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THE HEALTH STATUS OF THE ANCIENT INHABITANTS OF REMESIANA^[1]

Abstract:

Study of human diseases in the past has an important place in reconstruction of people's life conditions and health. This paper examines health status of a suburban ancient community in Remesiana which lived in the first half of the 4th century. Analyses of pathological and traumatic changes on skeletons and dental status were done on 51 individuals (28 children and 37 adults). The results show that the inhabitants of the ancient Remesiana had an optimal level of health, which distinguishes this population from the other suburban communities of that time.

Key words:

Remesiana, Gladno polje, health status, villa rustica, the Late Antiquity.

Introduction

Studies of health status of populations during the Roman period are not frequent and most of them focus on research of specific disorders or diseases (Belcastro et al. 2007; Bonfiglioli et al. 2003; Facchini et al. 2004; Fitzgerald et al. 2006; Salvadei et al. 2003). Although there are plenty of historical sources about the diseases of ancient populations from that period, there is little direct evidence on skeletons. A good opportunity for a complete overview of health status of a Late Antique population was offered by the discovery of a necropolis with inhumated human skeletal remains at the site of Gladno polje^[2]. The site is situated on the northern periphery of Remesiana and it is dated to the first half of the 4th century. Within the necropolis there were excavated 51 graves including inhumations of 28 children and 37 adults (Јовановић, Булатовић 2013). The previous research indicated that certain individuals had performed hard physical work which is proved by a large number of lesions and deformities on bones. At the same time, the analysis of musculoskeletal stress markers showed existence of sexual division of labour within this population. Since two buildings, probably agricultural farms, were found close to the necropolis, it is not impossible that physical activities, even very intensive ones, were performed within villa rustica (Јовановић 2013; Stefanović, Jovanović 2013).

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[2] Rescue archaeological research in 2011, on the route of the future Corridor 10 near Bela Palanka, was carried out by the Republic Institute for Protection of Cultural Monuments, in cooperation with the Faculty of Philosophy from Belgrade, under the direction of Mira Ružić, PhD.

Hard physical work could have also influenced the health status of the Remesiana's population. Therefore, the aim of this research is to determine health status on the basis of examination of nutritive and metabolic disorders, dental diseases, traumas, nonspecific infections and osteoarthritic changes. Besides data on health status, this will allow us to obtain an overall insight of life conditions of an ancient provincial suburban community.

Material and Methods

The material used to carry out this research includes 64 individuals, of which 36 adults and 28 children. It was possible to determine the sex of 29 adults (13 females and 16 males), while for 7 individuals, the sex could not have been determined due to poorly preserved material. The data on sex and individual age were obtained by using standard anthropological methods (Јовановић 2013). Special anthropological analysis carried out within this research in order to obtain data on the quality of life in Remesiana included identifying of cribra orbitalia, porotic hyperostosis, dental caries, hypoplasia of tooth enamel, calculus, rickets, traumas, nonspecific virulent infections and osteoarthritic changes.

The term cribra orbitalia indicates pathological changes which appear on upper vaults of eye orbits in form of small cavities or newly formed layers of porous bones. Those are, in fact, small lesions on orbit vaults with diameters smaller than 1mm or partially joined larger openings. Identical process can also appear on the cranial vault, the most usually on parietal bones and occipital bone when it is called porotic hyperostosis. Etiology of these processes has not been completely explained, but according to many authors, it is closely connected with anemia due to iron deficiency (Goodman, Martin 2002; Larsen 1997; Stuart-Macadam 1985, 1991; Huss-Ashmore et al. 1982). There are many causes of iron deficiency: first of all, poor diet, then gastrointestinal and parasitic infections (Mays 1998; Mensforth 1990; Walker 1986), lead intoxication (Stuart-Macadam 1991), changes in dietary habits (Roberts, Manchester 1995), as well as diet rich in phytic acids which prevent absorption of iron (Carlson et al. 1974). Moreover, Walker et al. specified that these processes can be caused by the so-called megaloblastic anemia, where cribra orbitalia is due to a deficiency of vitamin C, while porotic hyperostosis is due to vitamin B12 deficiency (Walker et al. 2009). In this population cribra orbitalia and porotic hyperostosis were analysed macroscopically, under strong light, in order to identify presence or absence, which then allowed the cases where lesions appeared after the death to be excluded (for example lesions due to earth acidity). During the analysis, we recorded the intensity of disorders (0-4) as well as their condition at the moment of death (active or healed) (Buikstra, Ubelaker 1994).

Dental caries is a chronic complex bacterial infection resulting in losses of minerals from the tooth caught by infection, measured in milligrams. Despite the complex nature of caries formation, the main causes of this infection are bacteria and eating habits which ensure this disease to be developed and recognized as such (Loesch 1985, 1). An individual's risk of developing caries is closely connected with its cultural environment. Within this population, caries was examined by macroscopic inspection. Caries was diagnosed under strong artificial light with help of periodontal probes, which is similar to the clinical procedure of caries diagnosis. Five types of caries were recorded by standard methodology: occlusal, caries of contact point, smooth surface caries, root surface caries and gross caries (Hilson 2001). The prevalence of caries was calculated by taking the total number of carious teeth and dividing by the number of observable teeth.

Dental enamel hypoplasia is an area on the crown of a tooth which has a deficient amount of enamel thickness caused by a disturbance in enamel matrix secretion. The analysis of hypoplasia in ancient populations is used to obtain data on their eating habits and health (Goodman et al. 1980; Cohen, Armelagos 1984; Larsen 1997; Hillson 2005). This deficiency is visible macroscopically and occurs as a pit, plane, furrow and linear (Hillson 2005). In this population, linear hypoplasia was analysed. Linear enamel hypoplasia, was recorded because it represents the most widespread form of tooth enamel hypoplasia (Buikstra, Ubelaker 1994). This defect is represented by small depressed linear bands in teeth (deciduous and permanent) which result from growth disturbances that disrupt the normal formation of dental enamel which is most frequently found on the buccal surface of the crown.

Dental calculus is mineralized dental plaque that adheres to tooth surfaces. By documenting presence of calculus, we can make inferences about diet, especially protein part and relate calculus presence to another indicator - periodontal disease. Besides that, the quantity and distribution of dental calculus can tell us about oral hygiene of an individual. Since calculus can be easily removed in course of excavation or during conservation (Brothwell 1981; Buikstra, Ubelaker 1994), within this research only "presence" or "absence" of supragingival and subgingival calculus were recorded.

Rickets appears due to metabolism disorders leading to defective mineralization of organ matrix of bones during their growth (Pettifor 2003). This disease usually occurs due to reduced intake of vitamin D, that is, reduced absorption of this vitamin caused by a disease of gastrointestinal tract. It manifests on bones in form of thin cranial vault, deformities of sternum, vertebral column, pelvis and bones of lower extremities. In children suffering from rickets, teeth usually appear later and they often have enamel defects created during its formation. In the population of Remesiana, rickets were diagnosed according to the criteria by Ortner and his colleagues (Ortner, Ericksen 1997; Ortner, Mays 1998).

Traumatic injuries are the most dramatic changes that can be identified in paleopathological analyses of human skeleton material. Analysis of those injuries gives information on important events in life of a person, but also data on frequency and distribution of violence within a community, which is an important precondition for understanding the lifeway of ancient populations. Bone fractures represent the most frequent types of trauma and they are the easiest to identify. In this analysis traumas are defined as fractures due to the action of force or contact with sharp or blunt objects. Presence of traumas was identified by macroscopic analysis including verification of bilateral asymmetry of bones, angular deformities and presence of bone calluses (Merbs 1989; Lovell 1997; Mann, Murphy 1990).

Nonspecific infectious diseases manifest on bone tissue as periostitis (inflammation of periosteum i.e. solid fibrous membrane that covers the whole bone except the articular processes) is the most benign manifestation of infectious diseases on bones, while osteomyelitis (inflammation which affects medullary cavity) is much more dangerous. Periostitis can occur as a result of nonspecific bacterial infections, traumas, specific infectious diseases spreading to bones by haematogenous routes or metabolic diseases (Mann, Murphy 1990; Ortner 2003). The analysis includes only the cases of periostitis occurred as a consequence of an infectious disease, while cases of periostitis due to traumas were excluded from the analysis. Within analysis of this disease we recorded the intensity (low, medium, high), as well as the condition at the moment of death (active or healed).

Osteoarthritis is a chronic progressive process which is usually not followed by inflammation. It is characterized by degradation and deteriorating of joint cartilage which becomes so thin that it can completely disappear from some areas of a joint (Hoffman 1993; Hough, Sokoloff 1989). New bone tissue forms along joint margins – osteophytes. After a certain period of time, such changes lead to deformation of joints. The primary causes responsible for the development of osteoarthritis are mechanical stress and physical activity (Hough, Sokoloff 1989; McKeag 1992).

Results

Porotic hyperostosis

Porotic hyperostosis was identified in one third of the Remesiana's population (35,93%). A total of 44,44% of adults suffered from this type of disorder. 69,23 % of the total number of males was affected by this disease. A smaller percentage of females suffered from porotic hyperostosis, in total 43,75%. Regarding the intensity, in all women it belongs to the category 1, while in most males the intensity is also generally low (77,7% category 1; 11,1% category 2; 11,1 % category 3). Among children, this disorder is present on 25,00% of analysed skulls with low intensity.

Cribra orbitalia

Unlike porotic hyperostosis, cribra orbitalia was identified in 15 % of individuals (Fig. 1). Among adults, cribra orbitalia was identified on 22,22 % analysed skulls, without important difference between males and females (30,76% among males and 25,00 % among females). Among women, the intensity mostly falls within the category 1 (75%), with a smaller percentage falling within the category 2 (25%). The intensity among males falls within the category 1. Frequency of cribra orbitalia among children is 7,14 %, and the intensity for all of them is within the category 1.



Figure 1 - *Cribra orbitalia*, child from the grave 1



Figure 2-Linear enamel hypoplasia on teeth 33 and 34, male from the grave 5

Caries

9% (47/519) of the total number of the examined teeth were affected by caries. The most frequent types in this population are occlusal caries and caries of contact point, which were recorded on 15 teeth (2,9%). Gros caries was identified on 8 teeth (1,5%), root surface caries on 6 (1%), while only 3 teeth (0,6%) were affected by smooth surface caries. The frequency of caries is slightly lower on female (8,4%) than on male teeth (9,2%).

Linear hypoplasia

Compared to the number of individuals, linear enamel hypoplasia affects 39,5 % (17/43) (Fig. 2). Moreover, it was noticed that difference in distribution of hypoplasia depends on the sex categories: it appears in 62,5% of females (10/16) and 41,7% (5/12) of males. Comparing to the number of the examined teeth, 7,9 % (43/545) of teeth were affected by linear hypoplasia. However, there are no important differences between men and women, although it is slightly more common in females (8,1%, 21/259) than in males (7,5%, 14/187).

Calculus

Comparing to the number of individuals, calculus is present in 32,5 % (14/43) (Fig. 3). It is more frequent among females (56,2%, 9/16) than among males (33,3%, 4/12). Calculus was distributed on 27,7 % of teeth (151/545). It was almost equally distributed on the teeth of females (31,6%, 82/259) and males (34,7%, 65/187).

Rickets

6,25 % of children in Remesiana suffered from rickets (Fig. 4). This bone disease can appear in all phases of their growth, among breast-fed children, but also among children in puberty. This is also the case of the population of Remesiana where it occurs at different ages: from 18 months to 18 years.



Figure 3 - Calculus on the teeth 33-35, women from the grave 10



Figure 4 - The curvature of diaphysis of the right radius as a result of rickets, child from the grave 25

Traumatic injuries

Among the inhabitants of the ancient Remesiana, these types of trauma were identified in four males and one female, which is 7,81 % of the population. No such cases were identified among children.

Nonspecific infectious diseases

Unspecific infectious diseases i.e. periostitis and osteomyelitis were identified in 6,25 % of this ancient population. Identical number of males and females suffered from this type of disease. None of the cases was identified among children.

Osteoarthritic changes

One fourth of the population of Remesiana was affected by osteoarthritic changes. They are more common in males (66,66 %) than in females (33,33%). Osteoarthritis is more frequent among individuals aged 30-40.

Discussion

Within the analysed sample, cribra orbitalia and porotic hyperostosis are present in active and healed state, with prevailing low intensity (category 1).

Frequency of cribra orbitalia in Remesiana is low comparing to the other suburban communities of that time (Cucina et al. 2006; Facchini et al. 2004; Novak, Šlaus 2010; Paine et al. 2009). Furthermore, the population of Remesiana had higher frequency of cribra orbitalia in adults than in children, as well as slightly higher presence in males than in females, which differs this population from other contemporary communities (Novak, Šlaus 2010; Salvadei et al. 2001; Paine et al. 2009; Facchini et al. 2004; Cucina et al. 2006). Namely, children are expected to be more affected by these disorders because of their higher needs in iron. On the other hand, women, especially those in the reproductive age group, are exposed to lack of iron due to childbirth and breastfeeding and that is why these disorders are expected to be more common in women than in men. Low frequency in children combined with a high rate of mortality might be explained by poor living conditions i.e. frequent appearance of acute diseases which, unlike chronic disorders, result in rapid death of an individual, without leaving any traces on bones (Paine et al. 2009; Wood et al. 1992). When examining cribra orbitalia, it is important to make difference between an active and healed one. Active state indicates that the entire physiological stress was too strong and frequent for the individual to survive, while healed state shows that the individual successfully fought against the stress and survived (Šlaus 2006). General absence of active cribra orbitalia in adults on Remesiana shows that it is a disorder which usually appears during childhood (Stuart-Macadam 1985). Namely, it is here present in active state only in two males, while it is remodelled in all the others individuals, which indicates that those disorders were successfully survived during childhood.

Porotic hyperostosis is usually related to anemia caused by different factors. Causes of anemia include in the first place poor nutrition and parasitic infections, but they can also be hereditary (Goodman et al. 1984; Stuart-Macadam 1989, 1982; Cohen, Armelagos 1984). This disorder is highly present in the population of Remesiana since more than one third of the inhabitants suffered from this type of disease. A similar situation was recorded in other ancient populations of that time (Paine et al. 2009; Facchini et al. 2004). Porotic hyperostosis is more common in adults than in children, which is

also the case with other communities of that time (Paine et al. 2009; Facchini et al. 2004). However, the same as *cribra orbitalia*, *porotic hyperostosis* is a disorder which is generally more common in women. The fact that in this population both disorders are more common in males than in females could be explained by different living habits or activities. One of the possibilities which should be tested in the future by analysing trace elements in bones is intoxication by lead that can also cause anemia. High levels of lead have already been discovered in some populations from the Roman period (Mackie et al. 1975; Waldron et al. 1976; Waldron 1982). It is estimated that the sources of lead representing the biggest danger to health of most people were: water supply pipes made of lead, lead vessels used for preparation and storage of food as well as lead used for conservation of food, especially as wine sweetener (Facchini et al. 2004, 132; Sič 2012, 192). The region of Remesiana was situated inside the Dardanian mining territory (Душанић 1980, 27) with a centre in Remesiana. The most important ore deposits in this region, both in ancient times and today, are found on Vlasina. Geological research has showed that this region is rich in lead, lead-zinc, copper and auriferous minerals. Rich content of lead was also certainly noticed by the Romans who exploited even thin ore wires containing much less metal (Milovanović 2009, 35). Roman writers wrote on harms of lead in mining places. Thus Vitruvius, Roman writer and architect, wrote about miners (Vitruvius, 8, 6, 11): “they are pale; because during casting, lead vapours rest in different parts of the body and those vapours from foundries reduce their blood strength on a daily basis“. According to estimations, in Greco – Roman times several hundreds of people (mostly slaves) died due to acute intoxication by lead in mines or during the treatment of that metal (Sič 2012). According to sources, we also know that this type of work was exclusively done by men. It is possible that a number of males from Remesiana participated in treatment of this metal which then can explain higher frequency of *porotic hyperostosis* and *cribra orbitalia* in men.

The population of Remesiana showed moderate values of caries prevalence (9%). As mentioned above, frequency of caries in a population depends on the content of carbohydrates in food, way of preparation and cooking of food as well as on the economy of a community. Low values of caries frequency are characteristic mostly for hunter-fisher-gatherer communities (0,0 – 5,3%). Frequency of caries in agricultural communities varies from 2,3 – 26,5%. Moderate caries frequency (0,44 – 10,3%) is characteristic for communities with mixed economy, which lived from hunting and farming (Manzi et al. 1999; Bonfiglioli et al. 2003). Taking into account the total frequency of caries in Remesiana as well as frequency of the different types of caries, it seems that this population, besides cereals, used to eat foods rich in proteins. This is indicated by the fact that the most common types of caries are occlusal caries and caries of contact point (2,9% each). Since those tooth surfaces remained preserved even in older individuals, one can propose that they used non-abrasive food, that is, cooked food (it has already been mentioned that cereals represented common daily meals for poor inhabitants of the Roman Empire). Root surface caries, is the least common type of caries in this population (1%). Although this type of caries appears from the Iron Age (500 BC) until the end of the Middle Ages (AD 1500), it is more common in populations whose diet is based on solid foods causing intensive tooth wear. Due to such tooth wear, occlusal surfaces disappear as places where caries could first develop. Since tooth wear reduces the height of crowns this results in compensational physiological growth of antagonists tooth. That leads to higher exposure of approximate surfaces of teeth and root itself, which become new convenient points for development of caries. If a population is mostly affected by the types of caries developing on crowns, it means that they consume softer, less abrasive food, which is the case of the examined community from Remesiana.

There were no important differences in frequency of caries rates between males and females in Remesiana. A certain studies suggest that significant differences in frequency of caries between males and females could be in their cultural activities (especially those related to the preparation and consuming of food), more than in physiological factors (earlier appearance of teeth in women, pregnancy and breastfeeding) (Larsen 1983, 1995, 1997; Luckas 1996). These differences are usual cause of higher caries rates in women. Since in Remesiana community, caries prevalence was even for almost one per cent lower in women than in men (8,4%; 9,2%), it suggest that there were no differences in cultural and dietary-habits between females and males in Remesiana. The same sources of food were, the most probably, available to both women and men and everything else also indicates that they all ate food prepared on the same way. This distinguished the population of Remesiana from most of the suburban communities of that time (Bonfiglioli et al. 2003).

Tooth enamel hypoplasia is nonspecific stress indicator appearing usually due to three factors: hereditary anomalies (Winter, Brook 1975), localised traumas, (when it appears only on one tooth or two adjoining teeth, Pindborg 1970) or metabolic stress. The latter factor is usually the most frequent cause of hypoplastic disorders on teeth. The most probably, hypoplasia of tooth enamel develops during childhood due to poor diet combined with infectious diseases (Solomonos, Keusch 1981). Moderate frequency of hypoplasia in the sample from Remesiana was probably due to moderate metabolic stress during the childhood of these individuals, which they likely experienced when cessation of breastfeeding started. Hypoplastic disorders of tooth enamel appear exactly after the first year of life of an individual (Reid, Dean 2000). According to historical sources, this age corresponds to the period of cessation of breastfeeding in the Roman society. According to Galen (130-200 AD) solid food could be given to children after the appearance of the first tooth, while the period of breastfeeding ended around the third year of life. Soranus (98-117 AD) believed that children should be fed only with mother's milk until the age of six months, after which solid food could be gradually introduced in their diet. Beside this, he suggests that, the period of cessation of breastfeeding ended around the third or between the third and fourth year. After that period, children could eat cereals and completely solid food (Fildes 1986). Based on the results of linear hypoplasia obtained for Remesiana population, one can conclude that nutritional deficiency and infectious diseases during the cessation of breastfeeding did not cause a strong systemic stress, but a moderate one, which implies an optimal level of health during childhood.

Frequency of dental calculus in this population, both at the level of individuals and teeth, is moderate comparing to other contemporary populations (Bongfioli 2003). Researchers agree that the main cause of calculus accumulation is alkaline environment in the oral cavity. Besides, it has been suggested that the diet rich in proteins cause increase of alkalinity in the oral cavity, which then contributes to the development of calculus. However, there are many factors causing the development of calculus in humans. Therefore, beside dietary habits, the other factors, such as oral hygiene, can also be taken into account when interpreting the presence and amount of dental calculus. A moderate frequency of calculus deposits at the individual level, indicates a diet rich in different nutrients, both proteins and carbohydrates, but however, not a high level of oral hygiene. Besides, the results indicate that there are no differences in diet and oral hygiene between males and females on Remesiana.

Frequency of traumatic injuries in this population is similar to other examined populations from this time (Paine et al. 2009). Regarding traumatic injuries, they are more common in males than in females. In all cases they represent healed fractures which show that these individuals survived

traumatic injuries and that they certainly did not cause their death. Traces of bandaging indicate that this ancient population took care of injured individuals. Although there is relatively high percentage of traumatic injuries in the population of Remesiana, they were probably not caused by violence. It is possible that the inhabitants of the ancient Remesiana got injured while performing physical activities.

Bilateral periosteal reaction was identified in men from the grave 20b (on femurs and tibiae), and in to women: from the grave 38 (on both fibulae) and from the grave 44 (on tibiae and fibulae), possibly indicating an infectious disease which certainly resulted in their reduced mobility. Osteomyelitis, that is, inflammation of bone marrow, was identified in male from the grave 29, where traces of that process are present on both fibulae. It is possible that he died exactly from this disease because at that time, before the discovery of antibiotics, osteomyelitis could have been fatal. In other Roman communities of that time it is noticed that periostitis was more common in men than in women, which can also be explained by a higher level of physical stress compared to women. Analyses of musculoskeletal stress markers, osteoarthritic changes on spine and appearance of Schmorl's nodes in the population of Remesiana corroborates the hypothesis that males had more intense physical activities comparing to females.

Rickets was identified in four children, that is in 6,25 % of population. It is a smaller percentage compared to other examined sites of that time, for example Poundbury (11%) and Isola Sacra (15 %) (Lewis 2010; Wood 2004). Rickets is a disease which is, in the narrow sense, caused by deficiency of vitamin D at the age when it is the most necessary for regular growth and development of children. Every organism provides itself with vitamin D in two basic ways: intake through food or creation of vitamin D in the skin which requires exposure to sunlight. According to sources, Roman care for children could have affected the appearance of rickets. That practice included complete wrapping of children with a fabric which prevented absorption of sunlight, early cessation of breastfeeding and weaning with food often poor in vitamin D (Wood 2004, 154). However, early cessation of lactation in Remesiana's population could generally be excluded as one of the factors, because there is only one child at the age (18 months) when lactation is still possible. Other individuals affected by this disease are over 10 years old and the most probable causes are small quantity of vitamin D in food or insufficient exposure to sunlight.

The vast number of arthritic changes was identified in the lower part of vertebral column, on thoracic and lumbar vertebrae. Moreover, these vertebrae are also often affected by the so-called Schmorl's nodes. Their presence on vertebrae indicates strong mechanical load of the lower part of the spine. Analyses of musculoskeletal stress markers show that the inhabitants of the ancient Remesiana practiced intensive physical activities (Јовановић 2013; Stefanović, Jovanović 2013). A large number of osteoarthritic changes in this population can certainly be connected with continuous and intensive physical activities.

Conclusion

Analysis of the health status of individuals buried at Gladno polje in Remesiana provided information on the quality of life of the population in this region during the Late Antiquity. Although a high degree of child mortality was recorded in this community, indicators of subadult stress (cribra orbitalia, porotic hyperostosis, tooth enamel hypoplasia of) are relatively rarely present, which distinguishes this community from the other communities of that time. It indicates that a high child mortality rate was not a result of systemic metabolic stress appeared during the cessation of breastfeeding or inadequate monotonous diet, but the most probably of a frequent appearance of acute diseases which, unlike chronic disorders, lead to rapid death of individuals, without leaving any traces on bones. The results of dental analysis indicate a good quality diet. Both men and women consumed food rich in various nutrients and prepared in the same manner, which also distinguishes the population of Remesiana from most of the suburban communities of that time. It was discovered that blood disorders were more common in men than in women, which may indicate differences in life habits, that is, performance of activities possibly resulting in intoxication by lead. Furthermore, it was noticed that traumas, unspecific infectious diseases and osteoarthritic changes were much more common among males. This can indicate that men performed the activities involving higher physical stress due to sexual division of labour. However, although both males and females were exposed to hard physical work, it seems that it did not deteriorate their health status. The inhabitants of the ancient Remesiana, despite the fact that many of them performed intense physical activities, had an optimum level of health, which certainly distinguishes this population from other suburban communities of that time.

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Bibliography

- ◆ **Belcastro et al. 2007** - G. Belcastro, E. Rastelli, V. Mariotti, C. Consiglio, F. Facchini, B. Bonfiglioli, Continuity or discontinuity of the life-style in central Italy during the Roman Imperial Age-Early Middle Ages Transition: Diet, health, and behavior, *American Journal of Physical Anthropology* 132 2007, 381-394.
- ◆ **Bongfioli et al. 2003** - B. Bonfiglioli, P. Brasili, M.G. Belcastro, Dento-alveolar lesions and nutritional habits of a Roman Imperial age population (1st-4th c. AD): Quadrella (Molise, Italy), *Homo* 54/1 2003, 36 -56.
- ◆ **Brothwell 1981** - D.R. Brothwell, *Digging up Bones*. Third edition. British Museum and Oxford University Press. London and Oxford.
- ◆ **Buikstra, Ubelaker 1994** - J. E. Buikstra and D. H., Ubelaker, *Standards for data collection from human skeletal remains*. Arkansas Archeological Survey Research Series, No 44. Fayetteville, Arkansas: Arkansas Archeological Survey 1994.
- ◆ **Carlson et al. 1974** - D.S. Carlson, G.J. Armelagos, D.P. Van Gerven, Factors influencing the etiology of cribra orbitalia in prehistoric Nubia, *Journal of Human Evolution* 3 1974, 405-410.
- ◆ **Cohen, Armelagos 1984** - M.N. Cohen, G. J. Armelagos (eds.), *Paleopathology at the Origins of Agriculture*, Academic Press, Orlando 1984.
- ◆ **Cucina et al. 2006** - A. Cucina, R. Vargiu, D. Mancinelli, R. Ricci, E. Santandrea, P. Catalano, A. Coppa, The Necropolis of Valleranno (Rome, 2nd-3rd Century AD): An anthropological perspective on the ancient Romans in the Suburium. *International Journal of Osteoarchaeology* 16 2006, 104-117.
- ◆ **Dušanić 1980** - S. Dušanić: Organizacija rudarstva u Noriku, Panoniji, Dalmaciji i Gornjoj Meziji, *Istorijski glasnik* 1-2 1980, 7-55.
- ◆ **Facchini et al. 2004** - F. Facchini, E. Rastelli, P. Brasil, Cribra orbitalia and cribra cranii in Roman skeletal remains from the Ravenna area and Rimini (1-IV century AD), *International Journal of Osteoarchaeology* 14 2004, 125-136.
- ◆ **Fildes 1986** - V. Fildes, *Breast, Bottles and Babies. A History of Infant Feeding*. Edinburgh University Press, Edinburgh 1986.
- ◆ **Fitzgerald et al. 2006** - C. Fitzgerald, S. Saunders, L. Bondioli, R. Macchiarelli, Health of infants in an Imperial Roman skeletal sample: Perspective from dental microstructure, *American Journal of Physical Anthropology* 130 2006, 179-189.
- ◆ **Goodman et al. 1980** - A.H. Goodman, G.J. Armelagos, J. C. Rose, Enamel hypoplasias as indicators of stress in three prehistoric populations from Illinois, *Human Biology* 52 1980, 515-528.
- ◆ **Goodman, Martin 2002** - A.H. Goodman, D.L. Martin, Reconstructing health problems from skeletal remains, in: *The Backbone of History: health and nutrition in the Western Hemisphere*, R.H. Steckel & J.C. Rose (eds), Cambridge University Press: Cambridge 2002, 11-60.
- ◆ **Hillson 2001** - S. Hillson, Recording dental caries in archaeological human remains. *International Journal of Osteoarchaeology* 11 2001, 249-289.
- ◆ **Hillson 2005** - S.W. Hillson, *Teeth*. Second edition. Cambridge University Press, Cambridge 2005.
- ◆ **Hough, Sokoloff 1989** - A. J. Hough, L. Sokoloff, Pathology of osteoarthritis. In: *Arthritis and Allied Conditions*, D. J. McCarty (ed.), Philadelphia 1989, 1571-1594.
- ◆ **Hoffman 1993** - D. F. Hoffman, Arthritis and exercise, *Primary Care* 20 1993, 895-910.
- ◆ **Huss-Ashmore et al. 1982** - R. Huss-Ashmore, A.H. Goodman, G.J. Armelagos, Nutritional inference from paleopathology, in: *Advances in Archaeological Method and Theory*, MB Schiffer (ed.), Academic Press: New York 1982, 395-474.

- ♦ **Јовановић, Булатовић 2013** - Ј. Јовановић, Ј. Булатовић: Домаћа кокошка (*Gallus domesticus*) у погребном ритуалу на Ремезијани, *Биоархеологија на Балкану: баланс и перспективе* 1 2013, 161-171.
- ♦ **Јовановић 2013** - Ј. Јовановић, Физичке активности античких становника Ремезијане: анализе трагова припоја мишића на костима, *Зборник Народног музеја XXI-1* 2013, 237-251.
- ♦ **Larsen 1983** - C.S. Larsen, Behavioural implications of temporal change in cariogenesis, *Journal of Archaeological Science* 10 1983, 1-8.
- ♦ **Larsen 1995** - C. S. Larsen, Biological changes in human populations with agriculture, *Annual Review of Anthropology* 24 1995, 185-213.
- ♦ **Larsen 1997** - C. S. Larsen, *Bioarchaeology. Interpreting Behaviour from the Human Skeleton*, Cambridge University Press, Cambridge 1997.
- ♦ **Lewis 2010** - M. E. Lewis, Life and death in a civitas capital: metabolic disease and trauma in the children from late Roman Dorchester, Dorset, *American Journal of Physical Anthropology* 142 (3) 2010, 405-416.
- ♦ **Loesch 1985** - W. J. Loesch, The rationale for caries prevention through the use of sugar substitutes, *International Dental Journal* 35 1985, 1.
- ♦ **Lovell 1997** - N. C. Lovell, Trauma analysis in paleopathology, *American Journal of Physical Anthropology* 104 1997, 139-170.
- ♦ **Luckas 1996** - J.R. Lukacs, Sex differences in dental caries rates with the origin of agriculture in South Asia, *Current Anthropology* 37 1996, 147-153.
- ♦ **Mays 1998** - S.Mays, *The Archaeology of Human Bones*, Routledge: London 1998.
- ♦ **Mann, Murphy 1990** - R.W. Mann & S. Murphy, *Regional Atlas of Bone Disease*, Springfield 1990.
- ♦ **Manzi et al. 1999** - G. Manzi, L. Salvadei, A. Vienna, P. Passarello, Discontinuity of life conditions at the transition from the Roman imperial age to the early middle ages: example from central Italy evaluated by pathological dento-alveolar lesions, *American Journal of Human Biology* 11 1999, 327-41.
- ♦ **Mackie et al. 1975** - A. Mackie, A. Townshend, H.A. Waldron, Lead concentrations in bones from Roman York, *Journal of Archaeological Sciences* 2 1975, 235-237.
- ♦ **Mensforth 1990** - R.P. Mensforth, Paleodemography of the Carlston Annis (Bt-5) late archaic skeletal population, *American Journal of Physical Anthropology* 82 1990, 81-99.
- ♦ **Merbs 1989** - C.F. Merbs, Trauma, in: *Reconstructing of life from the skeleton*, M.Y. Işcan, K.A.R. Kennedy (eds.), New York 1989, 161-190.
- ♦ **McKeag 1992** - D.B. McKeag, The relationship of osteoarthritis and exercise, *Clinics in Sports Medicine* 11 1992, 471-487.
- ♦ **Milovanović 2009** - B. Milovanović, Rimsko olovo u Srbiji - eksploatacija, proizvodnja i upotreba. Doktorska disertacija, Filozofski fakultet u Beogradu, 2009.
- ♦ **Novak, Šlaus 2010** - M. Novak, M. Šlaus, Health and disease in a Roman walled city: an example of Colonia Iulia Iader, *Journal of Anthropological Sciences* 88 2010, 189-206.
- ♦ **Ortner 2003** - D. J. Ortner, *Identification of Pathological Conditions in Human Skeletal Remains*, New York 2003.
- ♦ **Ortner, Ericksen 1997** - D.J. Ortner, M.F. Ericksen, Bone changes in the human skull probably resulting from scurvy in infancy and childhood, *International Journal of Osteoarchaeology* 7 1997, 212-220.
- ♦ **Ortner, Mays 1998** - D.J. Ortner & S. Mays, Dry-bone manifestations of rickets in infancy and early childhood, *International Journal of Osteoarchaeology* 8 1998, 45-55.
- ♦ **Paine et al. 2010** - R.R. Paine, R. Vargiu, C. Signoretti, A. Coppa, A health assessment for Imperial Roman burials recovered from the necropolis of San Donato and Bivio CH, Urbino, Italy, *Journal of Anthropological Science* 87 2010, 193-210.

- ◆ **Pettifor 2003** - J. Pettifor, Nutritional rickets, in: *Pediatric bone: biology and diseases*, F. Glorieux J. Pettifor, M. Juppner (eds.), New York 2003, 541-565.
- ◆ **Pindborg 1970** - J.J. Pindborg, *Pathology of the Dental Hard Tissues*, Munksgaard, Copenhagen 1970.
- ◆ **Reid, Dean 2000** - D.J. Reid & M.C. Dean, The timing of linear hypoplasias on human anterior teeth, *American Journal of Physical Anthropology* 113 2000, 135-140.
- ◆ **Roberts, Manchester 1995** - C. Roberts & K. Manchester, *The Archaeology of Disease* (2nd ed.), Cornell University Press: New York 1995.
- ◆ **Salvadei et al. 2001** - L. Salvadei, R. Ricci, G. Manzi, Porotic hyperostosis as a maker of health and nutritional conditions during childhood: studies at the transition between Imperial Rome and early Middle Ages, *American Journal of Human Biology* 13 2001, 709-717.
- ◆ **Sič 2012** - M. Sič, Uticaj zagađenja olovom na zdravlje čoveka (životnu sredinu) u starom Rimu, *Zbornik radova Pravnog fakulteta* 46 (3) 2012, 191-206.
- ◆ **Solomonos, Keusch 1981** - N.W. Solomons, G.T. Keusch, Nutritional implications of parasitic infections, *Nutrition Reviews* 39 1981, 149-160.
- ◆ **Stefanović, Jovanović 2013** - S. Stefanović, J. Jovanović, Skeletni pokazatelji napornog fizičkog rada na antičkoj nekropoli u Remesijani, *Zbornik radova sa naučnog skupa "1700 godina Milanskog edikta"*, Niš 2013, 825-844.
- ◆ **Stuart-Macadam 1985** - P. Stuart-Macadam, Porotic hyperostosis: representative of a childhood condition, *American Journal of Physical Anthropology* 66 1985, 391-398.
- ◆ **Stuart-Macadam 1991** - P. Stuart-Macadam, Anaemia in Roman Britain: Poundbury Camp, in: *Health in Past Societies. Biocultural Interpretations of Human Skeletal Remains in Archaeological Contexts*, H. Bush, M. Zvelebil (eds), British Archaeological Reports 1991.
- ◆ **Šlaus 2006** - M. Šlaus, *Bioarheologija – demografija, zdravlje, traume i prehrana starohrvatskih Populacija*, Zagreb 2006.
- ◆ **Vitruvius** - *Vitruvius: The Ten Books on Architecture*. Vitruvius. Morris Hicky Morgan. Cambridge: Harvard University Press, London: Humphrey Milford. Oxford University Press 1914.
- ◆ **Waldron 1982** - H. A. Waldron, Human bone lead concentrations, in: *Romano-British Cemeteries at Cirencester*, A. McWhirr, L. Viner, C. Wells (eds.), Alan Sutton Publishing Limited: Gloucester, Great Britain, 2 1982, 203-204.
- ◆ **Waldron et al. 1976** - H. A. Waldron, A. Mackie, A. Townshend, The lead content of some Romano-British bones, *Archaeometry* 18 1976, 221-227.
- ◆ **Walker 1986** - P. Walker, Porotic hyperostosis in marine dependent California Indian population, *American Journal of Physical Anthropology* 69 1986, 345-354.
- ◆ **Walker et al. 2009** - P.L. Walker, R.R. Bathurst, R. Richman, T. Gjerdrum, V.A. Andrushko, The Causes of Porotic Hyperostosis and Cribra orbitalia: A Reappraisal of the Iron-Deficiency-Anemia Hypothesis, *American Journal of Physical Anthropology* 139 2009, 109-125.
- ◆ **Winter, Brook 1975** - G.B. Winter, A.B. Brook, Enamel hypoplasia and anomalies of the enamel. *Dental Clinics of North America* 19 1975, 3-24.
- ◆ **Wood 2004** - C. E. C. Wood, *An Investigation of the Prevalence of Rickets among Subadults from the Roman Necropolis of Isola Sacra (1st to 3rd centuries AD)*, Italy, Open Access Dissertations and Theses, Paper 6933.
- ◆ **Wood et al. 1992** - J. W. Wood, G. R. Miner, H. C. Harpending, K. M. Weiss, The osteological paradox: Problems of inferring prehistoric health from skeletal samples, *Current Anthropology* 33 1992, 343-358.