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## PREVALENCE OF DENTAL ENAMEL HYPOPLASIA IN THE NEOLITHIC SITE OF WADI SHU'EIB IN JORDAN

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**ABSTRACT** A study of Neolithic Pre-Pottery B materials from Wadi Shu'eib revealed that 38.40% of the examined teeth have dental enamel hypoplasia (DEH). Sixty percent of the anterior teeth exhibit DEH while only 21.40% of the posterior have the defect. The most affected teeth are the maxillary central incisors (72.73%) and the lower canines (62.5%). The most prevalent type of defect is the groove which is present in 68.75% of the teeth with DEH. One notable case is a lateral incisor with a slight deep and sharp groove. The sharpness and the deepness of this groove may indicate a severe stress which caused DEH to occur in a very short period. The most likely causes of DEH were general nutritional stresses. Another cause may have been environmental stresses.

### INTRODUCTION

#### Historical Background

The site of Wadi Shu'eib dates to the Pre-Pottery Neolithic B (7,500-6,000 BC) (Rollefson, 1987). It is approximately 22 km west of Amman on the Salt Shuna road, 8 km south of Salt city, and less than a kilometer north of the village of Wadi Shu'eib (Simmons et al., 1989). The site is situated at an altitude of 375 m above sea level on a moderately steep slope near the Wadi Margin (Rollefson, 1987). Wadi Shu'eib is one of the few sites with Neolithic cultural remains known in the Levant.

#### MATERIALS AND METHODS

Mandibles and maxillae (complete and incomplete) representing eight individuals and loose teeth recovered from a salvage excavation at Wadi Shu'eib were examined. Sex determination was not possible because of loose teeth and small fragments of mandibles. One hundred and twenty five permanent teeth, many of which were loose teeth, were examined for DEH.

The teeth were first cleaned by using dry toothbrushes and fresh water. Then two well-trained anthropologists using a Nikon lens (x10mm) under a sufficient light observed and recorded DEH defects macroscopically in the archaeological laboratory of The Institute of Archaeology and Anthropology at Yarmouk University. The occurrences of DEH on the clear and cleaned permanent teeth were coded. If wear and calculus were present on a tooth, DEH was not recorded. However, the tooth was counted in the total tooth number. Dental enamel hypoplasia was classed as pits, lines and/ or grooves following the method of El-Najjar et al. (1978). Estimation of the age of DEH was based on the crown development at the incisal, mesial, and cervical zones of the teeth following Massler (1941) and modified from Goodman and Armelagos (1985).

### RESULTS

The prevalence of DEH in the permanent teeth of the Wadi Shu'eib sample is relatively high for Neolithic people. Forty eight-defects were recorded in 125 (38.44%) teeth (Table 1). The mandibular teeth show greater prevalence of DEH (40.84%, 29/71) than do the maxillary teeth (35.18%, 19/54).

#### DEH Frequency by Tooth Class and Location

The most affected tooth showing DEH is the upper central incisor (72.73%, 8/11) followed by the mandibular canine (62.50%, 5/8). Maxillary first and second premolars and second molars are free of DEH. By tooth region, the

TABLE 1. The prevalence distribution of DEH by tooth class.

Tooth Class	x	y	%
<b>Maxilla</b>			
Central incisors	11	8	72.73
Lateral incisors	5	3	60.00
Canines	6	3	50.00
First premolars	3	0	0.00
Second premolars	4	0	0.00
First molars	10	3	30.00
Second molars	8	0	0.00
Third molars	7	2	28.57
<b>Mandible</b>			
Central incisors	9	5	55.56
Lateral incisors	16	9	56.25
Canines	8	5	62.50
First premolars	6	2	33.33
Second premolars	6	1	16.67
First molars	13	2	15.38
Second molars	8	3	37.50
Third molars	5	2	40.00
<b>Total</b>	<b>125</b>	<b>48</b>	<b>38.40</b>

x is the number of teeth. y is the number of hypoplastic teeth. % is the frequency of y/x.

anterior teeth are more affected by the DEH (60.00%, 33/55) than are the posterior teeth (21.43%, 15/70) (Table 1).

**Types of DEH**

The type of DEH most often exhibited in the teeth of Wadi Shu'eib people is the groove. Thirty-three of 48 defects are grooves (68.75%). On the other hand, lines occur less frequently (25.00%, 12/48) than do grooves (Table 2).

**Age at DEH Occurrence**

The age at the time of DEH occurrence was estimated by noting DEH at a specific location in a particular tooth. The most highly involved zone of the most affected tooth is the middle zone on the central upper incisor which develops during the interval of 1.5 to 3.0 years of age (Table 3). The distribution of DEH on the lower central incisor is totally concentrated on the middle third, which develops during the interval of 1.3 to 2.6 years of age. A high frequency also appears on the middle zone of the lower lateral incisor that develops from 1.3 to 2.6 years of age. On the other hand, the least affected tooth, the lower second premolar, shows one defect on the middle third which develops from 3.7 to 5.4 years of age.

**Unusual Expression of DEH**

One of the lower lateral incisors has a very sharp and thin groove which is exhibited as a labiolingual circle on the crown of the tooth. The shape is similar to that of a cut in glass by diamond. Measurements to the tooth are: 10.7 mm total height from incisal to cervical edge, 4.6 mm from the incisal edge to the position of the groove and, 6.1 mm from the position of the groove to the cervical edge.

From the position of DEH, the age peak of the defect at the time of the development of the crown was about 1.7 years of age.

**DISCUSSION**

The prevalence of DEH in Wadi Shu'eib is relatively high (38.40% of the teeth), especially when the number of the teeth examined are few. Smith et al. (1984) reported that 38.00% of the people of Jericho during Pre-Pottery Neolithic B showed DEH.

The 38.40% prevalence of DEH in the teeth of the people of Wadi Shu'eib is important in determining the influences of DEH in prehistoric populations. In the prehistoric samples DEH is indicative of causes that obstruct the metabolic process and eventually the development of the dental enamel. The pathological causes of DEH cannot be identified directly in prehistoric populations. Studying the archaeological evidence of the nature of the environments in which the people lived might help in determining the factors responsible for a high rate of prevalence of DEH.

Ogilvie et al. (1989) report a difficulty in determining specific agents that cause DEH but consider metabolic stresses as highly reliable causative factors. As a result, they suggest that the nutritional stresses are the main causal agent of DEH. On the other hand, Goodman and Armelagos (1985) suggest that the identification of the etiology of DEH should not be limited to the environmental stress variations and other specific factors should be sought in paleopathological studies.

For the tooth type, the frequency of DEH is high on the upper central incisor (72.73%). This frequency is higher than that on the lower canine (62.50%, 5/8). The percentages are like those reported by Goodman and Armelagos (1985) and Lanphear (1989). The three posterior maxillary teeth are totally free of DEH, whereas all of the mandibular teeth exhibit DEH. These differences in the distributions of DEH by tooth types could be due to the chronology of the development of the enamel during the matrix formation. Each tooth has a different period of time to complete development (Goodman and Armelagos, 1985; Goodman et al., 1991).

The involvement of the mandibular teeth are significantly greater than that of the maxillary teeth. This result shows noticeable contrasts to many studies (El-Najjar et al., 1978; Hargreaves et al., 1989; Ogilvie et al., 1989).

TABLE 2. Percentage distribution of the occurrence of DEH by type of defects.

Type	%
Lines	25.00
Grooves	68.75
Pits	6.25

As it was noted above, grooves occur on most of the hypoplastic teeth (68.75%). This indicates that an acute event resulted in the interruption of the ameloblast in the matrix formation stage (Seow, 1991). The stresses seem to have been arduous and of long duration. This type of defect is a result of causes that have continued for fairly long time. In contrast, Al-Abbasi (1994) concluded that lines were a dominant type of the defects in his study of Jordanian school children among three sectors of the population (Bedouins, villagers, and city dwellers). The difference in the frequency of the types could be due to a variation in the causative factors.

The estimation of the age of occurrence of DEH confirms that the DEH was highly prevalent in the second and third years of age. This is indicative of the weakness in the metabolic process at the time of the occurrence of DEH. Many factors are interrelated in these susceptible years of the child and disrupt or inhibit the enamel matrix formation.

Lanphear (1990) argued that in prehistoric populations the prevalence of DEH occurred at an earlier peak age in agricultural groups than in hunter-gatherers. The hunter-gatherers were assumed to be weaning their children at later ages than were the agricultural groups. The Wadi Shu'eib people were agricultural and in some seasons practiced pastoralism. The high prevalence of DEH at the second and the third years indicate some nutritional stresses at the time of weaning.

The sharp thin groove observed on one lower lateral incisor suggests the occurrence of a very severe cause for a short period of time, which may have sharply slowed down the process of metabolism during the time of enamel matrix formation. A similar case was found in a lateral incisor of a Neolithic skull in Sweden (During and Nilson, 1991). Sometimes, fevers are thought to be related to the whole nutritional status of the population (Neiburger 1990). Al-Abbasi (1994) has found a significant correlation between pathological effects, mainly measles and diarrhea ( $t=3.98$ ;  $t=3.68$  at  $P>0.01$  respectively), and DEH in recent Jordanian populations. Since a nutritional stress needs a longer period of time to affect the metabolic process than do diseases, it might be discarded as the causative factor.

Hillson (1997, personal communication) agreed that this kind of groove is indeed a hypoplastic defect and suggested that a microscopic examination for the tooth would help in grasping the mechanisms of the this kind of enamel defect. Because the groove is so thin, the causative factor was likely a very acute disease that happened during childhood and severely affected the metabolic rate for a very short period. Some environmental diseases affect the metabolic rate and are actually related to the presence of DEH.

**CONCLUSION**

Dental enamel hypoplasia is one of the most coherent contributors used by anthropologists and paleodemographers for reconstructing the image of nutritional and health conditions of past people. The revolution of agriculture during the Neolithic period did not help the people of Wadi Shu'eib to avoid nutritional or other ecological stresses. The high frequency of DEH in the eight individuals examined expresses the instability of the living conditions of these people when they were alive. The high incidence of large grooves indicates that the people were suffering some long periods of multiple hard times, especially in their early lives. Weaning stress could have been among other environmental factors of the etiology of DEH. However, determining a single cause may be impossible because of the variability of DEH occurrence.

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TABLE 3. The Prevalence distribution of DEH on developmental zones by tooth types.

Tooth Type	Incisal Zone		Mesial Zone		Cervical Zone	
	n	%	n	%	n	%
<b>Maxilla</b>						
Central incisors	3	37.5	5	62.5	0	0.0
Lateral incisors	3	100.0	0	0.0	0	0.0
Canines	1	33.3	2	66.7	0	0.0
First premolars	0	0.0	0	0.0	0	0.0
Second premolars	0	0.0	0	0.0	0	0.0
First molars	3	100.0	0	0.0	0	0.0
Second molars	0	0.0	0	0.0	0	0.0
Third molars	0	0.0	2	100.0	0	0.0
<b>Mandible</b>						
Central incisors	0	0.0	5	100.0	0	0.0
Lateral incisors	3	33.0	4	44.5	2	22.2
Canines	1	20.0	4	80.0	0	0.0
First premolars	2	100.0	0	0.0	0	0.0
Second premolars	0	0.0	1	100.0	0	0.0
First molars	1	50.0	1	50.0	0	0.0
Second molars	0	0.0	2	50.0	0	0.0
Third molars	0	0.0	0	0.0	0	0.0

x is the number of DEH. % is the frequency.

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## WHO WERE THE NATUFIAN? A DENTAL ASSESSMENT OF THEIR BIOLOGICAL COHERENCY

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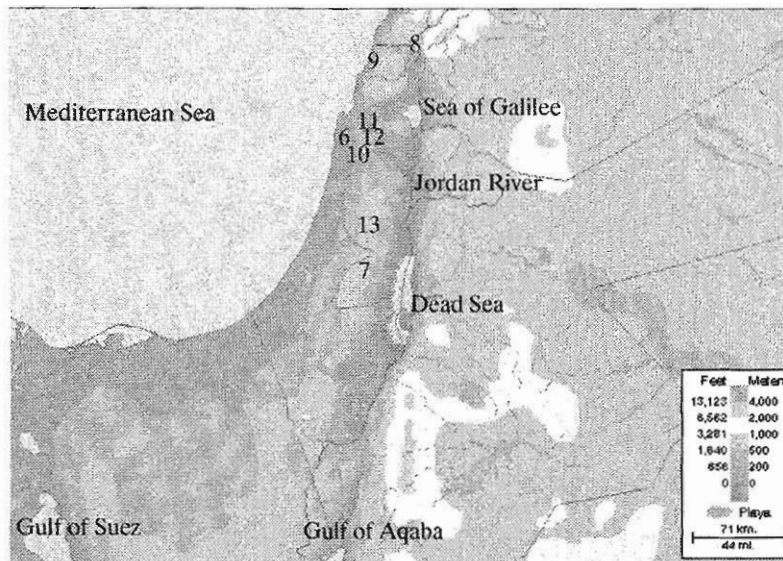


Fig. 1. Map of the southern Levantine sites from which the samples in this study originated. Key: 6-El-Wad, 7-Erq el-Ahmar, 8-Eynan, 9-Hayonim Cave and Terrace, 10-Kebara, 11-Nahal Oren, 12-Rakefet, 13-Shukba.

**ABSTRACT** The Natufians were complex, semi-sedentary hunter-gatherers who intensively exploited wild plant resources in the southern Levant 12,800 to 10,200 BP. They represent the human culturo-behavioral transition from simple, mobile hunter-gatherers to fully sedentary agriculturalists. The Natufians have been the subject of much archaeological and biological study because of their pivotal position in human prehistory. Previous studies of Natufian population biology, which employed osteometrics, craniometrics, and odontometrics, qualitatively supported the following archaeologically-defined hypothesis. Every human skeletal sample found at each Natufian site belonged to a biologically coherent population.

The present study tests the hypothesis of Natufian biological coherency by analyzing their dental morphology. The data were collected from nearly all available Natufian dental material, using

the Arizona State University Dental Anthropology System. The results of the multivariate Mean Measure of Divergence statistical analysis support the biological coherency of the Natufian population.

### INTRODUCTION

The Natufian techno-complex ( $C_{14}$ -dated between 12,800 and 10,200 BP) (Henry, 1989) represents an unprecedented change in the human lifestyle in the southern Levant from highly mobile, simple hunting and gathering to semi-sedentary, complex hunting and gathering. The transition likely involved the movement of people to new areas, as well as the fusion of more numerous, smaller, and more mobile groups (from the period preceding the Natufian) into less numerous, larger, and more sedentary groups (in the Natufian). Therefore, this period in the