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Evaluation of linear enamel hypoplasia (LEH) in western Anatolian skeletons from the late eastern roman period (Attepe settlements and Dereköy necropolis)

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ABSTRACT

Linear Enamel Hypoplasia (LEH) provides insight of the stresses undergone by ancient communities from a bioarchaeological perspective. This is a first study aiming to determine stress factors causing LEH formation on the teeth of skeletons from two Anatolian rural communities during the Eastern Late Roman era (10th–11th centuries AD). These communities had quite high social complexities and population densities. A total of 638 permanent teeth from 52 adult individuals from these two ancient populations were investigated. The work contributes to understanding of regional archaeological communities of the period. The health conditions and growth processes of both communities were successfully estimated. LEH was mostly observed to affect canine teeth. Infants and children were exposed to severe stress during their lives but in terms of severity and band counts, it is likely that the stress factors did not cause severe damage to these populations.

1. Introduction

It is a challenging activity to define ancient diseases and understand living styles of the societies lived in the past. Any skeleton discovered during archaeological expeditions contains cumulative records of the life experiences and conditions of that individual and most importantly represents direct archaeobiological evidence of historic populations (Larsen 2018). In this sense, such skeletons provide us with important ideas about nourishment, living activities as well as health, and present stress factors, genetic history, demographic dynamics, environment, social and cultural impacts, and demography which shaped their lives (Larsen, 2002, 2018).

Anatolia has hosted different cultures and different communities since the Paleolithic period. Along with agriculture, changing eating habits and social-cultural factors in Anatolia since the Neolithic period have led to significant differences in skeletal biology. Hypoplasia is one of the most prominent stress indicators of this changing environmental as well as cultural transformation. It also fills an important gap in clarifying infant and child health. Although many dental anthropological studies have been conducted on archaeological communities living in Asia Minor, detailed analyses of stress processes which are quite limited (see: Büyükkarakaya & Erdal, 2006; Büyükkarakaya, 2012; Erkman, 2008; Çırak et al., 2013; Büyükkarakaya, 2015; Gökkurt 2019) have been realized.

During the rescue project of archaeological settlements that will be inundated owing to dam construction in the Kütahya region in Western Anatolia, Attepe and Dereköy settlements dating to the Late Roman period and their necropolis areas were discovered. The tombs were excavated with great care for paleoanthropological analyses. In this study, LEH measurements have been made for the first time on skeleton groups in the area and the conditions conducive to hypoplasia in both rural communities have been evaluated. Even if there are limited archaeological and anthropological data on these communities, LEH data analyses have enabled us to understand stress processes and factors humans were exposed during 10th-11th Centuries. Although the results obtained are so specific to generalize about all the communities dated to the Late Roman Period, they allowed us to interpret such important information about living standards, baby weaning processes, the health of infant and child of these rural communities living in the Aegean region of Imperial Anatolia, living styles of the communities, and their adaptation to the environment.

The detection of health conditions in early infancy and childhood has made it possible to make predictions about the general socio-economic, environmental, or cultural practices of the community in these critical

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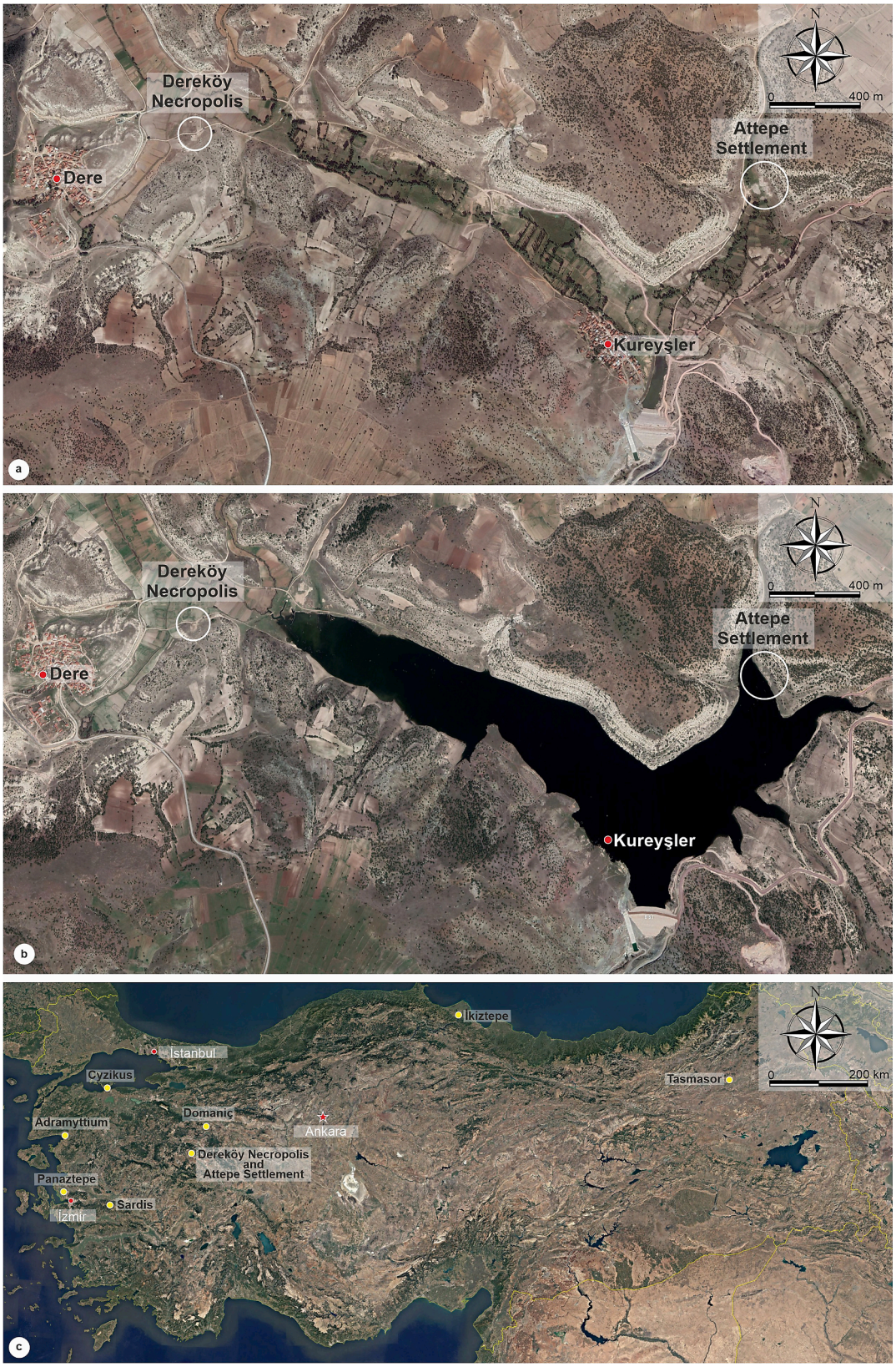

Fig. 1. a) Locations of Attepe settlement and Dereköy necropolis before Kureyşler Dam construction b) After Kureyşler Dam construction (www.googleearth.com) c) Geographic locations of ancient Anatolian civilizations evaluated in terms of LEH data.

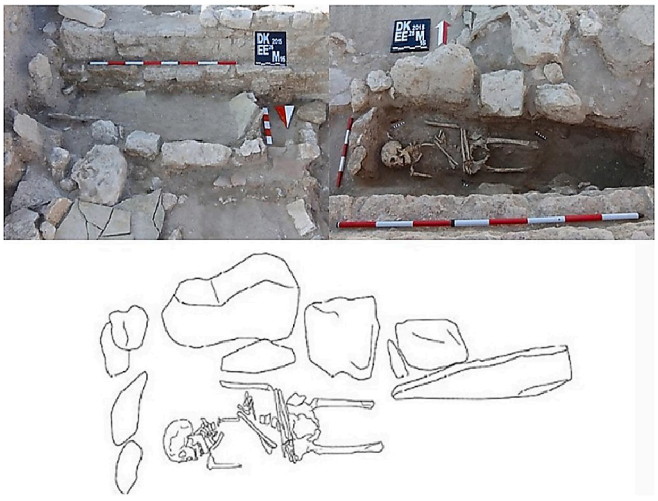

Fig. 2. The radiocarbon dated individual EE-26–007 coded in Dereköy necropolis.

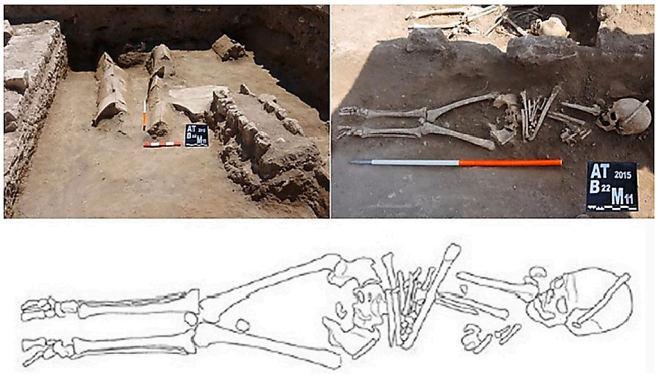

Fig. 3. The radiocarbon dated individual with code B-22–014 in Attepe settlement.

Table 1
Radiocarbon dates from Attepe and Dereköy populations.

Laboratory No	Location	Material	C^{14}	2Sigma Calibration	
				Cal. (AD)	Possibilty (%)
TUBITAK-0319	Attepe	Bone	997 ± 27	986–1050	71.2
				1083–1126	19.2
				1136–1151	5.0
TUBITAK-0318	Dereköy	Bone	1039 ± 27	986–1050	92.4
				903–919	3.0

processes. At the same time, it made it possible to determine the intensity and differences in stress periods by comparing the data on these stress processes with the limited data of other ancient Anatolian communities who lived in both communities especially around Western Anatolia. Thus, it will help revealing regional or population-specific factors of stress patterns. Additionally, it was intended to create a LEH data set belonging to the West Anatolian archaeological human populations and contributing some missing information regarding the life of the Roman period to the literature.

2. Linear enamel hypoplasia

Enamel is a structure that can be affected by environmental or physiological stresses the individual is exposed to during dental development (Roberts and Manchester, 2012). Enamel hypoplasia is defined as disruptions occurring in the structure of enamel during the dental development process and represents differences in secretion activities of ameloblast cells while forming the enamel structure (Goodman and Rose, 1990; Goodman et al., 1991). Enamel hypoplasia may be observed in different forms like colors on the surface of the tooth crown, transverse lines, points, grooves, and opacities and may be observed on the buccal and lingual surfaces of all tooth types (Federation Dentaire International, 1982; Clarkson, 1989; White et al., 2011). Defined as type 4 according to FDI classification, LEH provides important clues about stress in the infant and early childhood periods. Since the teeth are structures in which the growth-development process can be followed chronologically, the severity of the LEHs in the community, the ages at which they occur biologically, and their frequency of recurrence can be easily followed. As a result, these types of studies are beneficial to enlighten factors causing growth retardation in the growth-development period. When the studies about the etiology of LEH are considered, it appears that effective factors for formation of this defect include exanthematous diseases, hereditary factors, infectious diseases, respiratory tract infections, parasitic diseases, and many other factors (Sarnat and Schour, 1942; El-Najjar et al., 1978; Goodman and Rose, 1990). However, the studies of living populations have shown that factors such as insufficient nutrition, weaning process, and low economic income may cause formation of enamel hypoplasia (Peres and Lunardelli, 2006; Tourino et al., 2018). In archaeological populations, many researchers being interested in LEH through revealing the living standards of populations have focused on topics like nutritional cultures, health, socioeconomic status, environmental factor, and hygiene (Goodman et al., 1991; Blakey et al., 1994; Palubeckaitė, 2001; Lewis, 2002; Krenz-Niedbała and Kozłowski, 2011; Ritzman et al., 2008; Nakayama, 2016; Smith et al., 2016; Tourino et al., 2018). Consequently, it is not possible to associate LEH with any single specific disease or factor. Considering the literature data, the necessity to consider many factors namely as environmental factors, nutrition, socioeconomic conditions, political reasons, and hygiene conditions is emphasized (Goodman et al., 1984; Goodman and Rose, 1990; Blakey et al., 1994; Cucina and İşcan, 1997; Cucina, 2002; Littleton,2005; Ritzman et al., 2008; Miszkiewicz, 2015).

Enamel hypoplasia has frequently been a subject of research for investigating general health conditions of the currently living communities, historic communities, and health profiles of various intra-community sub-groups (various socio-economic groups or gender groups). While many variables such as changing nutritional forms, increasing population, mother-infant relationship, etc. contribute to formation of LEH, it might offer important insight into living style of the community in question.

3. Material

A rockfill dam was constructed for irrigation purposes near Kureyşler village in Aslanapa County in Kütahya province. Excavation work was performed in the region since 2014 to save the cultural assets of Höyüktepe and Attepe settlements and Dereköy necropolis located within the boundaries of the dam lake (Fig. 1a). As a result of excavations quickly performed due to dam reservoir construction, no stratigraphy has been compared in Attepe settlement and Dereköy necropolis. Accordingly, it is concluded that both of these settlements represent a single culture (i.e. Late East Roman).

During excavations, an Eastern Roman settlement was identified dated to the early Middle Ages. Apart from architectural findings, small finds (bowls-ceramics, metal, glass, etc.) and objects such as cross and censer used in religious life indicate that the settlement in the area had an important place among Eastern Roman cultural remains (Ünan and

Table 2
Distribution of LEH in people from Attepe and Dereköy according to tooth type.

	ATTEPE				DEREKÖY		
TOOTH TYPES	Examined (N)	Observed (N)	%	TOOTH TYPES	Examined (N)	Observed (N)	%
I1	43	9	20.9	**I1**	25	8	32.0
I2	50	9	18.0	**I2**	30	7	23.3
C	62	23	37.1	**C**	38	23	60.5
P1	69	14	20.3	**P1**	33	7	21.2
P2	63	6	9.5	**P2**	31	3	9.7
M1	43	3	7.0	**M1**	26	4	15.4
M2	49	8	16.3	**M2**	28	2	7.1
M3	27	–	–	**M3**	21	–	–
Total	406	72	17.7	**Total**	232	54	23.3

Table 3
Distribution of LEH in Attepe population according to severity.

TOOTH TYPES	Observed (n)	Mild	Moderate	Severe
I1	9	9	–	–
I2	9	9	–	–
C	23	22	1	–
P1	14	14	–	–
P2	6	6	–	–
M1	3	1	2	–
M2	8	6	2	–
M3	0	–	–	–
TOTAL	72	67	5	

Table 4
Band counts for LEH in Attepe and Dereköy populations.

		1 band		2 band		3 band	
	N	n	%	n	%	n	%
ATTEPE	72	53	73.6%	11	15.3%	8	11.1%
DEREKÖY	54	38	70%	11	20%	5	9%

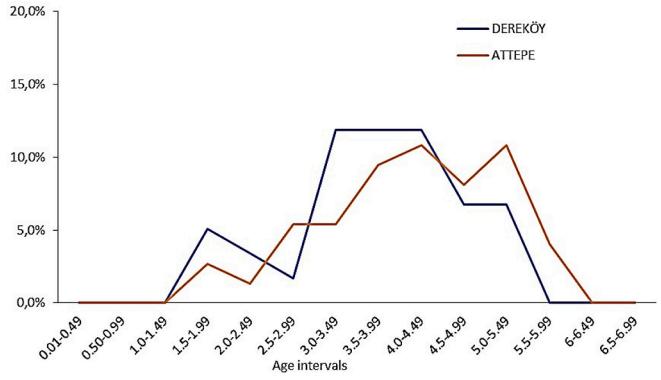

Fig. 4. Biological age graph of LEH in Attepe and Dereköy populations.

Ünan, 2016; Türktüzün et al., 2014; Türktüzün et al., 2016). A great majority of the metal findings discovered in Attepe and Dereköy settlements are such basic objects as nails, keys, lock mechanisms, etc., belonging to houses and farms which might be encountered in a typical settlement, agricultural and handicraft tools as well as censers, crosses, etc. being employed in religious life, being cultural remnants of East Roman culture (Oransay, 2015; Ünan and Ünan, 2016; Türktüzün et al., 2016). Such items as ornaments and warfare tools like arrowheads are very few (Oransay, 2015). All the arrowhead artifacts are dated to the Late East Roman Period. As a result of ^{14}C dating analysis on skeletons obtained from the graves, there is 92.4% possibility that Dereköy skeletons belong to AD 966–1033 (Late Eastern Rome) (Fig. 2), while there is 71.3% possibility that Attepe skeletons are from AD 986–1050 (Late Eastern Rome) (Fig. 3) (Table 1; Document 1).

The main reason for the analysis of Attepe and Dereköy as two different groups is different naming of the settlements made by the official institutions that allow such excavations. We had to evaluate our work as if there were two different societies by adhering to these official reports. However, as seen in Fig. 1a, these are contemporaneous and proximity-wise remarkably close settlements.

As a result of the studies conducted in Dereköy Necropolis, a total of 32 individuals were identified. Of these individuals, there were 18 adults with 9 females and 9 males. Of the other 14 individuals, 3 were infants and 11 were children. Excavations in the Attepe settlement revealed 53 skeletons. Of these, 20 were female and 19 males for 39 adults and 14 were infants and children. According to these studies, Attepe population had 26.4% age profile of infant and child deaths while the Dereköy population had 43.7% rates (Şahin and Erkman, 2020). However, it should be considered that the Dereköy population is represented by a low number of individuals at this point.

4. Method

In terms of LEH, 406 permanent teeth from 34 individuals in the Attepe settlement and 232 permanent teeth from a total of 18 individuals from the Dereköy necropolis were evaluated within the scope of this study. As required by the study, linear enamel hypoplasia observed on the tooth types and determined as type 4 based on the FDI index were recorded on the study form (FDI, 1982; Clarkson, 1989).

The repeated frequency and severity of LEH which were evaluated to determine stress periods experienced and seen were assessed with the aim of making inferences about the stress process. Accordingly, LEH in populations was graded as mild, moderate, and severe based on Brothwell's (1981) classification. At the same time, band counts of LEH were recorded for each tooth type.

The presence of LEH was measured by means of an electronic caliper with 0–150 mm sensitivity with the naked eye in daylight. When needed, a hand lens was used. LEH disappears with severe tooth wear and therefore teeth with wear degree 5+ according to Bouville (1983) were excluded from the observations. Additionally, some teeth were only represented by roots in the society and due to poor preservation of enamel structure, 14 teeth from the Attepe society and 11 teeth from the Dereköy society were excluded from observations.

For calculation of biological ages of LEH, the data set recommended by Reid and Dean (2000, 2006) for Northern European populations was considered. All the data obtained was analyzed with Microsoft Office Excel and IBM SPSS Statistics 23 program and presented as tables and figures.

5. Results

LEH was assessed in the adult individuals from both populations.

Fig. 5. LEH identified in the mandibula of individual coded A21-43–41 from Attepe.

Fig. 6. LEH identified in the mandibula of individual coded EE26-18–10 from Dereköy necropolis.

Fig. 7. LEH identified in the maxilla of individual coded EE26-18–11 from Dereköy necropolis.

Fig. 8. LEH identified in the mandibula of individual coded EE26-14–04 from Dereköy necropolis.

Tooth material from 34 adult individuals in the Attepe population and 18 individuals in the Dereköy necropolis could be assessed for LEH. LEH was identified in 45.7% of the adult individuals from the Attepe population and in 66.6% of the adults from the Dereköy necropolis. When the chi-square test was applied, there was no statistically significant difference identified between observation of LEH among individuals from these two populations (P: 0.983 > 0.05).

When permanent teeth were analyzed in total, LEH was identified in 72 (17.7%) of the 406 permanent teeth investigated from the Attepe settlement and 54 (23.2%) of the 232 permanent teeth investigated from Dereköy necropolis (Table 2). LEH in the Attepe and Dereköy populations were observed to intensify on the incisors (I1, I2 and C) compared to premolar (P1, P2) and molar (M1, M2, M3) teeth. Especially in both populations canine tooth type was the tooth type with intense LEH observed.

When the LEH incidence rate in both populations was tested with the chi-square test, there was no significant difference identified between the incidence of hypoplasia in both groups (P:0.091 > 0.05).

In terms of being able to interpret stress periods, the severity and band numbers of LEH in both populations were evaluated. All the LEH observed in Dereköy people had mild severity while the LEH of Attepe people was determined to have mild and moderate severity. In both populations, severe hypoplasia was not observed (Table 3).

When evaluated according to band numbers, at most 3 bands were observed for LEH in both populations. The majority of 73.6% of LEH was observed in the Attepe population and 70% in the Dereköy population was observed as a single band as seen in table (Table 4).

When stress periods were investigated for the populations in a six-month period, it is seen that the hypoplasia in Dereköy people intensified in the period encompassing the 3 to 4.49 age intervals. For the Attepe population, the highest values were observed to encompass the 4–4.49 and 5–5.49 age intervals (Fig. 4).

6. Discussion

The LEH distribution in the populations was assessed for both individuals and tooth types. The results of the analyses based on both individuals and tooth numbers did not indicate significant differences between the observations of LEH in both populations. In addition, our results were compared with some other communities in the Aegean region of Anatolia dating to the Roman period. However, the studies in the literature are extremely limited in terms of understanding the regional differences of stress dated to these periods (Fig. 4). Some of the studies in this context are discussed here (Fig. 1c).

The rate of 60.2% was recorded for the Adramyttium population (AD 5th –6th century) (Atamtürk and Duyar, 2008). The Cyzicus population (AD 2nd century and middle ages) had enamel hypoplasia frequency of 56.7% identified and this high rate was associated with nutritional insufficiency by some researchers (Gözlük Kırmızıoğlu et al., 2009). However, the LEH data of Domaniç (AD 2nd–5th century) people, who share a similar ecological environment and period with the people of Attepe and Dereköy, are merely the best example for comparison. Investigation of 17.2% hypoplasia rate in the causative context was explained by researchers as related to socialization and mobility of children (Erkman et al., 2017; Gökkurt, 2019). The stress processes observed in the Domanic population at the ages of 4–4.49 and 5–5.49 are similar to the stress periods of Attepe and Dereköy people. The dental anthropological data of these populations located in the province of Kütahya has shown that the Domanic community is an agricultural community and does not have any significant problems in nutrition. Therefore, it can be stated that Domaniç people stress processes are in the same periods as the people of Attepe and Dereköy. At the same time, the stress periods identified by the Domaniç people are not severe throughout the community, and in this respect, it is in line with our study material. For the Sardis population (Late Rome) dated to the Late Roman period, the rate was 64.5% (Eroğlu, 1998) while the rate of 22.7% was identified for Panaztepe skeletons dated to the Roman period (Güleç and Duyar, 1998). When evaluated proportionally, datas from the Attepe and Dereköy populations have lower percentage rates compared with Roman period populations apart from the Domaniç and Panaztepe-Roman period skeletons. However, comparative interpretation of hypoplasia data from ancient Anatolian populations has been found to be misleading by many researchers (Atamtürk and Duyar, 2010). In addition to many causes, it is affected by individual observations; as a result, when stress periods are evaluated based on percentage rates, it can be expressed that the data will be misleading. Consequently,

Table 5
Demographic distribution of diseases in Attepe and Dereköy populations (Şahin and Erkman, 2020).

	DEREKÖY NECROPOLIS						ATTEPE SETTLEMENTS					
	Female		Male		General		Female		Male		General	
	N	%	N	%	N	%						
Lifestyle-Related Anomalies												
Osteoarthritis	6/8	75	4/7	57,14	10/15	66,67	4/17	25,53	11/18	61,11	15/35	42,86
Ankylosing Spondylitis	0/3	0	0/5	0	0/8	0	0/8	0	0/7	0	0/15	0
DISH	0/3	0	0/5	0	0/8	0	0/8	0	0/7	0	0/15	0
Rhomboid Fossa	0/7	0	1/6	16,67	1/13	7,69	0/14	0	5/12	41,67	5/26	19,23
Spondylolysis	0/3	0	0/5	0	0/8	0	1/6	16,67	1/9	11,11	2/15	13,33
Distal Femoral Cortical Excavation	0/7	0	0/7	0	0/18	0	0/19	0	1/15	6,67	1/34	2,94
Enthesopathies	1/8	12,5	5/7	71,43	6/15	40	6/17	35,29	15/18	83,33	21/35	60
Vertebral Osteophytes												
Cervical	2/4	50	1/5	20	3/9	33,33	2/9	22,2	1/8	12,5	3/17	17,65
Throcal	3/4	75	1/6	16,67	4/10	40	2/6	33,33	5/9	55,56	7/15	46,67
Lumbar	2/3	66,67	2/5	40	4/8	50	1/6	16,67	6/9	66,67	7/15	46,67
Schmorl's Node												
Cervical	0/4	0	0/5	0	0/9	0	0/8	0	0/7	0	0/15	0
Throcal	0/4	0	2/6	33,33	2/10	20	2/6	33,33	5/9	55,56	7/15	46,67
Lumbar	0/3	0	2/5	40	2/8	25	0/5	0	5/8	62,5	5/13	38,46
Apophyseal Osteoarthritis												
Cervical	0/4	0	4/5	80	4/9	44,44	4/8	50	2/6	33,33	6/14	42,86
Throcal	2/5	40	1/6	16,67	3/11	27,27	4/6	66,67	5/8	62,5	9/14	64,29
Lumbar	0/2	0	1/5	20	1/7	14,29	2/5	40	3/7	42,86	5/12	41,67
Trauma												
Skull	0/4	0	0/6	0	0/10	0	0/8	0	1/6	16,67	1/15	6,67
Body	0/8	0	1/7	14,29	1/19	5,26	1/17	5,88	1/18	5,56	2/39	5,13
Metabolic Diseases												
Cribra Orbitalia	0/4	0	1/7	14,29	5/15	33,33	1/15	6,67	0/10	0	3/27	11,11
Porotic Hyperostosis	0/4	0	0/6	0	0/10	0	0/8	0	2/6	33,33	2/15	13,33
Cranial Hyperostosis	1/4	25	1/6	16,67	2/10	20	2/8	25	2/6	33,33	4/15	26,67
Vitamin D Deficiency	0/8	0	0/7	0	0/19	0	0/17	0	0/18	0	0/39	0
Congenital Anomaly												
Spina Bifida	0/3	0	0/2	0	0/5	0	0/6	0	1/5	20	1/11	9,09
Sacral Agenesis	0/3	0	0/2	0	0/5	0	0/6	0	0/5	0	0/11	0
Sacralisation	0/3	0	0/2	0	0/5	0	2/6	33,33	0/5	0	2/11	18,18
Hemivertebrae.	1/2	50	0/4	0	1/6	16,67	0/6	0	1/10	10	1/16	6,25
Separate Transverse Process	0/2	0	0/4	0	0/6	0	0/6	0	0/9	0	0/15	0
Cleft/bifid Arches	0/2	0	0/4	0	0/6	0	0/6	0	0/9	0	0/15	0
Supratrochlear Spur	0/8	0	1/5	20	1/18	5,56	0/19	0	0/15	0	0/40	0
Occipitalization Of Atlas	0/4	0	0/6	0	0/10	0	0/8	0	0/6	0	1/15	0
Infectious Diseases												
Periostitis	0/8	0	0/7	0	0/19	0	0/17	0	4/18	22,22	5/39	12,82
Osteomyelitis	0/8	0	0/7	0	0/19	0	0/17	0	0/18	0	0/39	0
Cardiovascular Diseases												
Legg-Calve Perthes	0/7	0	0/7	0	0/18	0	0/19	0	1/15	6,67	1/38	2,63

some studies and researchers have included interpretations. However, our investigated populations will be assessed without comparison and interpretation. There are studies in the literature that industrialization over time and changing environmental conditions lead to the formation of LEHs (Lewis, 2002). When the LEH rates in ancient Anatolian societies are examined, no regular increase or decrease is observed in this rate. This irregularity is likely to be related to the number of teeth and tooth types examined since LEHs are most common in single-rooted teeth such as incisor (I) and canine (C). However, these teeth are the teeth that fall out the easiest and most frequently after death. Thus, it can be mentioned that the number and types of teeth are effective on the proportional changes in this type of research.

When distributions of hypoplasia according to tooth types were examined, it was observed that the canine tooth type in the populations was intensely affected by LEH. At this point, when ancient Anatolian populations and the populations in different regions around the world are considered, it can be stated that the anterior tooth types reflect hypoplasia better (Eroğlu, 1998; Erdal, 2000; Büyükkarakaya, 2004; Büyükkarakaya and Erdal, 2006; Erkman, 2008; Yılmaz et al., 2009; Büyükkarakaya, 2011). The actual reason for this situation is explained as the development process for front tooth types being more sensitive to physiologic stress compared to molar teeth and the longer crown height compared to other teeth (Goodman and Rose, 1990; Goodman et al., 1991).

In terms of being able to determine stress periods, data about the biological ages when LEH occurs is important for the evaluation of stress factors which are playing a role in populations. As mentioned previously, the formation of LEH is not sourced in a single factor but it is affected by many situations from disruptions due to nutrition with breast milk, intake of supplementary food, a variety of acquired infectious diseases, and environmental as well as cultural factors. Some researchers have linked the process to diseases affecting infant-child health and weaning processes owing to insufficient nutrition (Goodman and Rose, 1990; Goodman et al., 1991; Moggi-Cecchi et al., 1994; Lewis, 2002). Within the scope of this study, the stress periods determined on Attepe and Dereköy people are not chronologically consistent with the periods associated with breast-feeding.

Based on LEH data, stress periods encompassed the ages of 3 to 4.49 years for Dereköy people and 4–4.49 years and 5–5.49 years for Attepe people (Fig. 4). At this point, based on both paleoanthropological data

and nutritional habits, it seems that living standards were not bad and they did not live in poor environmental conditions. As LEH data did not focus on the first years of life, it is not possible to say that these populations were sufficiently breastfed in this stage. The observed LEH intervals indicate later periods. These periods may be explained by the risk period of the child's increasing mobility and entering interactions with the environment when literature and paleoanthropological analyses of populations are considered. This process can be defined as a course of action in which the child gradually starts to get to know the environment and becomes more mobile, especially from the age of 3 (Lewis, 2007). Therefore, this process can emerge the result of being in direct contact with infectious and contagious diseases. Additionally, considering the severity and repeated frequencies of hypoplasia associated with stress processes (Tables 3 and 4), these processes did not cause severe damage and can be said to have passed with mild severity (Fig. 5 for Attepe population, Figs. 6–8 for Dereköy population).

As a result of dental pathology studies of both populations, the Attepe population had 13.8% caries and 13.1% calculus while the Dereköy population had 12.9% caries and 3.8% calculus. Besides, both populations were observed to have tooth wear of 3–4 degrees (Erkman et al., 2020). The paleopathology and dental pathology data for the Attepe and Dereköy populations show that these populations had a socioeconomic structure based on both in agriculture and livestock. Therefore, it is possible to conclude that they benefitted sufficiently from agricultural and animal proteins in their diet. Furthermore, infant and child mortality rates, as being the other significant indicator of living standards, can be important in terms of clarifying growth and development processes. There is a 43.7% infant and child mortality rate in the people from Dereköy necropolis and 26.4% in the Attepe population. The high infant-child mortality in the paleodemographic data suggests that these individuals were likely to suffer from infectious diseases and that their lives may have ended very quickly.

In addition, the data regarding body pathology and oral-dental health were investigated in terms of illuminating the lifestyle, disease, and nutrition profile of these populations. While the observed anemia was linked to iron deficiency and anomalies developing were linked to vitamin D deficiency, they were at lower rates compared to other populations. Infant and child death rates in paleodemographic data show rapidly progressing infections. At the same time, researchers have proposed that these populations partly should have dealt with agriculture and livestock based on paleoanthropological analysis (Table 5) (Şahin and Erkman, 2020). In fact, when the oral and dental health data of Attepe and Dereköy communities are evaluated, the relatively high caries rates indicate more carbohydrate consumption in their diets. When the abrasion and bruise rates are compared, the researchers conclude that the diets of the communities are based on well-ground and soft foods (Erkman et al., 2020).

At the same time, due to being in the same region and in almost the same period, the hypoplasia data for Kütahya-Domaniç people (Roman period) can be given as an example in this sense. It was determined that populations were exposed to intense stress in the early childhood period according to data obtained from LEH and the researcher associated these stress periods with periods of increased risk of infectious and transmitted diseases linked to mobility and socialization in these periods (Gökkurt, 2019). Considering literature data, these periods are the periods of risk owing to contact with many people as the infant leaves the carer's watch or increased effect rates from transmitted diseases because of more interaction with the environment. Additionally, it can be stated that many factors such as childcare, suitability of physical environment of inhabitation, hygiene, and inability to meet the child's needs from nutritional sources may contribute to stress processes (Blakey et al., 1994).

7. Conclusion

Archaeological data and paleoanthropological analysis of Attepe and Dereköy people indicate that they generally have a socioeconomic structure mainly based on agriculture and partly animal husbandry. In terms of hypoplasia data, Attepe and Dereköy populations have relatively low averages compared to other populations in the same periods. The data on the severity of hypoplasia shows that the teeth of both populations are not severely damaged and accordingly the average LEH values are less affected by physiological stress in early childhood. When the stress processes are evaluated periodically, it does not reflect critical periods for babies such as weaning periods. Therefore, we cannot associate the two communities specifically with more social processes such as food shortages, severe diseases, and early weaning of babies. These periods are mostly associated with socialization related to general child health and later contagious, febrile, and infectious diseases that develop due to new contamination environments and contact with other individuals in the community.

It is not possible to make a generalized deduction about the communities dated to the Late East Roman era because of data obtained merely in this study. However, it is considered that determining the stress processes experienced by both rural communities which have been dated to final centuries of the Late East Roman era and are located to the eastern front of the Empire and western front of Anatolian peninsula would provide a contribution to discovering general living conditions of the people.

It is estimated that the populations of these villages which engaged in agriculture and animal husbandry in the 10-11th centuries were mainly successful in coping with epidemics and infectious diseases, wars, and possibly seasonal famine. Their daily activities were mostly related to agriculture-based animal husbandry, and it can be easily stated that they had a socioeconomic life above the average compared to other contemporary Anatolian societies.

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