had 21 had no diastema. Compared to the 22 modern populations that participated in this study 13 had normally aligned teeth, 5 showed crowded teeth and 4 spaces between their teeth, 4 had rotated teeth and 18 of no rotation, 8 had deviated, 14 had not and 8 had diastema while 14 had no. These results showed more population than in ancient through all the above variables of malocclusion as stated by Perets et al (11)any variation from this resulted in different types of classes of malocclusion. Also, these results are supported by Corruccini and environmental factors include diet, mastication forces, extra-oral habits, nonnutritive sucking, habitual mouth breathing, and early loss of primary teeth associated with malocclusions (14).

For impaction no tooth impaction among the 22 ancient samples and the 22 modern participants there were 5 had impacted teeth these

finding related to the jaw length, which can give convenient space for normal full teeth eruption, this was similar to the finding of Ciochon et al(19) in their study on soft and hard diets found the four pigs on soft food had serious malocclusions and differed significantly in facial shape with shorter mandibular rami and narrower mid faces than pigs on hard diet.

PERIODONTAL DISEASES & DENTAL CALCULUS

Of the 22 ancient cases, 8 had calculus on their teeth and of the 22 modern participants 5 had calculus, this difference is related to both types of diet and the dietary habits regarding diet processing and cleaning as it was explained in the literature, calculus production is associated with relatively high levels of dietary protein, which increases the alkalinity of the oral cavity and calculus was detected on ancient early on (26, 27).

DENTAL STAIN

This study found that 14 ancients out of the 22 samples had staining on their teeth and 6 of the 22 modern participants had tooth staining, usually the staining is caused by certain types of foods and drinks and precipitates if not removed properly, so here dental stain was more in ancient due to their diet which most probably from the plants this finding is supported by Aramaean(34) who stated the causes extrinsic like food, drinks, smoking, neglected dental plaque and calculus or Tabaco, and intrinsic discoloration stated by Hattab (30).

TOOTH WEAR

In Table (4) the 22 ancient, showed attrition in the 22 sample, 1erosion, and 1abrasion while the 22 modern participants showed 3 had attrition, 6 had erosion and 3 had abrasion, these differences in the tooth between the two populations are due to the type of diet. The ancient diet is harder and natural so associated with attrition and modern softer and some inorganic components and there increase in the introduction of abrasive material in the cleaning habits both associated with erosion and abrasion, these results go with Richter (21) studies on skull material from archaeological excavations he found tooth wear mainly attributed to factors related to the diet, and Towle (22) findings the nature of the food material being consumed affect the type and the level of tooth wear, the high meat content found in the diet of the ancient populations which would have required a greater amount of chewing leads to attrition.

DENTAL CARIES

Table (5) showed of the 22 ancients 10 of them had caries and 12 were free of caries both with no cavitation. Of the 22 modern participants, 18 with caries 4 of no caries 13 with cavitation, and 9 of no cavitation. The results of this table are associated with the increase in carbohydrates and sugars of the diet today that leads to the increase in dental caries prevalence, as it was stated in literature fermented carbohydrates (such as sucrose) by the bacteria produce acid that adhere to the tooth surface as dental plaque which in dental caries with time as stated by Adler(24) and Touger-Decker,(25).

REFERENCES

1. Fryar CD, Hughes JP, Herrick KA, Ahluwalia N, Ogden CL (2020), "Fast Food Consumption among Adults in the United States, 2013–2016." NCHS Data Brief, 322, 1-8.
2. Dixon DM. (1972), "Masticatories in ancient Egypt." J Hum Evol, 1(5), 433–48.
3. Forshaw RJ. (2009), "Dental health and disease in ancient Egypt." British Dent Journal, 206(8), 421–4.
4. Thompson AH, Chaix L, Richards MP. (2008), "Stable isotopes and diet at Ancient Kerma, Upper Nubia (Sudan)." J Archaeol Sci, 35(2), 376–87.
5. Wendorf F, Schild R, Close AE. (1984), Cattle Keepers of the Eastern Sahara: The Neolithic of Bir Kiseiba.
6. Fuller DQ. (2014), "Agriculture and the Development of Complex Societies in the Nile Valley." Mitchell P, Lane P, editors. Oxford Handbook of African Archaeology. Oxford University Press.
7. Strabo. Geographica. Book XVII, Chapter 2, Section 2.
8. Popkin BM. (2006), "Global nutrition dynamics: The world is shifting rapidly toward a diet linked with noncommunicable diseases." Am J Clin Nutr, 84(2), 289-298.
9. Palmer CA. (2013), "Important relationships between diet, nutrition, and oral health." Nutr Clin Care, 6(4), 181-188.
10. Larsen CS. (1995), "Biological changes in human populations with agriculture." Annu Rev Anthropol, 24(1), 185-213.
11. Peres KG, Cascaes AM, Nascimento GG, Victora CG, Flores-Mir C. (2015), "Effect of breastfeeding on malocclusions: a systematic review and meta-analysis." Acta Paediatr, 104, 54-61.
12. Peck CC. (2016), "Biomechanics of occlusion--implications for oral rehabilitation." J Oral Rehabil, 43(3), 205-14.
13. von Cramon-Taubadel, N. (2011). "Global human mandibular variation reflects differences in agricultural and hunter-gatherer subsistence strategies." Proceedings of the National Academy of Sciences, 108(49), 19546-19551.
14. Corruccini RS, Townsend GC, Richards LC, Brown T. (1990), Genetic and Environmental Determinants of Dental Occlusal Variation in Twins of Different Nationalities." Hum Biol, 62(3), 353–67.
15. Lieverse AR. (1999), "Diet and the Aetiology of Dental Calculus". Int J Osteoarchaeol, 9(4), 219-232.
16. Teaford, M. F., and Ungar, P. S. (2016). "Diet and the evolution of the earliest human ancestors." In Human Evolution Source Book, Routledge, 209-216.
17. Lieberman DE, Krovitz GE, Yates FW, Devlin M, St. Claire M. (2004), "Effects of food processing on masticatory strain and craniofacial growth in a retrognathic face." J Hum Evol, 46(6), 655–77.
18. Mahmood Rafea, Yahya Al-Mallah, Sarmad Sobhi Salih Al Qassar, Omer Khalid M. (2023), "The Effect of Diet Consistency on the Craniofacial Morphology: A review Article." Tikrit Journal for Dental Sciences, 11(2), 339-348.
19. Ciochon RL, Nisbett RA, Corruccini RS. (1997), "Dietary consistency and craniofacial development related to masticatory function in minipigs." J Craniofac Genet Dev Biol, 17(2), 96–102.
20. Pihlstrom BL, Michalowicz BS, Johnson NW. (2005), "Periodontal diseases." The Lancet, 366(9499), 1809-1820.
21. Richter S, Eliasson S. Tannrótarígerðir í Íslendingum til forna. (2007).
22. Towle I, Irish JD, Elliott M, De Groote I. (2018), "Root grooves on two adjacent anterior teeth of Australopithecus africanus." Int J Paleopathol, 22, 163–7.
23. Bardsley PF, Taylor S, Milosevic A. (2004) "Epidemiological studies of tooth wear and dental erosion in 14-year-old children in North West England. Part 1: The relationship with water fluoridation and social deprivation." Br Dent J, 197(7), 413–6.
24. Adler CJ, Dobney K, Weyrich LS, Kaidonis J, Walker AW, Haak W. (2013), "Sequencing ancient calcified dental plaque shows changes in oral microbiota with dietary shifts of the Neolithic and Industrial revolutions." Nat Genet, 45(4), 450–5.
25. Touger-Decker and R, van Loveren C. (2003), Sugars and dental caries." Am J Clin Nutr, 78(4), 881S-892S.
26. Eshed V, Gopher A, Hershkovitz I. (2006), "Tooth wear and dental pathology at the advent of agriculture: New evidence from the Levant." Am J Phys Anthropol., 130(2), 145-159.
27. Lieverse AR. (1999), "Diet and the Aetiology of Dental Calculus." Int J Osteoarchaeol, 9(4), 219-232.
28. Hershkovitz I, Kelly J, Latimer B, Rothschild B, Simpson S, Polak J, et al. (1997), "Oral bacteria in Miocene Sivapithecus." J Hum Evol, 33, 507–12.
29. Aramaean N, Spencer J, Ou S. (2002), "The prevalence of betel-quid chewing, tobacco use, and alcohol consumption among Asians in the United States." Public Health Rep., 117(1), 50-55.
30. Hattab FN, Qudeimat MA, al-Rimawi HS. (1999), "Dental discoloration: an overview." J Esthet Dent., 11(6), 291-310.
31. Mishra MB and Mishra S. (2014), The effects of habitual areca nut chewing on oral health." Dent Res J (Isfahan), 11(5), 561-568.
32. Watts A. and Addy M. (2001) "Intrinsic and extrinsic tooth discoloration: A review." Clin Oral Investig., 5(2), 127-133.