Subadultni stres u srednjovjekovnim i novovjekovnim populacijama kontinentalne Hrvatske

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Subadult Stress in the Medieval and Early Modern Populations of Continental Croatia

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Svrha rada jest analiza učestalosti i distribucije dva pokazatelja subadultnog stresa (cribrae orbitaliae i hipoplazije zubne cakline), njihove međusobne korelacije i njihova odnosa s pokazateljem nespecifičnih zaraznih bolesti – periostitisom. U radu je analizirano 415 kostura iz kontinentalne Hrvatske, s nalazišta Crkvari, Ivanec, Mala Črešnjevica, Prozorje, Nova Rača, Suhopolje, Tomaš i Torčec, koja se datiraju u srednji i novi vijek (12.-18. st.). U analiziranom uzorku muškarci su živjeli značajno duže od žena (37,2 prema 33,6 godina). Učestalost cribrae orbitaliae u ukupnom uzorku iznosi 37,2%. Djeca pokazuju statistički značajno višu učestalost cribrae orbitaliae od odraslih osoba, a poremećaj je nešto češći kod žena nego kod muškaraca. Odrasle osobe kod kojih je uočena cribra orbitalia u prosjeku žive 6,5 godina kraće od osoba kod kojih ovaj poremećaj nije prisutan. Učestalost hipoplazije zubne cakline u analiziranom uzorku iznosi 44,6%, a nešto viša učestalost zabilježena je kod žena na svim analiziranim zubima. Učestalost nespecifičnog periostitisa iznosi 48,4% s nešto višom učestalošću kod žena u odnosu na muškarce. Značajna pozitivna korelacija između cribrae orbitaliae i nespecifičnog periostitisa prisutna je na razini čitavog uzorka. Znatno kraći životni vijek, viša učestalost cribrae orbitaliae, hipoplazije zubne cakline i periostitisa kod žena sugerira da su žene bile sklonije epizodama biološkog stresa, što može biti posljedica smanjenih zaliha željeza kod žena kao rezultat reproduktivnih funkcija ili lošijeg tretmana djevojčica, posebice tijekom najranijeg djetinjstva (tijekom dojenja). Skeletni uzorak, analiziran u ovom radu, odlikuje se lošim životnim uvjetima i niskim zdravstvenim standardom koji je najvjerojatnije bio posljedica sinergističkog djelovanja anemije izazvane nedostatkom željeza, zaraznih bolesti, neodgovarajuće prehrane i parazitskih infekcija.

Ključne riječi: subadultni stres, srednji vijek, novi vijek, kontinentalna Hrvatska, cribra orbitalia, anemija izazvana nedostatkom željeza, hipoplazija zubne cakline, nespecifični periostitis.

The purpose of this paper is to analyze the frequency and distribution of two indicators of subadult stress (cribra orbitalia and enamel hypoplasia), their correlation and their relationship with an indicator of non-specific infectious diseases – periostitis. The paper contains an analysis of 415 skeletons from continental Croatia, from the sites of Crkvari, Ivanec, Mala Črešnjevica, Prozorje, Nova Rača, Suhopolje, Tomaš and Torčec, dated to the Middle Ages and the Early Modern period (12th-18th cent.). Males in the analyzed sample lived significantly longer than females (37.2 vs. 33.6 years). The frequency of cribra orbitalia in the total sample is 37.2%. The frequency of cribra orbitalia in subadults is significantly higher than in adults, and females are affected somewhat more frequently than males. Adults that exhibited cribra orbitalia lived 6.5 years shorter on the average than the individuals without this disorder. The frequency of dental enamel hypoplasia in the analyzed sample is 44.6%, with a somewhat higher frequency registered in females on all analyzed teeth. The frequency of non-specific periostitis is 48.4%, with a somewhat higher frequency in females than in males. A significant positive correlation between cribra orbitalia and non-specific periostitis is present at the level of the entire sample.
A significantly shorter life span, a higher frequency of cribra orbitalia, enamel hypoplasia and periostitis in females suggests that females were more prone to the episodes of biological stress, which may have been a consequence of diminished stocks of iron in females as a result of their reproductive function or poorer treatment of young girls, particularly during earliest childhood (during breastfeeding). The skeletal sample analyzed in this paper is characterized by poor living conditions and low health standard, which was most likely a consequence of a synergic action of iron deficiency anemia, infectious diseases, inadequate diet and parasitical infections.

Key words: subadult stress, Middle Ages, Early Modern period, continental Croatia, cribra orbitalia, iron deficiency anemia, enamel hypoplasia, non-specific periostitis.

UVOD

Proučavanje skeletnih patologija, uključujući i indikatore subadultnog stresa kao što su *cribra orbitalia* i hipoplazija zubne cakline, pokazalo se kao vrlo uspješna metoda određivanja životnih uvjeta arheoloških populacija (Cohen, Armelagos 1984; Huss-Ashmore et al. 1982; Larsen 1987). Analiza tih patoloških promjena pruža informacije o mogućim uzročnicima stresa tijekom rasta i razvoja, kada je stres najizraženiji te o posljedicama koje subadultni stres ostavlja na zdravlje djece.

U početku ovih istraživanja analize su se poglavito usredotočile na pojedinačne pokazatelje stresa kao što su *cribra orbitalia*, Harrisove linije, hipoplazija zubne cakline i sl. S vremenom se taj pristup promijenio u korist analiza kombinacije dva ili više pokazatelja subadultnog stresa (Buikstra, Cook 1980; Cohen, Armelagos 1984), što je značajno pridonijelo boljem razumijevanju ljudske biološke prilagodbe (Repetto et al. 1988).

Pojam *cribra orbitalia* uveo je Welcker (1888) kako bi opisao koštane promjene koje je uočio na svodovima orbita lubanje. Otada je *cribra orbitalia* uočena u mnogobrojnim osteološkim uzorcima diljem svijeta, posebice u Europi, Africi te Sjevernoj i Južnoj Americi, pa se općenito danas smatra pokazateljem fiziološkog stresa (Huss-Ashmore et al. 1982; Martin et al. 1985; Mittler, Van Gerven 1994).

Iako se proučavanje *cribrae orbitaliae* u skeletnim uzorcima pokazalo kao važno oruđe za rekonstrukciju životnih i zdravstvenih uvjeta arheoloških populacija, podaci prikupljeni diljem svijeta pokazuju kako se ova patologija može razviti u različitim ekološkim, socijalnim i kulturnim okružjima. Sukladno tome, etiologija *cribrae orbitaliae* može se razumjeti samo u uskoj povezanosti s drugim pokazateljima biološkog stresa (Fairgrieve, Molto 2000; Larsen 1997). Iako se neki čimbenici, kao što su parazitizam, neprimjerena prehrana i zarazne bolesti pojavljuju u gotovo svim okružjima, pri interpretaciji *cribrae orbitaliae* u arheološkim populacijama u obzir se moraju uzeti okolnosti koje su specifične za određena nalazišta ili geografska područja. Nama dostupni podaci o životnim uvjetima i načinu života prijašnjih stanovnika kontinentalne Hrvatske, kao što su gustoća naseljenosti, kvaliteta i kvantiteta prehrane, razina higijene, uvjeti stanovanja i lokalni ekološki sustavi koji su okruživali određene populacije, često su nepotpuni ili dvosmisleni. Zbog tih ograničenja analiza i interpretacija učestalosti *cribrae orbitaliae* u ovom radu korelirana je s učestalošću još jednog pokazatelja subadultnog stresa – hipoplazije zubne cakline.

Mnogobrojni čimbenici mogu usporiti ili zaustaviti stvaranje zubne cakline tijekom djetinjstva, a istraživanja su pokazala da je zubna caklina posebno osjetljiva na metaboličke poremećaje koji su rezultat nekvalitetne prehrane i bolesti. Budući da zubna caklina, za razliku od kosti, nema sposobnost remodeliranja, razvojni poremećaj, tj. hipoplazija zubne cakline ostat će zabilježena sve dok se zahvaćeni dio krune ne uništi abrazijom zuba (Šlaus 2006, 124).

Zarazne bolesti u arheološkim su populacijama bile vo-

INTRODUCTION

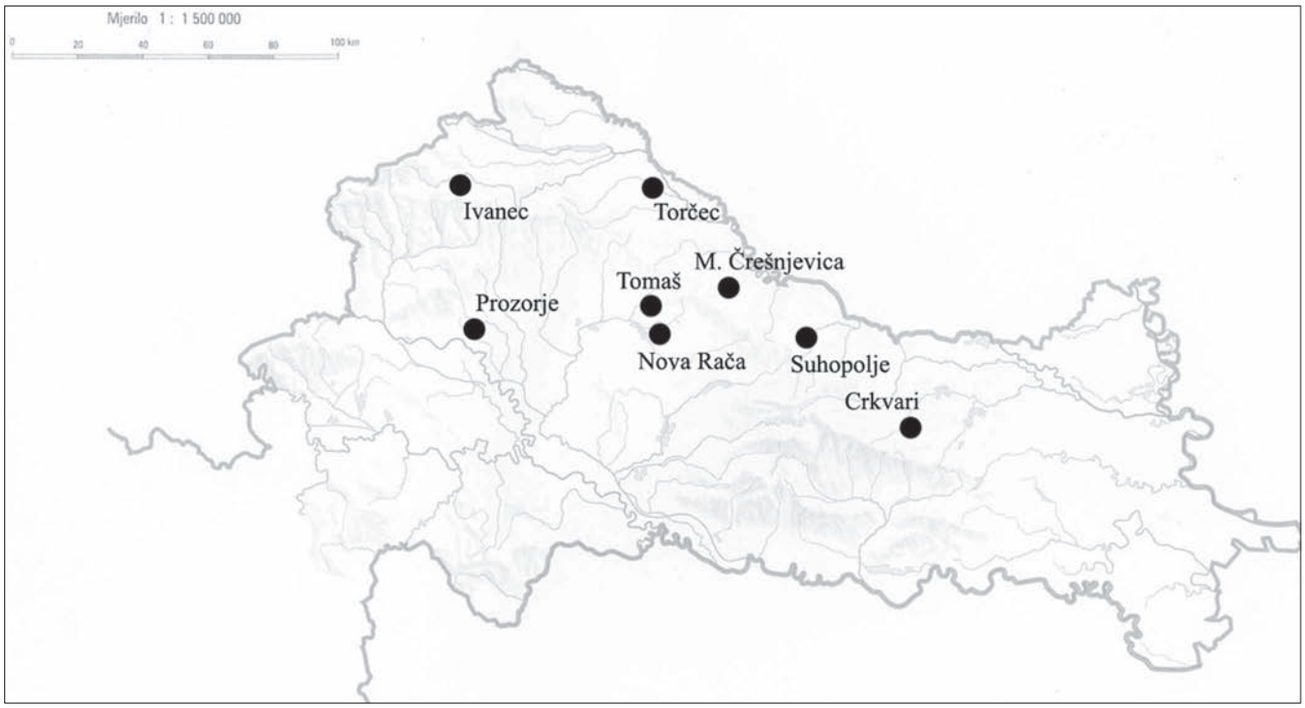
The study of skeletal pathologies, including the indicators of subadult stress, such as cribra orbitalia and enamel hypoplasia, proved to be a highly successful method of determining conditions of life of archaeological populations (Cohen, Armelagos 1984; Huss-Ashmore et al. 1982; Larsen 1987). By analyzing those pathological changes one can obtain information on possible causes of stress during growth and development, when the stress is most pronounced, as well as on the consequences of subadult stress on the health of children.

In the beginning of this research the analyses primarily focused on individual stress markers, such as cribra orbitalia, Harris lines, enamel hypoplasia etc. This approach gradually gave way to analyses of a combination of two or more indicators of subadult stress (Buikstra, Cook 1980; Cohen, Armelagos 1984), which significantly contributed to a better understanding of human biological adaptation (Repetto et al. 1988).

The term cribra orbitalia was introduced by Welcker (1888) with the aim of describing bone changes that he had observed on the orbital vaults of the skull. Since then cribra orbitalia has been detected in a number of osteological samples throughout the world, particularly in Europe, Africa as well as North and South America, and it is nowadays generally considered an indicator of physiological stress (Huss-Ashmore et al. 1982; Martin et al. 1985; Mittler, Van Gerven 1994).

Even though the study of cribra orbitalia in skeletal samples proved to be an important tool for the reconstruction of the life and health conditions of archaeological populations, the data collected all over the world show that this pathology can develop in various ecological, social and cultural environments. Correspondingly, one can understand the etiology of cribra orbitalia only in a close relationship with other indicators of biological stress (Fairgrieve, Molto 2000; Larsen 1997). Although certain factors, such as parasitism, inadequate diet and infectious diseases, appear in almost all environments, when interpreting cribra orbitalia in archaeological populations it is necessary to take into account the specific circumstances in distinct sites or geographic areas. The available data on living conditions and the way of life of previous inhabitants of continental Croatia that were available to us, such as population density, quality and quantity of diet, the level of hygiene, dwelling conditions and local ecosystems that surrounded individual populations, were often incomplete or ambiguous. Due to these limitations the analysis and interpretation of the frequency of cribra orbitalia in this paper was correlated with the frequency of another marker of subadult stress – enamel hypoplasia.

There are many factors that can slow down or prevent the formation of tooth enamel in childhood. The research has shown that tooth enamel is particularly sensitive to metabolic disorders resulting from a poor-quality diet and diseases. As tooth enamel, in contrast to bone, is unable to remodel itself, a developmental disorder, i.e. enamel hypo-



Karta 1 Zemljopisni položaj analiziranih nalazišta
Map 1 Geographic position of the analyzed sites

deći uzrok smrti, a posebno tijekom najranijeg djetinjstva (Ortner, Putschar 1985). Većina zaraznih bolesti, koje se pojavljuju u arheološkim populacijama, nespecifičnog su porijekla, što znači da su patološke promjene izazvane različitim mikroorganizmima čija etiologija nije poznata, a na kostima se najčešće manifestiraju kao periostitis. U ovom radu pokušat će se utvrditi eventualna korelacija pokazatelja subadultnog stresa s nespecifičnim zaraznim bolestima.

Svrha ovog rada je analiza učestalosti *cribrae orbitaliae* i hipoplazije zubne cakline prema spolu i dobnim skupinama, kao i njihova eventualna međusobna povezanost, te njihova moguća povezanost s nespecifičnim zaraznim bolestima (periostitisom) u kompozitnom srednjovjekovnom/ novovjekovnom uzorku iz kontinentalne Hrvatske. Budući da su se istraživanja pokazatelja subadultnog stresa u Hrvatskoj intenzivirala tek u posljednjih desetak godina te da ne postoji dovoljan broj analiza koja se bave tim problemom, ovaj rad će pomoći u pojašnjavanju slike o načinu i kvaliteti života stanovništva kontinentalne Hrvatske tijekom srednjega i novog vijeka. Također, jedan od ciljeva ovog rada jest dobivene rezultate (učestalosti *cribrae orbitaliae* i hipoplazije zubne cakline) iz Hrvatske usporediti s učestalostima istih pokazatelja u drugim skeletnim uzorcima iz Europe.

MATERIJALI I METODE

U ovom radu korišten je skeletni materijal s osam arheoloških nalazišta iz Hrvatske sjeverno od Save. Sav materijal datira se između 12. i 18. stoljeća. Koštani materijal (415 kostura) različitog stupnja uščuvanosti potječe s nalazišta: Crkvari, Ivanec, Mala Črešnjevica, Prozorje, Nova Rača, Suhopolje, Tomaš i Torčec (tablica 1, karta 1).

plasia, will remain documented as long as the affected part of the crown has not been destroyed by dental abrasion (Šlaus 2006, 124).

Infectious diseases were the leading cause of death of archaeological populations, especially during the earliest childhood (Ortner, Putschar 1985). Most of infectious diseases that appear in archaeological populations are of non-specific origin, which means that pathological changes were caused by various microorganisms of unknown etiology, and on bones they most often appear as periostitis. In this paper we shall try to establish possible correlation of the markers of subadult stress with non-specific infectious diseases.

The aim of this paper is to analyze the frequency of cribra orbitalia and enamel hypoplasia by sex and age groups, as well as their possible correlation and their possible connection with non-specific infectious diseases (periostitis) in a composite medieval/Early Modern sample from continental Croatia. As the research on the markers of subadult stress in Croatia intensified only in the last ten years or so, and we are still lacking a sufficient number of analyses dealing with that problem, this paper will contribute to a clearer picture of the way and quality of life of the population of continental Croatia during the Middle Ages and the Early Modern period. Also, one of the objectives of this paper is to compare the obtained results (the frequency of cribra orbitalia and enamel hypoplasia) from Croatia with the frequency of the same markers in other skeletal samples from Europe.

MATERIALS AND METHODS

The skeletal material in this paper comes from eight archaeological sites in Croatia north of the river Sava. The

Nalazište	Veličina uzorka	Datacija
Crkvari	122	12. – 17. st.
Ivanec	31	12. – 17. st.
Mala Črešnjevica	5	kasni srednji vijek/rani novi vijek
Prozorje	84	12. – 18. st.
Nova Rača	104	13. – 18. st.
Suhopolje	30	12. – 16. st.
Tomaš	20	16. st.
Torčec	19	14. – 18. st.

Tablica 1 Popis, veličina i datacija analiziranih uzoraka
Table 1 A list, size and date of the analyzed samples

Crkva Sv. Lovre, u početku gotička a kasnije barokizirana, podignuta je na izdvojenom brežuljku uza selo Crkvare, a neposredno uokolo nje prostiralo se srednjovjekovno groblje (Tkalčec 2006, 23). Skeletni materijal potječe iz arheoloških istraživanja koja su se vodila od 2003. do 2006. pod vodstvom Instituta za arheologiju iz Zagreba (prvu i drugu sezonu vodio je prof. dr. sc. Željko Tomičić (Tomičić, Tkalčec 2005, 14; Tomičić et al. 2004, 161), a kasnija istraživanja preuzela je mr. sc. Tatjana Tkalčec (Tkalčec 2006, 23; 2007, 22). Do 2006. otkriveno je 140 grobova koji se mogu podijeliti u tri horizonta ukapanja (dva srednjovjekovna i jedan novovjekovni) koji se datiraju od 12. do 17. st. (Tkalčec 2006, 23-24, 26; Tomičić, Tkalčec 2005, 21).

Nalazište Stari grad u Ivancu nalazi se na dominantnoj točki u središtu grada, na mjestu današnjega gradskog parka. Istraživanja je na mjestu bivšega kaštela obitelji Pethö de Gerse i kapele Sv. Ivana Krstitelja 1998. i 1999. vodio prof. dr. sc. Željko Tomičić, a od 2002. vodi ih dr. sc. Juraj Belaj iz Instituta za arheologiju iz Zagreba. Do 2004. otkrivena su 34 groba te mnoštvo dislociranih kostiju i kosturnica koje su posljedica čestih građevinskih intervencija na samom terenu tijekom 18. i 19. st. (Belaj 2005, 64). Početak ukapanja na ovom nalazištu može se datirati u 12. st., a završetak u 17. st. (Belaj 2008, 24, 38).

Mala Črešnjevica nalazi se jugozapadno od Pitomače, a samo nalazište smješteno je na ovećem brežuljku oko crkve Sv. Martina (današnja crkva 318 Bogonosnih otaca) u središtu sela (Tkalčec 2002, 99). Arheološka iskopavanja godine 2001. vodila je mr. sc. Tatjana Tkalčec iz Instituta za arheologiju iz Zagreba. Istraživanja su objelodanila nekoliko građevinskih faza, kao i grobove koji se mogu datirati u kasni srednji i rani novi vijek (Tkalčec 2002, 99).

Nova Rača smjestila se pored Bjelovara, a istraživanja provedena na groblju oko crkve Uznesenja Sv. Djevice Marije, pod vodstvom dr. sc. Gorana Jakovljevića iz Gradskog muzeja u Bjelovaru, trajala su od 1986. do 1995. Na temelju arheoloških nalaza i C14 datuma, groblje se može podijeliti

Starost	Djeca	Žene	Muškarci
0-1	40		
2-5	50		
6-10	44		
11-15	15		
16-20		10	11
21-25		18	13
26-30		19	14
31-35		17	26
36-40		13	41
41-45		11	31
46-50		7	17
51-55		3	4
56-60		3	4
60+		2	2
Ukupno	**149**	**103**	**163**
Prosječna starost		x = 33,6 (sd = 11,2)	x = 37,2 (sd = 9,94)

Tablica 2 Raspored spola i starosti u kompozitnom uzorku iz kontinentalne Hrvatske
Table 2 Sex and age distribution in the composite sample from continental Croatia

entire material dates from the 12th to 18th cent. The bone material (415 skeletons), in various degrees of preservation, comes from the following sites: Crkvari, Ivanec, Mala Črešnjevica, Prozorje, Nova Rača, Suhopolje, Tomaš and Torčec (Table 1, Map 1).

The church of St. Lawrence (*Sv. Lovro*), Gothic at first and later turned baroque-style, was erected on an isolated hill near the village of Crkvari. It was surrounded by a medieval cemetery (Tkalčec 2006, 23). The skeletal material comes from the archaeological investigations carried out from 2003 to 2006 under the direction of the Institute of Archaeology in Zagreb. The first two seasons were managed by Prof. Željko Tomičić (Tomičić, Tkalčec 2005, 14; Tomičić et al. 2004, 161), while the investigations were subsequently managed by Dr. Tatjana Tkalčec (Tkalčec 2006, 23; 2007, 22). Until 2006 a total of 140 graves were discovered, which can be divided into three burial horizons (two medieval and an Early Modern one), dated from the 12th to the 17th cent. (Tkalčec 2006, 23-24, 26; Tomičić, Tkalčec 2005, 21).

The site of Stari Grad (*Old Town*) in Ivanec lies on a commanding point in the centre of the town, at the position of the present-day town park. The investigations at the position of the former citadel of the Pethö de Gerse family and St. John the Baptist's chapel in the year 1998. and 1999. have been carried out by Proff. Željko Tomičić and since 2002. by Dr. Juraj Belaj from the Institute of Archaeology in Zagreb since 1998. Thirty-four graves were discovered until 2004 as

u tri horizonta pokapanja koji se datiraju od 13. do 18. st. (Jakovljević, Šlaus 2003, 125).

Crkva Sv. Martina u selu Prozorje nalazi se na vrhu brežuljka, 2 km sjeverno od Dugog Sela. Sama crkva tijekom svoje povijesti bila je više puta pregrađivana i dograđivana, a danas se smatra da su najstariji vidljivi dijelovi građevine kasnogotički i da potječu iz 16. st. Istraživanja se na ovom nalazištu kontinuirano vode od 2002. pod vodstvom dr. sc. Jurja Belaja iz Instituta za arheologiju iz Zagreba (Belaj 2006, 79). Do 2006. u crkvi i oko nje otkriveno je 137 grobova i kosturnica od kojih neke nisu istražene (Belaj 2007, 81). Na temelju nalaza u grobovima i crkvi može se pretpostaviti da se s ukapanjem na ovom nalazištu počelo krajem 12. st. te da je i trajalo do kraja 18. st. (Belaj 2006, 81; 2006a, 257, 264).

Arheološko nalazište Suhopolje – Kliškovac ili Turski grad blagi je konični brežuljak jugozapadno od Suhopolja, koji je presjekla trasa željezničke pruge Virovitica – Osijek. Na ovom nalazištu iskopavanja, pod vodstvom prof. dr. sc. Željka Tomičića iz Instituta za arheologiju iz Zagreba, traju od 2005. sve do danas (Tomičić, Jelinčić 2007, 38). Stariji horizont ukopa na ovom groblju pripada razdoblju bjelobrdske kulture (12. st. i prva polovina 13. st.) (Tomičić, Jelinčić 2007, 44), dok se mlađi horizont groblja u Kliškovcu može smjestiti u kasni srednji vijek i traje do kraja 15. st. (Tomičić et al. 2008).

Selo Tomaš smjestilo se pokraj Bjelovara, a arheološka istraživanja na groblju smještenom oko crkve vodio je 1997. dr. sc. Goran Jakovljević iz Gradskog muzeja u Bjelovaru. Upotreba groblja se na temelju grobnih nalaza datira u 16. st. (Jakovljević 1999, 28).

Selo Torčec smješteno je između Drnja i Đelekovca u Koprivničko-križevačko županiji. Istraživanja na nalazištu Cirkvišče vođena su 2002. g. pod vodstvom dr. sc. Tajane Sekelj Ivančan iz Instituta za arheologiju iz Zagreba. Tijekom iskopavanja otkriveno je 18 grobnih cjelina koje se na temelju fragmenata keramike pronađene u grobnim ispunama, nalaza nakita i dijelova odjevnih predmeta, može datirati između 14. i prve polovine 18. st. (Sekelj Ivančan, Tkalčec 2003, 5).

Antropološka analiza provedena je u laboratoriju Odsjeka za arheologiju Hrvatske akademije znanosti i umjetnosti u Zagrebu. Tijekom analize spol je određen na temelju morfoloških razlika koje su prisutne u kosturima muškaraca i žena. Najvažnije razlike nalaze se u zdjeličnom obruču (Kelly 1978; Kimura 1982; Krogman, Işcan 1986; Phenice 1969; Sutherland, Suchey 1991; Weaver 1980) i bile su korištene kad god je to bilo moguće. U slučajevima kada zdjelica nije bila uščuvana, korištene su druge kranijalne i postkranijalne morfološke razlike (Bass 1987), a vrlo korisnima pokazale su se diskriminantne funkcije za određivanje spola odraslih osoba na temelju dimenzija bedrene (Šlaus 1997) i goljenične kosti (Šlaus, Tomičić 2005). Spol djece nije određivan.

Doživljena starost određena je na temelju više čimbenika: stupnja spojenosti kranijalnih šavova (Meindl, Lovejoy 1985), promjena na pubičnoj simfizi (Brooks, Suchey 1990; well as a number of displaced bones and ossuaries, which is a consequence of frequent building interventions at the site itself during the 18th and 19th cent. (Belaj 2005, 64). The beginning of burials at this site can be dated to the 12th cent., and the end to the 17th cent. (Belaj 2008, 24, 38).

Mala Črešnjevica lies southwest of Pitomača, and the site itself is situated on a rather large hill around St. Martin's Church (the present-day Church of the 318 Nicene Fathers) in the centre of the village (Tkalčec 2002, 99). The 2001 archaeological excavations were led by Dr. Tatjana Tkalčec, from the Institute of Archaeology in Zagreb. The investigation revealed several building phases, as well as graves datable to the late Middle Ages and the Early Modern period (Tkalčec 2002, 99).

Nova Rača is situated near Bjelovar, and the investigations carried out at a cemetery around the church of the Assumption of Holy Virgin Mary, under the directorship of Dr. Goran Jakovljević from the Bjelovar Municipal Museum, lasted from 1986 to 1995. Based on archaeological finds and C^{14} dates, the cemetery can be divided into three burial horizons, datable from the 13th to the 18th cent. (Jakovljević, Šlaus 2003, 125).

St. Martin's church in the village of Prozorje lies at the top of a hill, 2 km north of Dugo Selo. The church itself underwent several reconstructions and annexes**,** and it is thought that the oldest visible parts of the structure are late Gothic, dating from the 16th cent. The investigation of this site has been carried out continuously since 2002 under the direction of Dr. Juraj Belaj from the Institute of Archaeology in Zagreb (Belaj 2006, 79). Until 2006 a total of 137 graves and ossuaries were discovered in the church and around it. Several of those ossuaries have not been investigated yet (Belaj 2007, 81). Based on the finds from the graves and the church, it can be assumed that the burials at this site started at the end of the 12th cent., and lasted until the end of the 18th cent. (Belaj 2006, 81; 2006a, 257, 264).

The archaeological site of Suhopolje – Kliškovac or Turski Grad is a gentle conical hill southwest of Suhopolje, cut across by the Virovitica – Osijek railway. The excavations at this site have been carried out since 2005 under the direction of Prof. Željko Tomičić from the Institute of Archaeology in Zagreb (Tomičić, Jelinčić 2007, 38). The earlier horizon of burials at this cemetery belongs to the period of the Bijelo Brdo culture (the 12th and the first half of the 13th cent.) (Tomičić, Jelinčić 2007, 44), while the later horizon of the cemetery in Kliškovac can be dated to the late Middle Ages, until the end of the 15th cent. (Tomičić et al. 2008).

The village of Tomaš is situated near Bjelovar, and the archaeological investigations at the cemetery that surrounds the church were carried out in 1997 by Dr. Goran Jakovljević from the Bjelovar Municipal Museum. The grave finds reveal that the cemetery was in use in the 16th cent. (Jakovljević 1999, 28).

The village of Torčec is situated between Drnje and Đelekovac in the Koprivnica-Križevci county. The investigations at the Cirkvišće site were carried out in 2002 under the management of Dr. Tajana Sekelj Ivančan from the Institute

Gilbert, McKern 1973; McKern, Stewart 1957; Todd 1920; 1921), promjena na aurikularnoj plohi crijevne kosti (Lovejoy et al. 1985), promjena na sternalnim krajevima rebara (Işcan et al. 1984; 1985) te na temelju pojave degenerativnih promjena na zglobnim plohama dugih kostiju i kralježaka (Pfeiffer 1991). Starost dječjih kostura procijenjena je na temelju promjena koje nastaju tijekom formiranja i nicanja mliječnih i stalnih zuba, stupnja osifikacije kostiju (spajanje epifiza s dijafizama) te dužine dijafiza dugih kostiju (Bass 1987; Fazekas, Kósa 1978; McKern, Stewart 1957; Moorees et al. 1963; Scheuer, Black 2000). U svim analizama korišten je najveći mogući broj kriterija kako bi se smanjio učinak loše uščuvanosti nekih kostura. Starost odraslih osoba dana je u rasponu od pet godina (npr., 21 - 25), dok je starost djece dana u rasponu od jedne godine.

Cribra orbitalia nastaje zbog hipertrofije diploë (središnjega, poroznog dijela kosti lubanje), što dovodi do stanjivanja i uništenja korteksa te stvaranja porozne i šupljikave kosti na mjestu korteksa. Makroskopski se očituje u pojavi malih rupičastih lezija na svodovima orbita koje mogu biti promjera manjega od jednog milimetra do većih otvora koji se djelomično spajaju. *Cribra orbitalia* pojavljuje se kod djece i odraslih osoba, a može biti u aktivnom ili zaraslom stanju. Zarasla i aktivna *cribra orbitalia* razlikuju se po površini kosti koja je zahvaćena, promjeru šupljina koje nastaju i debljini porozne kosti.

Prema mišljenju većine autora danas, *cribra orbitalia* se veže uz anemiju izazvanu nedostatkom željeza (Carlson et al. 1974; Cybulski 1977; El-Najjar 1976; Hengen 1971; Huss-Ashmore et al. 1982; Lallo et al. 1977; Larsen 1997; Mensforth et al. 1978; Mittler, Van Gerven 1994; Stuart-Macadam 1985; 1991). Ova vrsta anemije definira se kao redukcija hemoglobina i hematokrita u krvi ispod normalne razine. Njezini uzroci mogu biti različiti. Hengen (1971) je zaključio da je anemija izazvana nedostatkom željeza primarno rezultat parazitizma, a Stuart-Macadam (1992) je na temelju svojih istraživanja pretpostavila da je takva anemija zapravo prilagođavanje organizma na bolest te njegov pokušaj da iscrpi i izgladni patogene kao što su bakterije i virusi, kojima je željezo neophodno kako bi se mogli reproducirati u tijelu domaćina. Uz ovdje navedene, u brojnim arheološkim populacijama uočeni su još neki čimbenici koji se vezuju uz pojavu anemije izazvane nedostatkom željeza: loša i neodgovarajuća prehrana, gastrointestinalne i parazitske infekcije (Mays 1998; Mensforth 1990; Walker 1986), trovanje olovom (Stuart-Macadam 1991), promjene u prehrambenim navikama (Roberts, Manchester 1995) kao i prehrana bogata fitatima (Carlson et al. 1974) koji sprječavaju apsorpciju željeza.

Podaci prikupljeni u arheološkim skeletnim uzorcima diljem svijeta pokazuju da se aktivna *cribra orbitalia* najčešće pojavljuje kod djece, dok se kod odraslih osoba ova patologija gotovo uvijek nalazi u zaraslom stanju (Larsen et al. 1992; Mensforth et al. 1978; Mittler, Van Gerven 1994; Šlaus 2006; Walker 1986; i mnogi drugi autori). Prema Stuart-Macadam (1985, 395) takva distribucija sugerira da je *cribra orbitalia* rezultat anemije u dječjoj dobi i da je zarasla *cribra orbitalia*

of Archaeology in Zagreb. The excavations yielded 18 grave assemblages, which, based on the fragments of pottery found in the grave fills, the finds of jewellery and pieces of costume, can be dated between the 14th and the first half of the 18th cent. (Sekelj Ivančan, Tkalčec 2003, 5).

The anthropological analysis was carried out in the laboratory of the Department of Archaeology of the Croatian Academy of Sciences and Arts in Zagreb. In the analysis, the sex was determined on the basis of morphological differences present in skeletons of males and females. The most important differences are in the pelvic girdle (Kelly 1978; Kimura 1982; Krogman, Işcan 1986; Phenice 1969; Sutherland, Suchey 1991; Weaver 1980), and these were observed whenever possible. In cases when the pelvis was not preserved, cranial and postcranial morphological differences were used (Bass 1987). Discriminant functions for adult sex determination on the basis of the thigh bone (Šlaus 1997) and the shin bone (Šlaus, Tomičić 2005) proved highly useful. Sex of subadults was not determined.

The age at death was determined on the basis of several factors: the degree of fusion of cranial sutures (Meindl, Lovejoy 1985), changes in the pubic symphysis (Brooks, Suchey 1990; Gilbert, McKern 1973; McKern, Stewart 1957; Todd 1920; 1921), changes on the auricular surface of the ilium (Lovejoy et al. 1985), changes on the sternal ends of the ribs (Işcan et al. 1984; 1985), and on degenerative changes on the joint surfaces of long bones and vertebrae (Pfeiffer 1991). The age of subadult skeletons was assessed on the basis of changes occurring during the formation and emergence of deciduous and permanent teeth, the degree of ossification of long bones (*epiphyseal-diaphyseal fusion*) and the length of diaphyses of long bones (Bass 1987; Fazekas, Kósa 1978; McKern, Stewart 1957; Moorees et al. 1963; Scheuer, Black 2000). In order to minimize the effect of poor preservation of some skeletons, as many criteria as possible were applied in each analysis. The age of adults was expressed within a five-year margin (e.g. 21-25), while the age of children was expressed within a one-year span.

Cribra orbitalia is caused by hypertrophy of the diploë (the porous central part of the cranial bone), which leads to thinning and destruction of cortex and the creation of porous bone in place of cortex. It is manifested macroscopically in the form of small lesions riddling the orbital vaults, with a diameter from less than a millimetre to larger holes that partially merge. Cribra orbitalia appears in subadults and adults, and can be found in active or healed state. Healed and active cribra orbitalia are distinguished by the amount in which a bone was affected, by the diameter of the resulting hollows and the thickness of the porous bone.

In the opinion of most authors today, cribra orbitalia is connected with iron deficiency anemia (Carlson et al. 1974; Cybulski 1977; El-Najjar 1976; Hengen 1971; Huss-Ashmore et al. 1982; Lallo et al. 1977; Larsen 1997; Mensforth et al. 1978; Mittler, Van Gerven 1994; Stuart-Macadam 1985; 1991). This type of anemia is defined as the reduction of hemoglobin and hematocrit in blood below the normal level. It has different causes. Hengen (1971) concluded that iron

uočena kod odraslih osoba posljedica anemije preboljene tijekom djetinjstva (Mittler, Van Gerven 1994, 294).

Prisutnost *cribrae orbitaliae* procijenjena je kod svih osoba koje su imale potpuno uščuvanu barem jednu orbitu. Sve raspoložive lubanje analizirane su makroskopski, pod jakim svjetlom kako bi se utvrdila prisutnost ili odsutnost *cribrae orbitaliae*, nakon čega su isključeni slučajevi kod kojih su lezije na orbitama nastale postmortalno (najčešće zbog kiselosti tla ili ljudskog djelovanja). Tijekom analize podrobnije je bilježena jačina poremećaja (blago, umjereno ili jako), kao i stanje u trenutku smrti (aktivno ili zaraslo), po kriterijima koje su predložili Mittler i Van Gerven (1994, 289) i Mensforth et al. (1978).

Hipoplazija zubne cakline (HZC) očituje se kao niz vodoravnih linija na bukalnoj strani zuba koje nastaju zbog smanjenja debljine cakline (Goodman, Rose 1990; Suckling 1989). Hipoplaziju zubne cakline mogu uzrokovati različiti čimbenici, ali u arheološkim i u modernim populacijama najvjerojatniji uzročnik je sustavni metabolički stres. Na skeletnom arheološkome materijalu najčešće nije moguće odrediti točan uzrok nastanka hipoplazije zubne cakline pa se ona smatra pokazateljem nespecifičnoga fiziološkog stresa (Goodman, Rose 1990; Pindborg 1982). Hipoplastične defekte mogu uzrokovati genetski čimbenici, lokalizirane traume i sustavni fiziološki stres (Goodman, Rose 1991), ali brojna su istraživanja (Goodman et al. 1991; Hillson 1996; Pindborg 1970) pokazala kako su genetski čimbenici i lokalizirane traume relativno rijetko odgovorni za razvoj hipoplazija u arheološkim populacijama. Velika većina hipoplastičnih defekata u suvremenim i arheološkim populacijama povezana je sa sustavnim fiziološkim stresom u koji spadaju izgladnjivanje, zarazne bolesti i metabolički poremećaji. Prisutnost hipoplastičnih defekata stoga je pouzdan pokazatelj nespecifičnoga fiziološkog stresa i lošega zdravstvenog stanja kod djece.

Iz još nedovoljno razjašnjenih razloga hipoplazija zubne cakline se najčešće pojavljuje na prednjim zubima (sjekutićima i očnjacima), uglavnom na srednjoj trećini krune zuba, pa su zbog toga u analiziranom uzorku podaci o učestalosti te patologije prikupljeni za središnje sjekutiće gornje čeljusti te za očnjake gornje i donje čeljusti. Ti zubi su izabrani iz sljedećih razloga: 1) središnji sjekutići i očnjaci podložniji su hipoplastičnim defektima od drugih zuba (Goodman, Rose 1990); 2), očnjaci se razvijaju relativno dugo – od četvrtog mjeseca do šeste godine života (Lysell et al. 1962); 3), sjekutići i očnjaci imaju najmanju količinu mineraliziranih zubnih naslaga koje u arheološkom materijalu ponekad pokriju krunu zuba i onemoguće određivanje prisutnosti hipoplazije. Podaci su prikupljani na taj način da je kod svake osobe analiziran samo jedan zub – u ovom slučaju zub na lijevoj strani, a ukoliko on nije bio uščuvan, pregledan je desni zub. Na taj su način izbjegnute moguće greške zbog različite uščuvanosti dentalne građe. U obzir su uzimani samo makroskopski vidljivi hipoplastični defekti.

Kako bi se dobio što bolji uvid u kvalitetu života tog uzorka, analizirana je eventualna međusobna korelacija

deficiency anemia is above all a result of parasitism, while Stuart-Macadam (1992), based on her research, concluded that such anemia in fact represents adaptation of the organism to a disease, and its endeavour to exhaust and starve the pathogens such as bacteria and viruses, which require iron to reproduce in the host body. In addition to the factors mentioned here, several other factors connected with iron deficiency anemia have been observed in a number of archaeological populations: poor and inadequate diet, gastrointestinal and parasitic infections (Mays 1998; Mensforth 1990; Walker 1986), lead poisoning (Stuart-Macadam 1991), changes in dietary customs (Roberts, Manchester 1995), as well as a phytate-rich diet (Carlson et al. 1974)

The information collected in archaeological skeletal samples throughout the world show that active cribra orbitalia most often appears in subadults, while in adults this pathology is almost always present in the healed state (Larsen et al. 1992; Mensforth et al. 1978; Mittler, Van Gerven 1994; Šlaus 2006; Walker 1986 and a number of other authors). In Stuart-Macadam's opinion (1985, 395), such distribution suggests that cribra orbitalia is a result of childhood anemia and that healed cribra orbitalia in adults is a consequence of anemia experienced during childhood (Mittler, Van Gerven 1994, 294).

Presence of cribra orbitalia was assessed on all individuals with at least one preserved orbit. All available skulls were analyzed macroscopically, under strong light, in order to ascertain presence or absence of cribra orbitalia. Following this, the orbits with post-mortem lesions (by and large brought about by soil acidity or human action) were excluded. The degree of disorder (mild, moderate or severe) was recorded in the analysis, as well as the state at death (active or healed), following the criteria put forward by Mittler and Van Gerven (1994, 289) and Mensforth et al. (1978).

Enamel hypoplasia (EH) appears in the form of a series of horizontal lines on the buccal side of the teeth, caused by the thinning of dental enamel (Goodman, Rose 1990; Suckling 1989). Enamel hypoplasia is caused by various factors, but in the archaeological and modern populations the most probable cause is systematic metabolic stress. It is most often impossible to establish the precise cause of enamel hypoplasia on the skeletal archaeological material, and it is therefore considered a marker of non-specific physiological stress (Goodman, Rose 1990; Pindborg 1982). Hypoplastic disorders can be caused by genetic factors, localized traumas and systematic physiological stress (Goodman, Rose 1991), but a number of studies (Goodman et al. 1991; Hillson 1996; Pindborg 1970) have shown that genetic factors and localized traumas are relatively rarely responsible for the development of hypoplasias in archaeological populations. By far the greatest part of hypoplastic disorders in the modern and archaeological populations is connected with systematic physiological stress, which includes starvation, infectious diseases and metabolic disorders. Presence of hypoplastic disorders is therefore a reliable indicator of non-specific physiological stress and poor health condition in subadults.

između pokazatelja subadultnog stresa (*cribrae orbitaliae* i hipoplazije zubne cakline), kao i njihova moguća povezanost s pokazateljima nespecifičnih zaraznih bolesti (periostitisom).

Periostitis je patološka promjena koja zahvaća vanjsku (periostalnu) površinu kosti, a periostalne reakcije uzrokovane stafilokokima i streptokokima nastaju kao posljedica uzdignuća vanjskog fibroznog omotača periosta, do čega dolazi zbog kompresije i širenja krvnih žila (Jaffe 1972).

Za potrebe ovog rada periostitis je dijagnosticiran samo kod kostura koji su imali barem 50% svih dugih kostiju te kosti glave (čeone, tjemene i zatiljne kosti). U analizu su uključeni samo slučajevi periostitisa koji su nastali kao posljedica zaraznih bolesti, dok su slučajevi periostitisa nastali kao posljedica trauma isključeni iz analize. Budući da je gotovo nemoguće odrediti je li periostitis na nekoj kosti nastao zbog bakterijske upale ili traume, pri isključivanju potencijalnih slučajeva koji su rezultat ozljeda korišteno je sljedeće vrlo jednostavno pravilo. U svim slučajevima kada je periostitis bio prisutan na nekoj kosti koja je u isto vrijeme imala jasne pokazatelje doživljene traume (npr. prisutnost kalusa ili asimetrije u duljini dijafiza između antimera), prisutan je periostitis pripisan traumi. U analiziranom uzorku uključeni su samo slučajevi periostitisa koji su evidentirani na kostima bez traumatskih oštećenja.

Razlike u prosječnim doživljenim starostima između pojedinaca sa ili bez *cribrae orbitaliae* i hipoplazije zubne cakline testirane su pomoću neparametrijskoga Kruskal-Wallis testa. Razlike u učestalosti *cribrae orbitaliae*, hipoplazije zubne cakline i periostitisa između čitavih uzoraka, između djece i odraslih te muškaraca i žena testirane su pomoću χ^2 testa, a u slučajevima kada je to bilo potrebno korištena je Yatesova korekcija. Eventualna korelacija *cribrae orbitaliae*, hipoplazije zubne cakline i periostitisa analizirana je pomoću Spearmanova testa. Prilikom svih statističkih izračuna i testova korišten je statistički računalni program SPSS 10.0 for Windows.

REZULTATI

Distribucija smrtnosti prema spolu i starosti za kompozitni srednjovjekovni i novovjekovni uzorak iz kontinentalne Hrvatske prikazana je u tablici 2. Spolna distribucija prema analiziranom nalazištu prikazana je u tablici 3. Uzorak se sastoji od 415 osoba, od kojih je 149 (35,9%) djece, 103 (24,8%) su žene i 163 (39,3%) muškarca. Omjer između djece, žena i muškaraca je 0,91 : 0,63 : 1,00, a muškarci su čak 1,59 puta zastupljeniji od žena, što predstavlja statistički značajnu razliku (χ^2=19,258; P<0,01).

Prosječna doživljena starost odraslih osoba iz analiziranog uzorka je 35,8 godina (sd=10,57). Muškarci su u prosjeku živjeli 37,2 godine, a žene 33,6 godina. Razlika je statistički značajna (χ^2=10,284; P<0,01). Žene imaju gotovo dvostruko višu stopu smrtnosti od muškaraca između 16. i 30. godine života (45,6 : 23,3%), što predstavlja statistički značajnu razliku (χ^2=13,45; P<0,01).

Učestalost i distribucija *cribrae orbitaliae* u uzorku iz kon-

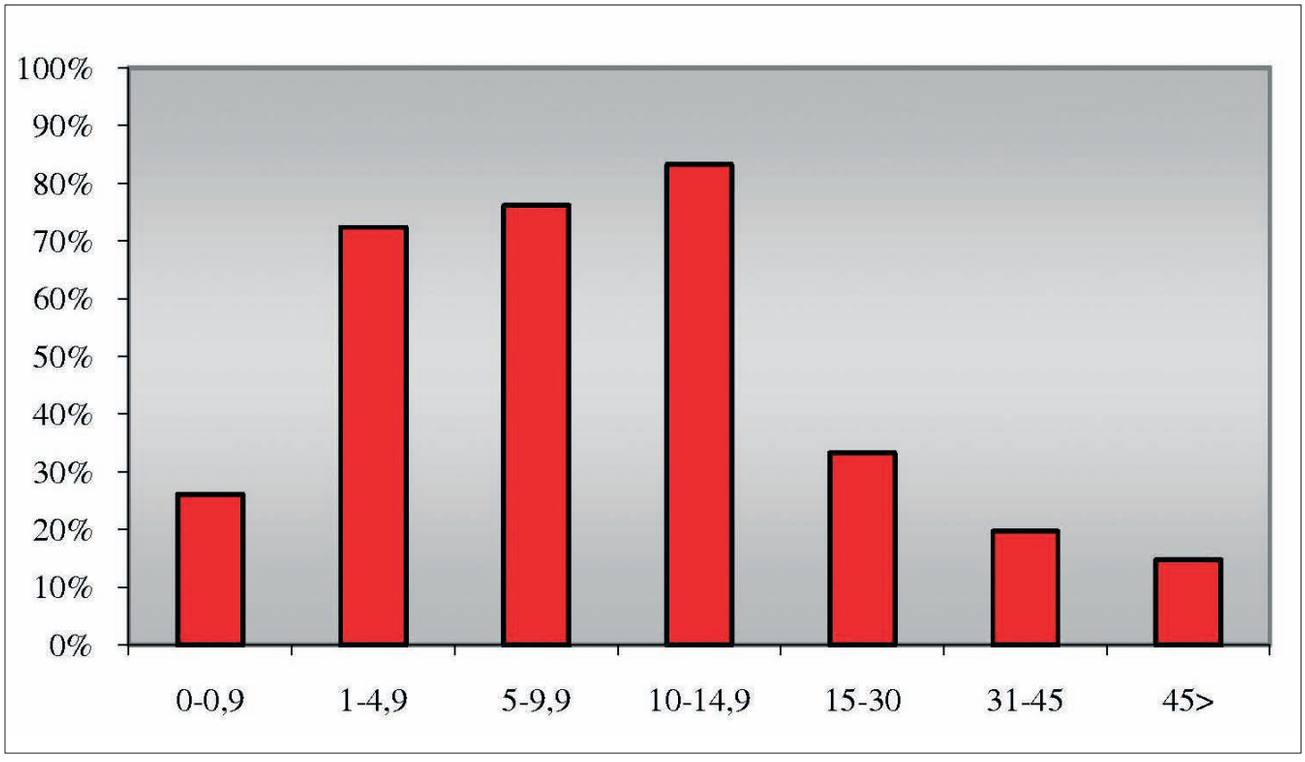
Enamel hypoplasia most often affects the front teeth (incisors and canines), for reasons that are still insufficiently clear. It mostly appears on the middle third of the tooth crown, which is why in the analyzed sample we collected data on the frequency of that pathology for the central incisors of the upper jaw and the canines of the upper and lower jaws. These teeth were selected for the following reasons: 1) the central incisors and canines are more prone to hypoplastic disorders than the other teeth (Goodman, Rose 1990); 2); the canines develop over a relatively long time – from the fourth month until the sixth year of life (Lysell et al. 1962); 3); incisors and canines have the smallest amount of mineralized dental deposits that sometimes cover the tooth crown in the archaeological material thereby preventing the determination of the presence of hypoplasia. The method of collection of data included analysis of only one tooth in each individual – in this case the tooth on the left side. In cases where this tooth was not preserved, we analyzed the right tooth. That way we avoided possible errors caused by different degree of preservation of dental material. Only macroscopically visible hypoplastic disorders were considered.

In order to gain as good insight into the quality of life of that sample as possible, we analyzed possible correlation between indicators of subadult stress (cribra orbitalia and enamel hypoplasia), as well as their possible link with the markers of non-specific infectious diseases (periostitis).

Periostitis is a pathological change that affects the outer (periosteal) bone surface, and periosteal reactions caused by staphylococci and streptococci appear as a consequence of the elevation of the exterior fibrous layer of the periosteum, which is caused by the compression and extension of blood vessels (Jaffe 1972).

For purposes of this paper, periostitis was diagnosed only on skeletons with at least 50% of all long bones as well as cranial bones (frontal, parietal and occipital bones). Only those cases of periostitis were included in the analysis that were present as a consequence of infectious diseases, while those caused by traumas were left out of the analysis. As it is almost impossible to establish whether periostitis appeared on a bone due to bacterial inflammation or trauma, a simple rule was followed for excluding potential cases of trauma-caused periostitis: in all cases when periostitis was present on a bone that at the same time exhibited clear indicators of experienced trauma (e.g. presence of callus or asymmetry in the length of the diaphyses between antimeres), the periostitis was attributed to trauma. The analyzed sample included only those cases of periostitis that were registered on bones without traumatic damage.

Differences in the average age at death between the individuals with and without cribra orbitalia and enamel hypoplasia were tested with the help of the non-parametric Kruskal-Wallis test. Differences in the frequency of cribra orbitalia, enamel hypoplasia and periostitis between the entire samples, between subadults and adults, and between males and females, were tested with the χ^2 test. Yates's correction was used when necessary. Possible correlation



Sl. 1 Učestalost *cribrae orbitaliae* prema dobnim skupinama u kompozitnom uzorku iz kontinentalne Hrvatske
Fig. 1 Frequency of cribra orbitalia by age groups in the composite sample from continental Croatia

tinentalne Hrvatske prikazana je u tablici 4. U analiziranom uzorku *cribra orbitalia* prisutna je u zaraslom i aktivnom stanju, a po intenzitetu varira od vrlo blage do izrazito jake. U kompozitnom srednjovjekovnom i novovjekovnom uzorku iz kontinentalne Hrvatske, *cribra orbitalia* uočena je na 78 od 209 lubanja (37,3%) s barem jednom očuvanom orbitom.

Kod odraslih osoba *cribra orbitalia* je uočena na 23,1%

Sl. 2 Umjerena zarasla cribra orbitalia u lijevoj orbiti. Ivanec – Stari grad, dijete 4 – 5 godina
Fig. 2 Moderate healed cribra orbitalia in the left orbit. Ivanec – Stari Grad, a child 4-5 years of age

of cribra orbitalia, enamel hypoplasia and periostitis was analyzed with Spearman's test. The statistical computer programm SPSS 10.0 for Windows was used for all statistical calculations and tests.

RESULTS

The mortality distribution by sex and age for the composite medieval and Early Modern sample from continental Croatia is shown in Table 2. Sex distribution by the analyzed sites is shown in Table 3. The sample consists of 415 individuals: 149 (35.9%) subadults, 103 (24.8%) females and 163 (39.3%) males. The ratio of subadults, females and males is 0.91 : 0.63 : 1.00, and males are as much as 1.59 times more frequent than females, which is a statistically significant difference (χ^2=19.258; P<0.01).

The average age at death of adults in the analyzed sample is 35.8 years (sd=10.57). Males lived 37.2 years on the average, and females 33.6 years. The difference is statistically significant (χ^2=10.284; P<0.01). The mortality rate of females is almost twice that of males between 15 and 30 years of age (45.6% vs. 23.3%), which is a statistically significant difference (χ^2=13.45; P<0.01).

The frequency and distribution of cribra orbitalia in the sample from continental Croatia is shown in Table 4. In the analyzed sample cribra orbitalia is present in healed and active condition, with intensity varying from very mild to very severe. In the composite medieval and Early Modern sample from continental Croatia, cribra orbitalia was observed on 78 out of 209 skulls (37.3%) with at least one preserved orbit.

Nalazište	Djeca	Žene	Muškarci
Crkvari	45	23	54
Ivanec	13	6	12
Mala Črešnjevica	1	2	2
Prozorje	32	15	37
Nova Rača	36	33	35
Suhopolje	6	13	11
Tomaš	9	5	6
Torčec	7	6	6
Ukupno	**149**	**103**	**163**

Tablica 3 Spolni raspored po analiziranim nalazištima
Table 3 Age distribution by the analyzed sites

analiziranih lubanja (30/130) bez značajne razlike između muškaraca i žena (21,3% kod muškaraca i 25,4% kod žena). Kod oba spola uočava se povezanost učestalosti *cribrae orbitaliae* s doživljenom starošću: učestalosti *cribrae orbitaliae* i kod muškaraca i kod žena smanjuju se u starijim dobnim skupinama.

Učestalost kod djece iznosi 60,8%, s time da je više od polovine (54,2% ili 26/48) slučajeva bilo aktivno u trenutku smrti. Razlika u učestalosti *cribrae orbitaliae* kod djece i odraslih osoba jest značajna (χ^2=28,239; P<0,01). Najniža učestalost *cribrae orbitaliae* kod djece uočena je u najmlađoj dobnoj skupini, gdje iznosi 26,1%. U svim drugim dobnim kategorijama *cribra orbitalia* evidentirana je u više od polovine analiziranih osoba, s time da je najviša učestalost uočena u dobnoj skupini od 10 do 14,9 godina, kada iznosi vrlo visokih 83,3% (sl. 1). Kada se u obzir uzmu samo aktivni oblici *cribrae orbitaliae*, najviša učestalost prisutna je u najmlađoj dobnoj skupini (100%), a najniža u dobnoj skupini od 1 do 4,9 godina (38,1%) (tablica 4).

Prisutnost *cribrae orbitaliae* u analiziranom uzorku značajno je korelirana s doživljenom starošću. Prosječna doživljena starost odraslih osoba, bez znakova *cribrae orbitaliae,* iznosi 37,6 godina, dok kod onih kod kojih su prisutni znakovi tog poremećaja iznosi 31,1 godinu. Razlika iznosi 6,5 godina i statistički je značajna (χ^2=7,717; P<0,01).

Analiza jakosti izražaja *cribrae orbitaliae* pokazala je kako se kod djece blagi oblik javlja u 60,4% slučajeva, umjereni u 29,2% (sl. 2) i jaki u 10,4% slučajeva. Kod odraslih osoba blagi oblik *cribrae orbitaliae* uočen je u 86,7% slučajeva, umjereni kod 10,0%, a jaki oblik u tek 3,3% slučaja.

Učestalost i distribucija hipoplazije zubne cakline u uzorku iz kontinentalne Hrvatske prikazana je u tablici 5. Ukupna učestalost HZC kod odraslih osoba iznosi 44,6%, bez statistički značajnih razlika između spolova (muškarci 42,9% i žene 46,9%) (χ^2=0,444; P=0,505). Na svim analiziranim zubima učestalost HZC viša je kod žena u odnosu na muškarce, ali ni jedna razlika nije statistički značajna. Kod

Dob/spol	*Cribra orbitalia*			Aktivne lezije	
	O[1]	A1[2]	%	A2[3]	% od A1
0 – 0,9	23	6	26,1	6	100,0
1 – 4,9	29	21	72,4	8	38,1
5 – 9,9	21	16	76,2	9	56,2
10 – 14,9	6	5	83,3	3	60,0
Djeca ukupno	**79**	**48**	**60,8**	**26**	**54,2**
Žene 15 – 30	25	9	36,0	0	0,0
Žene 31 – 45	16	3	18,7	0	0,0
Žene 45>	14	2	14,3	0	0,0
Žene ukupno	55	14	25,4	0	0,0
Muškarci 15 – 30	17	5	29,4	0	0,0
Muškarci 31 – 45	45	9	20,0	0	0,0
Muškarci 45>	13	2	15,4	0	0,0
Muškarci ukupno	75	16	21,3	0	0,0
Odrasli ukupno	**130**	**30**	**23,1**	**0**	**0,0**

[1]O = broj analiziranih čeonih kostiju
[2]A1 = broj čeonih kostiju gdje bar jedna orbita pokazuje znakove pojave *cribrae orbitaliae*
[3]A2 = broj čeonih kostiju gdje je *cribra orbitalia* aktivna u trenutku smrti

Tablica 4 Učestalost i distribucija cribrae orbitaliae u kompozitnom uzorku iz kontinentalne Hrvatske
Table 4 Frequency and distribution of cribra orbitalia in the composite sample from continental Croatia

In adults, cribra orbitalia was observed on 23.1% of analyzed skulls (30/130), without significant difference between males and females (21.3% in males and 25.4% in females). A correlation between the frequency of cribra orbitalia and age at death is observable in both sexes: the frequency of cribra orbitalia in both males and females decreases in older age groups.

The frequency in subadults is 60.8%, with more than a half of the cases (54.2% or 26/48) active at the time of death. The difference in the frequency of cribra orbitalia in subadults and adults is significant (χ^2=28.239; P<0.01). The lowest frequency of cribra orbitalia in subadults was observed in the youngest age group, with 26.1%. In all other age categories cribra orbitalia was registered in more than a half of analyzed individuals, with the highest frequency in age group between 10 and 14.9 years of age, with very high 83.3% (Fig. 1). When we look at active forms of cribra orbitalia only, the highest frequency is present in the youngest age group (100%), and the lowest in the age group between 1 and 4.9 years (38.1%) (Table 4).

The presence of cribra orbitalia in the analyzed sample is significantly correlated with the age at death. The average

Zubi	Odrasli ukupno		Žene		Muškarci	
	NHZC[2]/N[1]	%sHZC	NHZC/N	%sHZC	NHZC/N	%sHZC
Max I1[3]	39/111	35,1	17/47	36,2	22/64	34,4
Max C	56/128	43,8	24/51	47,1	32/77	41,6
Man C	77/147	52,4	34/62	54,8	43/85	50,6

[1] N = broj analiziranih zuba
[2] NHZC = broj zuba s jednim ili više HZC
[3] Max I1 = središnji sjekutić gornje čeljusti; Max C = očnjak gornje čeljusti; Man C = očnjak donje čeljusti

Tablica 5 Učestalost hipoplazije zubne cakline u kompozitnom uzorku iz kontinentalne Hrvatske
Table 5 Frequency of enamel hypoplasia in the composite sample from continental Croatia

oba spola HZC se najčešće pojavljuje na očnjacima donje čeljusti (kod muškaraca 50,6%, a kod žena 54,8%).

Za razliku od *cribrae orbitaliae*, uzročnici hipoplazije zubne cakline nisu bitnije utjecali na doživljenu starost u analiziranom uzorku. Tako osobe kod kojih je prisutna HZC u prosjeku žive 1,2 godinu duže od osoba kod kojih ovaj poremećaj nije prisutan (34,5 : 33,3 godine).

Od 75 osoba s uščuvanom barem jednom orbitom i svim trajnim zubima pogodnima za analizu HZC (središnji sjekutići gornje čeljusti te očnjaci gornje i donje čeljusti), 14 osoba (18,7%) pokazuje znakove *cribrae orbitaliae* i hipoplazije zubne cakline (tablica 6). Najviša učestalost kombinacije tih poremećaja prisutna je u dobnoj skupini od 15 do 30 godina.

age at death in adults, without signs of cribra orbitalia, is 37.6 years, while in those that exhibit sings of that disorder is 31.1 years. The difference amounts to 6.5 years and is statistically significant (χ^2=7.717; P<0.01).

The analysis of the intensity of cribra orbitalia showed that in subadults the mild form appears in 60.4% of cases, moderate in 29.2 % (Fig. 2), and the severe in 10.4% cases. In adults, the mild form of cribra orbitalia was observed in 86.7% cases, the moderate in 10.0%, and the severe in only 3.3% cases.

The frequency and distribution of enamel hypoplasia in the sample from continental Croatia is shown in Table 5. The total frequency of EH in adults is 44.6%, without statistically

Dobne skupine	N[1]	A1[2]	%	A2[3]	%	A3[4]	%
15 – 30	28	6	21,4	1	3,6	13	46,4
31 – 45	38	7	18,4	2	5,3	16	36,8
45>	9	1	11,1	0	0,0	6	66,7
Ukupno	**75**	**14**	**18,7**	**3**	**4,0**	**44**	**58,7**

[1]N = broj osoba s trajnim zubima i uščuvanim čeonim kostima
[2]A1 = broj osoba s CO i HZC
[3]A2 = broj osoba s CO i bez HZC
[4]A3 = broj osoba bez CO i s HZC

Tablica 6 Učestalost cribrae orbitaliae i hipoplazije zubne cakline prema dobnim skupinama u kompozitnom uzorku iz kontinentalne Hrvatske
Table 6 Frequency of cribra orbitalia and enamel hypoplasia by the age groups in the composite sample from continental Croatia

	A[1]	O[2]	%
Djeca	55	71	77,5
Muškarci	14	65	21,5
Žene	8	23	34,8
Ukupno	**77**	**159**	**48,4**

[1]A = broj kostura s periostitisom
[2]O = broj dobro uščuvanih kostura

Tablica 7 Učestalost periostitisa u kompozitnom uzorku iz kontinentalne Hrvatske
Table 7 Frequency of periostitis in the composite sample from con tinental Croatia

dina (21,4%), a prema starijim dobnim skupinama ta se učestalost smanjuje. Učestalost *cribrae orbitaliae* i HZC, kombinirano kod muškaraca i žena, gotovo je identična (muškarci 18,4%, žene 19,2%).

U kompozitnom srednjovjekovnom i novovjekovnom uzorku iz kontinentalne Hrvatske učestalost hipoplazije zubne cakline veća je od učestalosti *cribrae orbitaliae* kod odraslih osoba (44,6 prema 23,1%). Ovaj obrazac očituje se i u sljedećim učestalostima: kod 46,7% osoba kod kojih je uočena *cribra orbitalia* prisutna je i hipoplazija zubne cakline, dok je kod svega 23,7% osoba s HZC uočena prisutnost *cribrae orbitaliae*.

Analiza međusobne povezanosti *cribrae orbitaliae* s hipoplazijom zubne cakline na razini uzorka odraslih osoba nije pokazala značajnu korelaciju tih pokazatelja subadultnog stresa. Granično neznačajna korelacija prisutna je kod žena (P=0,067), dok kod muškaraca ta korelacija nije statistički značajna.

U uzorku analiziranom u ovom radu ukupna učestalost nespecifičnog periostitisa iznosi 48,4% (tablica 7). Kod odraslih osoba periostitis se češće pojavljuje kod žena (34,8% significant differences between the sexes (males 42.9% and females 46.9%) (χ^2=0.444; P=0.505). The frequency of EH is higher in females than in males in all analyzed teeth, but none of the differences are statistically significant. In both sexes EH most frequently appears on the canines of the lower jaw (in 50.6% males and 54.8% females).

In contrast to cribra orbitalia, the causes of enamel hypoplasia did not have a significant effect on the age at death in the analyzed sample. Thus the individuals with EH lived 1.2 years longer on the average than the individuals without signs of this disorder (34.5 vs. 33.3 years).

Out of 75 individuals with at least one preserved orbit and all permanent teeth that were suitable for an EH analysis (the central incisors of the upper jaw and the canines of the upper and lower jaws), 14 individuals (18.7%) showed signs of cribra orbitalia and enamel hypoplasia (Table 6). The highest frequency of the combination of these disorders is present in the age group between 15 and 30 years (21.4%), and it diminishes towards older age groups. The frequency of cribra orbitalia and EH, combined in males and females, is almost identical (males 18.4%, females 19.2%).

In the composite medieval and Early Modern sample from continental Croatia the frequency of enamel hypoplasia exceeds that of cribra orbitalia in adults (44.6% vs. 23.1%). This pattern is observed also in the following frequencies: 46.7% of individuals with signs of cribra orbitalia have also enamel hypoplasia, while merely 23.7% of individuals with EH exhibit signs of cribra orbitalia.

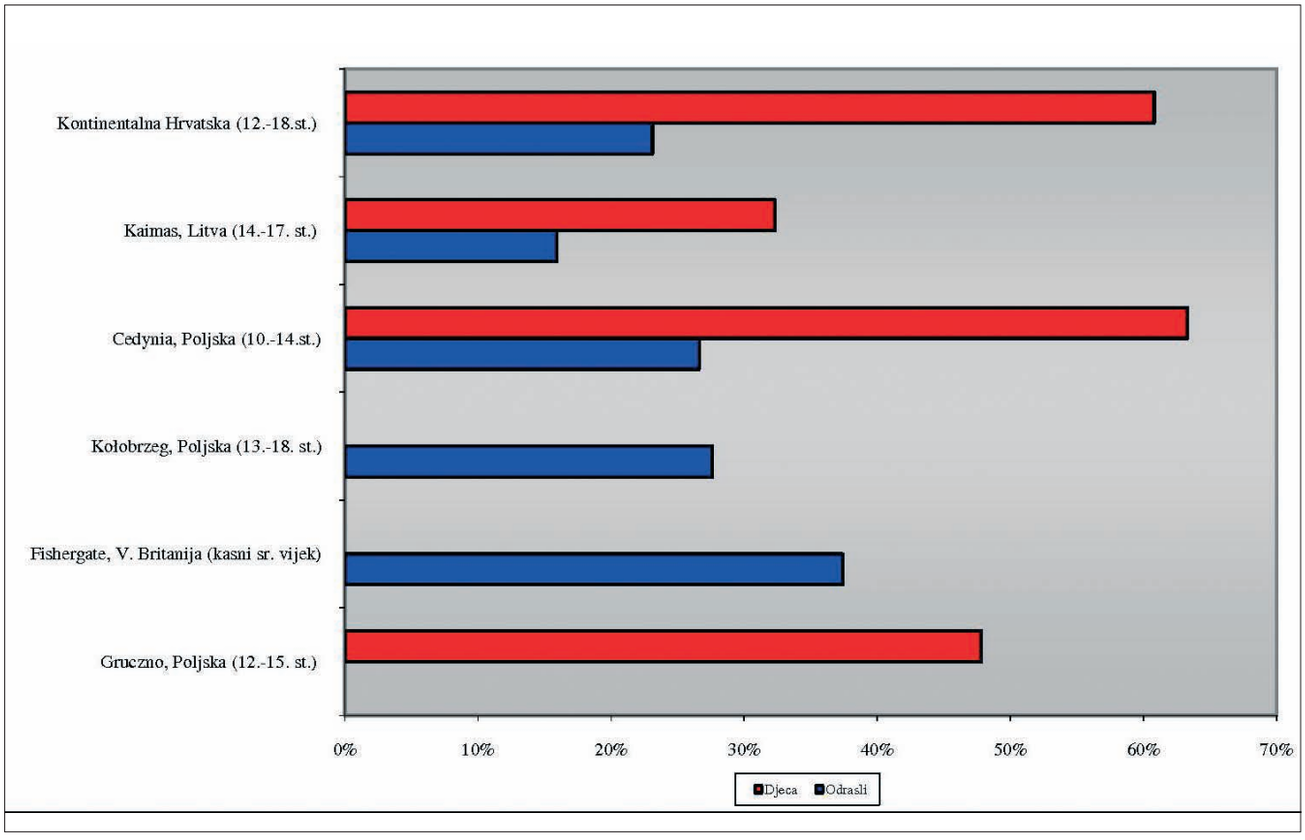
The analysis of correlation of cribra orbitalia and enamel hypoplasia in the adult sample did not show a significant correlation of these indicators of subadult stress. A correlation at the margin of insignificance is present in females (P=0.067), while in males this correlation is not statistically significant.

The total frequency of non-specific periostitis in the sample analyzed in this paper is 48.4% (Table 7). In adults,

		Kontinentalna Hrvatska	**Zagreb**[1]	**Koprivno**[2]	**Dugopolje**[3]
Datacija		12. – 18. st.	13. – 16. st.	15. – 18. st.	14. – 16. st.
Veličina uzorka		415	169	146	362
Prosječna starost	Muškarci	37,2	40,1	47,1	38,6
	Žene	33,6	39,6	42,2	36,7
Učestalost CO	Odrasli	23,1%	21,2%	18,5%	17,3%
	Djeca	60,8%	76,9%	43,2%	63,2%
Učestalost HZC		44,6%	39,1%	55,8%	49,7%
Učestalost periostitisa		48,4%	X	61,7%	34,3%

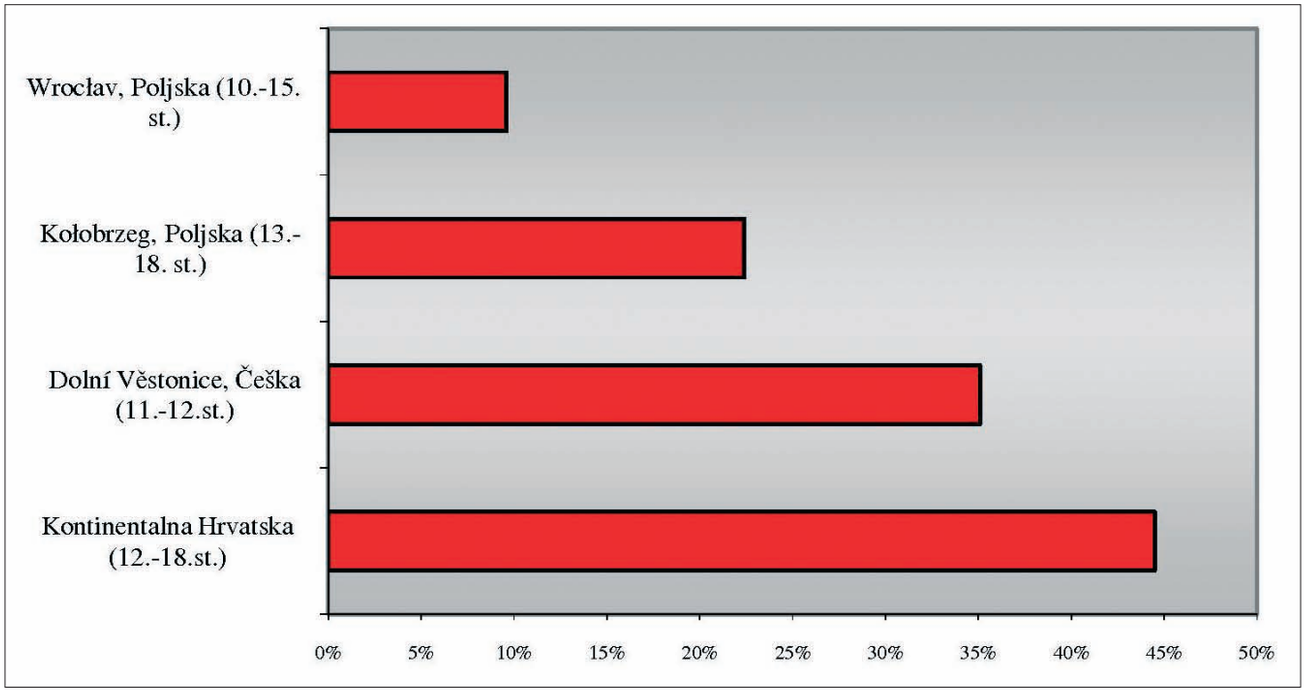
[1]preuzeto iz Šlaus et al. 2007
[2]preuzeto iz Novak et al. 2007
[3]preuzeto iz Novak, Šlaus 2007

Tablica 8 Bioarheološke značajke nekih hrvatskih srednjovjekovnih i novovjekovnih populacija
Table 8 Bioarchaeological characteristics of certain Croatian medieval and Early Modern populations



Sl. 3 Učestalost cribrae orbitaliae u uzorku iz kontinentalne Hrvatske u usporedbi s nekim srednjovjekovnim i novovjekovnim europskim populacijama

Fig. 3 Frequency of cribra orbitalia in the sample from continental Croatia compared with certain medieval and Early Modern European populations



Sl. 4 Učestalost hipoplazije zubne cakline u uzorku iz kontinentalne Hrvatske u usporedbi s nekim srednjovjekovnim i novovjekovnim europskim populacijama

Fig. 4 Frequency of enamel hypoplasia in the sample from continental Croatia compared with certain medieval and Early Modern European populations

kod žena naprama 21,5% kod muškaraca), ali razlika nije statistički značajna. Kod djece je periostitis uočen na čak 77,5% dobro uščuvanih kostura, što u odnosu na odrasle osobe predstavlja statistički značajnu razliku (χ^2=41,233; P=0,00).

Na razini čitavog uzorka uočena je značajna pozitivna korelacija između *cribrae orbitaliae* i nespecifičnog periostitisa (P=0,016).

U tablici 8 prikazane su bioarheološke značajke (prosječna doživljena starost, učestalost pokazatelja subadultnog stresa i nespecifičnih zaraznih bolesti) u nekoliko srednjovjekovnih i novovjekovnih populacija s područja Hrvatske.

Na slikama 3 i 4 prikazane su učestalosti *cribrae orbitaliae* i hipoplazije zubne cakline u različitim srednjovjekovnim i novovjekovnim populacijama iz Europe u usporedbi s kompozitnim uzorkom iz kontinentalne Hrvatske. Podaci za usporedbu učestalosti *cribrae orbitaliae* uzeti su za skeletne uzorke: Kaimas u Litvi (14.-17. st.) (Jankauskas 1995), Cedynia u Poljskoj (10.-14. st.) (Jerszyńska 1991; Piontek et al. 2001), Kołobrzeg u Poljskoj (13.-18. st.) (Kozak, Krenz-Niedbala 2001), Gruczno u Poljskoj (12.-15. st.) (Piontek, Kozlowski 2002) i Fishergate u Velikoj Britaniji (kasni srednji vijek) (Sullivan 2005). Podaci za usporedbu učestalosti hipoplazije zubne cakline uzeti su za skeletne uzorke: Dolní Věstonice u Češkoj (11.-12. st.) (Jarošová 2006), kompozitni uzorak iz Wrocława u Poljskoj (10.-15. st.) (Woźniak et al. 2005) i Kołobrzeg u Poljskoj (13.-18. st.) (Kozak, Krenz-Niedbala 2001).

RASPRAVA

U hrvatskoj bioarheologiji objavljeno je nekoliko radova koji se bave izučavanjem populacija srednjega i novog vijeka (npr. Novak et al. 2007; Šlaus 1996; 2000; 2002.a; 2006; Šlaus et al. 2003; 2007). Ti su se radovi poglavito usredotočili na cjelovite bioarheološke analize istraživanih uzoraka. Analiza učestalosti i distribucije subadultnog stresa nije bila glavni cilj istraživanja, nego se proučavala uz niz drugih pokazatelja kvalitete i uvjeta života. Kako je do danas u Hrvatskoj objavljen samo jedan rad (Novak, Šlaus 2007) koji se ponajprije bavi problematikom učestalosti *cribrae orbitaliae*, pojavila se potreba za iscrpnim i minucioznim istraživanjem većega skeletnog uzorka koji ne bi bio podložan različitim lokalnim posebnostima. Kao što je već u uvodu istaknuto, proučavanje kombinacije dva ili više pokazatelja stresa pokazalo se vrlo uspješnom metodom određivanja životnih uvjeta arheoloških populacija, posebice ako za te populacije ne postoje nikakvi pisani izvori koji bi nam pružili podatke o uvjetima i kvaliteti života tih ljudi. Povijesni izvori za razdoblje kojim se bavi ovaj rad najčešće se bave opisima života velikodostojnika ili velikih bitaka, dok su opisi svakodnevnog života, zdravstvenog stanja, kvalitete prehrane i razine higijene svih slojeva stanovništva izuzetno rijetki. U slučajevima kada pisani izvori i arheološki nalazi mogu dati samo djelomičan uvid u svakodnevni život arheoloških populacija, antropološke analize, a posebice izučavanje pokazatelja subadultnog stresa, pokazale su se izvanrednim izvorom informacija o uvjetima života naših predaka.

Demografske značajke kompozitnog uzorka iz kontinentalne Hrvatske

periostitis appears more frequently in females (34.8% of females compared with 21.5% of males), but the difference is not statistically significant. Periostitis in subadults was observed in as much as 77.5% of well-preserved skeletons, which is a statistically significant difference when compared with adults (χ^2=41.33; P=0.00).

The overall sample shows a significant positive correlation between cribra orbitalia and non-specific periostitis (P=0.016).

Table 8 shows the bioarchaeological characteristics (average age at death, frequency of indicators of subadult stress and non-specific infectious diseases) in several medieval and Early Modern populations from Croatia.

Figures 3 and 4 show the frequency of cribra orbitalia and enamel hypoplasia in various medieval and Early Modern populations from Europe compared with the composite sample from continental Croatia. The data for the comparison of the frequency of cribra orbitalia were taken for the following skeletal samples: Kaimas in Lithuania (14th-17th cent.) (Jankauskas 1995), Cedynia in Poland (10th-4th cent.) (Jerszyńska 1991; Piontek et al. 2001), Kołobrzeg in Poland (13th-18th cent.) (Kozak, Krenz-Niedbala 2001), Gruczno in Poland (12th-15th cent.) (Piontek, Kozlowski 2002) and Fishergate in Great Britain (late Middle Ages) (Sullivan 2005). The data for the comparison of the frequency of enamel hypoplasia were taken for the skeletal samples: Dolní Věstonice in the Czech Republic (11th-12th cent.) (Jarošová 2006), a composite sample from Wrocław in Poland (10th-15th cent.) (Woźniak et al. 2005) and Kołobrzeg in Poland (13th-18th cent.) (Kozak, Krenz-Niedbala 2001).

DISCUSSION

Several works dealing with the research on the medieval and Early Modern populations have been published in Croatian bioarchaeology (e.g. Novak et al. 2007; Šlaus 1996; 2000; 2002a; 2006; Šlaus et al. 2003; 2007). These works primarily focused on integral bioarchaeological analyses of investigated samples. The analysis of the frequency and distribution of subadult stress was not the main aim of the research, but it was studied parallel with a number of other indicators of quality and conditions of life. As to this day only one paper has been published in Croatia (Novak, Šlaus 2007), primarily dealing with the body of issues related with the frequency of cribra orbitalia, a need arose for a thorough and detailed research of a larger skeletal sample that would not be subjected to diverse local particularities. As we already pointed out in the introduction, the study of a combination of two or more indicators of stress proved a highly successful method in determination of life conditions of archaeological populations, particularly if there are no written sources about those populations that would offer information on the conditions and quality of life of those people. Historical sources for the period dealt with in this paper are by and large concerned with the descriptions of lives of aristocrats or great battles, whereas descriptions of everyday life, health conditions, quality of diet and the level of hygiene of all classes of population are exceptionally rare.

nentalne Hrvatske razlikuju se od drugih uzoraka s područja Hrvatske po vrlo atipičnom omjeru djece, žena i muškaraca, različitom od onoga koji se obično opaža na srednjovjekovnim i novovjekovnim grobljima. Naime, na većini grobalja u Hrvatskoj iz tog razdoblja, broj žena i muškaraca vrlo je sličan – najčešće 1 : 1 (Šlaus 2002, 41, T. 82, 65, T. 133; 2006, 99, T. 14, 105, T. 16). U analiziranom uzorku ovaj omjer iznosi 0,63 : 1,00. Veći broj muškaraca posebno je svojstven za nalazišta Ivanec, Prozorje i Crkvari. Nažalost, razlozi takve spolne distribucije u ovom trenutku ne mogu se sa sigurnošću objasniti.

Žene u analiziranom uzorku žive značajno kraće od muškaraca i iskazuju bitno višu stopu smrtnosti u dobi između 16. i 30. godine života. Kraći životni vijek kod žena i viša stopa smrtnosti u ovoj dobnoj skupini uočeni su na brojnim drugim arheološkim nalazištima (npr., Angel 1968; Blakely 1995; Boldsen 2000; Novak et al. 2007, 330, T. 1; Owsley, Bass 1979; Šlaus 2002, 24, T. 43, 45, T. 90, 64, T. 133; 2006, 100, 104, T. 15, 105, T. 16). Neki autori taj odnos objašnjavaju povećanim rizicima kojima su žene izložene zbog komplikacija vezanih uz trudnoću i porod (npr. Acsádi i Nemeskéri (1970) za brojna arheološka nalazišta u Mađarskoj), ali problem je to i dokazati. Naime, brojne pretporodiljne i poslijeporodiljne komplikacije, kao što su toksemija, prerano pucanje membrana, hemoragija, poremećaji krvnog tlaka i puerperalna sepsa ne ostavljaju traga na kostima, pa je jedini način da se smrtni slučaj pri porodu dokaže taj da se prilikom arheoloških iskopavanja utvrdi postojanje fetalnih ostataka *in utero* kod odraslih žena. No takvi dokazi iznimno su rijetki čak i u svjetskim okvirima. Međutim, u grobu 211 iz Nove Rače ustanovljeni su ostaci fetusa starog 39 tjedana *in utero* odrasle žene (Šlaus 2000, 197), što bi mogla biti potvrda prije iznesenoj teoriji o povećanim rizicima vezanima uz trudnoću i porod, barem za područje kontinentalne Hrvatske tijekom srednjega i novog vijeka.

Ukupna učestalost *cribrae orbitaliae* u analiziranom uzorku iznosi 37,3%. Slične vrijednosti zabilježene su i na drugim srednjovjekovnim i novovjekovnim nalazištima iz Hrvatske i Europe. Tako učestalost *cribrae orbitaliae* na kasnosrednjovjekovnom nalazištu Zagreb – Sv. Franjo/Opatovina iznosi 32,3% (Šlaus et al. 2007, 227), na kasnosrednjovjekovnom nalazištu Dugopolje 33,7% (Novak, Šlaus 2007, 457), a na novovjekovnom nalazištu Koprivno – Kod križa 32,8% (Novak et al. 2007, 318). Za nalazište Cedynia u Poljskoj navodi se da je ukupna učestalost ove patologije 31,4% (Jerszyńska 1991, 106; Piontek et al. 2001, 175, T. 3), a na nalazištu Kaimas u Litvi 19,9% (Jankauskas 1995).

Kod odraslih osoba učestalost *cribrae orbitaliae* u kontinentalnoj Hrvatskoj iznosi 23,1%, s nešto većom učestalošću kod žena (25,4 : 21,3%). Višu učestalost *cribrae orbitaliae* kod žena, posebice u reproduktivnoj dobi, uočili su brojni autori diljem svijeta (npr. Cybulski 1977, 33, T. 1; Fairgrieve, Molto 1999; Hengen 1971; Kozak, Krenz-Niedbala 2002, 78; Lubocka 2000; Novak, Šlaus 2007, 474, T. 4; Novak et al. 2007, 331, T. 9; Piontek et al. 2001, 176; Stuart-Macadam 1985, 396, T. 6; Sullivan 2005, 10, T. 3; Šlaus 2002, 66, T. 139, 77, T. 160; Walker

In cases when written sources and archaeological finds can offer only a partial insight into the everyday life of archaeological populations, anthropological analyses, and above all the study of markers of subadult stress, have proved an exceptional source of data about the life conditions of our ancestors.

Demographic features of the composite sample from continental Croatia differ from the other samples from Croatia in the quite atypical ratio of subadults, females and males, different from the one usually observed in the medieval and Early Modern cemeteries. Most cemeteries of the period in Croatia exhibit very similar figures for females and males – mostly 1 : 1 (Šlaus 2002, 41, Pl. 82, 65, Pl. 133; 2006, 99, Pl. 14, 105, Pl. 16). In the analyzed sample this ratio is 0.63 : 1.00. The higher number of males is particularly characteristic for the sites of Ivanec, Prozorje and Crkvari. Unfortunately, the reasons for such a sex distribution cannot be explained with certainty in this moment.

Females in the analyzed sample live significantly shorter than males and exhibit a significantly higher mortality rate in the age group between 15 and 30 years. The shorter life span in females and higher mortality rate in this age group were observed in a number of other archaeological sites (e.g. Angel 1968; Blakely 1995; Boldsen 2000; Novak et al. 2007, 330, Pl. 1; Owsley, Bass 1979; Šlaus 2002, 24, Pl. 43, 45, Pl. 90, 64, Pl. 133; 2006, 100, 104, Pl. 15, 105, Pl. 16). Certain authors interpret this relationship by increased risks that females are exposed to due to complications involving pregnancy and childbirth (e.g. Acsádi and Nemeskéri (1970) for numerous archaeological sites in Hungary), but it remains a problem to prove this. A number of prenatal and postnatal complications, such as toxemia, premature rupture of membrane, hemorrhage, blood pressure disorders and puerperal sepsis leave no trace on bones, and the only way to prove death at childbirth is to find evidence of fetal remains *in utero* of adult women during archaeological excavations. But, such proofs are extremely rare even on the world scale. However, in grave 211 in Nova Rača, the remains of a 39-week old fetus were found *in utero* of an adult female (Šlaus 2000, 197), which might be a confirmation of the previously mentioned theory about increased risks related to pregnancy and childbirth, at least for continental Croatia during the Middle Ages and the Early Modern period.

The total frequency of cribra orbitalia in the analyzed sample is 37.3%. Similar values were documented on other medieval and Early Modern sites in Croatia and Europe. For instance, the frequency of cribra orbitalia at the late medieval site of Zagreb – Sv. Franjo/Opatovina is 32.3% (Šlaus et al. 2007, 227), at a late medieval site in Dugopolje 33.7% (Novak, Šlaus 2007, 457), and at the Early Modern site of Koprivno – Kod Križa 32.8% (Novak et al. 2007, 318). The total frequency of this pathology at the site of Cedynia in Poland is reported at 31.4% (Jerszyńska 1991, 106; Piontek et al. 2001, 175, T. 3), and that at the Kaimas site in Lithuania at 19.9% (Jankauskas 1995).

The frequency of *cribra orbitalia* in adult individuals in continental Croatia is 23.1%, with a somewhat higher fre-

1986; Wapler et al. 2004, 335). Razlog takvoj učestalosti najvjerojatnije je razlika između muškoga i ženskog organizma. Naime, poznato je da žene u reproduktivnoj dobi vrlo često imaju nižu razinu željeza u organizmu, što je izravno povezano sa ženskom fiziologijom. Menstruacija, trudnoća, porod i laktacija, čimbenici su koji najviše pridonose povišenoj redukciji razine željeza u ženskom organizmu. Stoga je vrlo vjerojatno da su povećana potražnja za željezom i redovito osiromašivanje zaliha željeza u ženskom organizmu, nastali kao posljedica reproduktivnih funkcija, doveli velik broj žena u određenom razdoblju njihova života u stanje anemije uzrokovane nedostatkom željeza (Sullivan 2005, 13). Mittler i Van Gerven (1994, 295), mišljenja su da je neznatno viša učestalost *cribrae orbitaliae* kod žena (što je slučaj i u analiziranom uzorku) posljedica slabije sposobnosti žena da stvaraju novu i zdravu kost.

Učestalost *cribrae orbitaliae* kod djece u analiziranom uzorku iznosi 60,8%, što se uklapa u prosjek srednjovjekovnih i novovjekovnih populacija s područja Hrvatske (41% do 77%), dok se te vrijednosti na europskim nalazištima kreću od 32% u Kaimasu (Litva) (Jankauskas 1995) do 63% na nalazištu Cedynia u Poljskoj (Jerszyńska 1991, 106).

U najmlađoj dobnoj skupini kod djece *cribra orbitalia* je uočena na svega 26,1% analiziranih čeonih kostiju, a sva djeca kod koje je taj poremećaj uočen starija su od šest mjeseci. Naime, u dobi ispod šest mjeseci nedostatak željeza, koji je glavni uzročnik *cribrae orbitaliae*, vrlo je rijedak, budući da je količina željeza akumulirana tijekom devet mjeseci *in utero* dovoljna za prvih pola godine života djeteta (Bernat 1983), pa je učestalost *cribrae orbitaliae* kod djece mlađe od šest mjeseci općenito izrazito niska (Mensforth et al. 1978; Mittler, Van Gerven 1994, 293).

Vrlo nisku učestalost *cribrae orbitaliae* u najmlađoj dobnoj skupini slijedi dramatično povećanje u idućim dobnim skupinama. Ono svoj vrhunac dostiže u dobnoj skupini od 10 do 14,9 godina, kada čak 83,3% čeonih kostiju pokazuje znakove tog poremećaja. Ovaj podatak ne iznenađuje, jer su adolescenti i djeca između 9 i 16 godina posebno izloženi riziku od anemije zbog snažne fiziološke potrebe organizma za željezom tijekom rasta i razvoja.

Učestalost aktivne *cribrae orbitaliae* kod djece iznosi vrlo visokih 54,2%. Na prostoru Hrvatske je na sličnim nalazištima učestalost aktivnog oblika te patologije mnogo niža. Tako na kasnosrednjovjekovnom nalazištu Zagreb – Sv. Franjo/Opatovina ova učestalost iznosi 0,0% (Šlaus et al. 2007, 228, T. 9), na kasnosrednjovjekovnom nalazištu Dugopolje 18,2% (Novak, Šlaus 2007, 474, T. 4), na novovjekovnom nalazištu Koprivno 9,4% (Novak et al. 2007, 331, T. 9), a u kompozitnom starohrvatskom uzorku (9.-11. st.), koji čine nalazišta Dubravice, Donje Polje i Radašinovci, ova učestalost iznosi 12,5% (Pasarić 2008, 60, T. 11). Na svega nekoliko srednjovjekovnih i novovjekovnih nalazišta u Hrvatskoj uočene su slične ili više učestalosti aktivnog oblika *cribrae orbitaliae* od onih koje su prisutne u kompozitnom uzorku iz kontinentalne Hrvatske koji je analiziran u ovom radu (npr. na kasnosrednjovjekovnom nalazištu Danilo Gornje 60%

quency in females (25.4% vs. 21.3%). Higher frequency of cribra orbitalia in females, particularly at reproductive age, was noted by a number of authors throughout the world (e.g. Cybulski 1977, 33, Pl. 1; Fairgrieve, Molto 1999; Hengen 1971; Kozak, Krenz-Niedbala 2002, 78; Lubocka 2000; Novak, Šlaus 2007, 474, Pl. 4; Novak et al. 2007, 331, Pl. 9; Piontek et al. 2001, 176; Stuart-Macadam 1985, 396, Pl. 6; Sullivan 2005, 10, Pl. 3; Šlaus 2002, 66, Pl. 139, 77, Pl. 160; Walker 1986; Wapler et al. 2004, 335). The reason behind such frequency most probably lies in the difference between male and female organism. It is known that females of reproductive age frequently have a lower level of iron in organism, which is directly related with female physiology. Menstruation, pregnancy, childbirth and lactation are factors that contribute most to increased reduction of iron level in female organism. It is therefore highly likely that the increased demand for iron and regular depletion of iron stocks in female organism, brought about by reproductive functions, led many women at a certain period of their life into a state of iron deficiency anemia (Sullivan 2005, 13). Mittler and Van Gerven (1994, 295) think that a slightly higher frequence of cribra orbitalia in women (which is also the case in the analyzed sample) is a consequence of lower ability of women to form new and healthy bone.

The frequency of cribra orbitalia in subadults in the analyzed sample is 60.8%, which fits into the average of the medieval and Early Modern populations from the territory of Croatia (41% to 77%), while these values in the sites in Europe range from 32% in Kaimas (Lithuania) (Jankauskas 1995) to 63% at the site of Cedynia in Poland (Jerszyńska 1991, 106).

In subadults of the youngest age group cribra orbitalia was observed in merely 26.1% analyzed frontal bones, and all the subadults that exhibited signs of that disorder were older than six months. This is explained by the fact that the lack of iron, the main cause of cribra orbitalia, is very rare below six months of age, because the amount of iron accumulated during nine months *in utero* is sufficient for the first half a year of a child's life (Bernat 1983), so the frequency of cribra orbitalia in children less than six months of age is generally extremely low (Mensforth et al. 1978; Mittler, Van Gerven 1994, 293).

Very low frequency of cribra orbitalia in the youngest age group is followed by dramatic increase in the next age groups. It reaches its height in the age group from 10 to 14.9 years, when as much as 83.3% frontal bones exhibit signs of that disorder. This detail is not surprising, because adolescents and children between 9 and 16 are particularly exposed to risk from anemia due to the organism's strong physiological demand for iron during growth and development.

The frequency of active cribra orbitalia in subadults is very high (54.2%). The frequency of active form of this pathology at similar sites in Croatia is much lower. For instance, this frequency at the late medieval site of Zagreb – Sv. Franjo/Opatovina is 0.0% (Šlaus et al. 2007, 228, Pl. 9), at the late medieval site of Dugopolje 18.2% (Novak, Šlaus 2007, 474, Pl. 4), at the Early Modern site of Koprivno 9.4% (Novak et al. 2007, 331, Pl. 9), while in the composite early Croatian sam-

slučajeva *cribrae orbitaliae* kod djece u trenutku smrti bilo je u aktivnom stanju (Šlaus 1996, 350), a na srednjovjekovnom nalazištu Stenjevec 70,0% (Šlaus 2002, 66, T. 139). Ovdje je važno naglasiti bitnu razliku između zarasle i aktivne ili nepreboljene *cribrae orbitaliae*: zarasli oblik te patologije pokazuje da je osoba preživjela anemiju koja je uzrokovala hipertrofiju i porozitet superiornih orbita, dok aktivni oblici pokazuju kako je ukupni stres pod kojim se ta osoba nalazila bio prevelik da bi ona preživjela. Većina djece iz kompozitnoga srednjovjekovnoga i novovjekovnog uzorka, koja su razvila anemiju uzrokovanu nedostatkom željeza, nije je uspjela preživjeti.

Viša učestalost *cribrae orbitaliae* kod djece u odnosu na odrasle osobe, koja je uočena i u analiziranom uzorku, poznata je s mnogih arheoloških nalazišta (npr. Cybulski 1977, 33; Facchini et al. 2004, 130; Fairgrieve, Molto 2000; Mittler, Van Gerven 1994, 289; Novak, Šlaus 2007, 457; Robledo et al. 1995, 188; Stuart-Macadam 1985, 396, T. 6; Šlaus 2002, 12, T. 17, 42, T. 87, 47, T. 97; 2006, 162, T. 29; Šlaus et al. 2007, 227). Na tu razliku najvjerojatnije je utjecala kombinacija čimbenika, poput veće potrebe za željezom kod male djece, niske razine željeza u majčinom mlijeku te prehrana kojom se djeca hrane nakon prestanka dojenja, bogata ugljikohidratima koji sadrže fosfor i fitate koji usporavaju apsorpciju željeza u probavnom sustavu (Mensforth et al. 1978; Morris 1987). Prestanak dojenja izuzetno je osjetljivo razdoblje kod djece, jer tijekom tog razdoblja prelaze s prehrane koja se temelji na sterilnom majčinom mlijeku na prehranu i vodu koji su prepuni raznih mikroorganizama koji mogu uzrokovati različite zarazne bolesti, a one su praćene dijarejom (Rowland, Rowland 1986; Rowland et al. 1988). Dijareja smanjuje apetit kod djece i povećava metabolički gubitak važnih hranidbenih tvari kao što je željezo, što također može dovesti do pojave anemije, unatoč prehrani koja sadrži dovoljne količine željeza i drugih potrebnih tvari (Gordon et al. 1963; Mittler, Van Gerven 1994, 293).

U uzorku kojim se ovaj rad bavi, kao i u nizu drugih skeletnih uzoraka, uočeno je progresivno zarastanje aktivnih lezija s godinama i odsutnost aktivne *cribrae orbitaliae* kod odraslih osoba te odsutnost promjena na lopaticama, rebrima i dugim kostima koje sugeriraju da su promjene na svodovima orbita u analiziranom uzorku prouzročene anemijom, izazvanom nedostatkom željeza (npr. Hershkovitz et al. 1991; Novak, Šlaus 2007, 460; Salvadei et al. 2001). Ti podaci također potkrepljuju tezu Stuart-Macadam (1985, 395) da je *cribra orbitalia* poremećaj koji se prvenstveno pojavljuje u djetinjstvu. Viša učestalost *cribrae orbitaliae* u mlađim dobnim skupinama u odnosu na starije kod odraslih osoba, kao i mnogo jači intenzitet tog poremećaja kod djece u odnosu na odrasle osobe, sugerira loše zdravstvene uvjete te veću izloženost riziku od smrti za mlađe dobne skupine.

U uzorku analiziranom u ovom radu uzročnici *cribrae orbitaliae* (prvenstveno anemija izazvana nedostatkom željeza) znatno su utjecali na prosječni životni vijek, a razlika u prosječnoj doživljenoj starosti između osoba kod kojih *cribra orbitalia* nije prisutna i osoba kod kojih je ova patologija (9^{th}-11^{th} cent.), comprising the sites of Dubravice, Donje Polje and Radašinovci, this frequency is 12.5% (Pasarić 2008, 60, Pl. 11). Similar or higher frequencies of the active form of cribra orbitalia in comparison with those present in the composite sample from continental Croatia, analyzed in this paper, were documented at only few medieval and Early Modern sites in Croatia. For instance, at the late medieval site of Danilo Gornje 60% of cribra orbitalia in subadults at death was in the active form (Šlaus 1996, 350), as well as 70.0% in the case of the medieval site of Stenjevec (Šlaus 2002, 66, Pl. 139). It is important to draw attention to an important difference between healed and active or unhealed cribra orbitalia: the healed form of this pathology shows that an individual survived anemia that caused hypertrophy and porosity of superior orbits, while the active forms show that the total stress that an individual suffered was great enough to kill him. Most of the subadults from the composite medieval and Early Modern sample that developed iron deficiency anemia did not survive it.

Higher frequency of cribra orbitalia in subadults vs. adults, detected also in the analyzed sample, is known from a number of archaeological sites (npr. Cybulski 1977, 33; Facchini et al. 2004, 130; Fairgrieve, Molto 2000; Mittler, Van Gerven 1994, 289; Novak, Šlaus 2007, 457; Robledo et al. 1995, 188; Stuart-Macadam 1985, 396, Pl. 6; Šlaus 2002, 12, Pl. 17, 42, Pl. 87, 47, Pl. 97; 2006, 162, Pl. 29; Šlaus et al. 2007, 227). This difference is most likely influenced by a combination of factors, including greater demand for iron in young children, low iron level in mother's milk, as well as the diet of children following weaning, which is rich in carbohydrates that contain phosphorus and phytates that slow down iron absorption in the digestive system (Mensforth et al. 1978; Morris 1987). Weaning is an exceptionally sensitive period in subadults, because they leave diet based on mother's sterile milk and are introduced to the diet and water swarming with various microorganisms that can cause diverse infectious diseases, which are followed with diarrhea (Rowland, Rowland 1986; Rowland et al. 1988). Diarrhea reduces the desire for appetite in children and increases the metabolic loss of important nutritional substances like iron, which can also lead to anemia, in spite of a diet containing enough iron and other necessary substances (Gordon et al. 1963; Mittler, Van Gerven 1994, 293).

The sample dealt with in this paper, as well as a number of other skeletal samples, exhibited progressive healing of active lesions during growth. It also showed absence of active cribra orbitalia in adults and absence of changes on shoulder blades, ribs and long bones that suggest that the changes on orbital vaults in the analyzed sample were caused by iron deficiency anemia (e.g. Hershkovitz et al. 1991; Novak, Šlaus 2007, 460; Salvadei et al. 2001). These data also corroborate Stuart-Macadam's thesis (1985, 395) about cribra orbitalia being a disorder primarily present in childhood. Higher frequency of cribra orbitalia in younger age groups compared to older ones in adults, as well as a much greater intensity of that disorder in subadults compared to adults, suggests poor health conditions and greater exposure to risk of death for younger age groups.

In the sample analyzed in this paper the causes of cribra

loška promjena prisutna, statistički je značajna (37,6 prema 31,1 godina). Sličnu situaciju uočili su Novak i Šlaus (2007, 458) u kasnosrednjovjekovnom uzorku iz Dugopolja, gdje je razlika iznosila 6,2 godine. Nedostatak željeza može imati negativne posljedice na zdravlje pojedinca, što dovodi do navedenih razlika. Neodgovarajuća količina željeza u organizmu pojedinca može djelovati na spoznavanje i ponašanje (Pollitt 1987; Taras 2005), radnu sposobnost koja je bitno smanjena kod anemičnih osoba (Lozoff 1989; Scrimshaw 1991), te otpornost na bolesti koja je bitno smanjena zbog negativnog utjecaja anemije na imunitet (Bhaskaram 1988.; Dallman 1987). Tome u prilog ide i češća pojava zaraznih bolesti kod anemičnih osoba, koju su uočili Basta et al. (1979).

Učestalost hipoplazije zubne cakline u kompozitnom uzorku iz kontinentalne Hrvatske iznosi 44,6%. Te vrijednosti uklapaju se u prosjek drugih istodobnih nalazišta s područja Hrvatske, gdje učestalost tog poremećaja iznosi između 39 i 56%, dok se u Europi hipoplazija zubne cakline pojavljuje u rasponu od 9,4% u kompozitnom uzorku iz Wrocława u Poljskoj (Woźniak et al. 2005) do 35,1% na nalazištu Dolní Věstonice u Češkoj (Jarošová 2006). Ovakve učestalosti hipoplazije zubne cakline svojstvene su za zajednice koje žive sjedilačkim životom i svoju prehranu temelje na poljoprivredi, a analizirani uzorak tipični je predstavnik takvih populacija. Naime, brojna su istraživanja (Goodman et al. 1980; Lanphear 1990, 39; Larsen, Hutchinson 1992; Malville 1997; Ubelaker 1992; Wood 1996) pokazala da do naglog povećanja učestalosti tog poremećaja dolazi pri prijelazu s lovačko – skupljačke privrede na ekonomiju koja se temelji na poljoprivredi. Vjeruje se da su sjedilački način života, promjene u načinu prehrane i nagli porast gustoće stanovništva doveli do značajnog povećanja količine stresa koji se očituje u povećanju učestalosti hipoplazije zubne cakline (Cohen, Armelagos 1984). Također, visoka učestalost tog poremećaja sugerira da je gotovo polovina osoba iz analiziranog uzorka doživjela snažan metabolički stres tijekom djetinjstva, najvjerojatnije tijekom razdoblja dojenja. Naime, neki su autori uočili kako se u sjedilačkim populacijama najviše hipoplastičnih defekata stvara između prve i treće godine života, tj. u vremenu prelaska s prehrane sterilnim majčinim mlijekom na prehranu koja je bogata mikroorganizmima (npr. Goodman 1988; Goodman et al. 1984, 264; Lanphear 1990, 42).

Kao i u slučaju *cribrae orbitaliae*, učestalost hipoplazije zubne cakline nešto je viša kod žena (46,9 : 42,9%). Autori koji su uočili više vrijednosti kod žena (Goodman et al. 1987; Guatelli-Steinberg, Lukacs 1999; Gurri et al. 1996; May et al. 1993; Šlaus 2000, 202, T. 8) sugeriraju da bi to mogla biti posljedica kulturoloških razlika – u većini arheoloških populacija dječaci su bili zaštićeniji od stresa u odnosu na djevojčice, odnosno djevojčice su bile manje favorizirane od dječaka, posebice tijekom razdoblja dojenja kada dječaci imaju bolju roditeljsku skrb i prehranu (Guatelli-Steinberg, Lukacs 1999).

Za razliku od anemije izazvane nedostatkom željeza koja je glavni uzročnik *cribrae orbitaliae*, uzročnici hipoplazije zubne cakline nisu bitnije utjecali na doživljenu starost.

orbitalia (primarily iron deficiency anemia) had a significant impact on the average life expectancy, and the difference in the average age at death between the individuals without cribra orbitalia and those that have it is statistically significant (37.6 compared with 31.1 years). Similar situation was observed by Novak and Šlaus (2007, 458) in the late medieval sample from Dugopolje, where the difference was 6.2 years. Iron deficiency can have negative consequences on individual's health, leading to the mentioned differences. Inadequate amount of iron in the organism of an individual can affect learning and behaviour (Pollitt 1987; Taras 2005), capacity for work, which is considerably reduced in anemic persons (Lozoff 1989; Scrimshaw 1991), as well as resistance to diseases, which is significantly decreased due to negative influence of anemia on the immune system (Bhaskaram 1988.; Dallman 1987). In favour of this speaks the higher presence of infectious diseases in anemic persons, observed by Basta et al. (1979).

The frequency of enamel hypoplasia in the composite sample from continental Croatia is 44.6%. These values fit into the average of the other contemporary sites in Croatia, where the frequency of that disorder is between 39% and 56%, while in Europe enamel hypoplasia appears in the range from 9.4% in the composite sample from Wrocław in Poland (Woźniak et al. 2005) to 35.1% at the site of Dolní Věstonice in the Czech Republic (Jarošová 2006). These frequences of enamel hypoplasia are characteristic for sedentary communities that base their diet on agriculture, and the analyzed sample is a typical representative of such populations. A number of studies (Goodman et al. 1980; Lanphear 1990, 39; Larsen, Hutchinson 1992; Malville 1997; Ubelaker 1992; Wood 1996) showed that an abrupt increase in the frequency of this disorder occurs at the transition from foraging economy to that based on agriculture. It is believed that the sedentary way of life, dietary changes and sharp increase of population density led to a significant increase of stress intensity, manifested in the increased frequency of enamel hypoplasia (Cohen, Armelagos 1984). Also, high frequency of that disorder suggests that nearly a half of the individuals from the analyzed sample experienced intense metabolic stress during childhood, in all likelihood during the breastfeeding period. Certain authors noticed that most hypoplastic disorders in sedentary populations form between the first and third years of age, i.e. during transition from a diet consisting of sterile mother's milk to a diet rich in microorganisms (e.g. Goodman 1988; Goodman et al. 1984, 264; Lanphear 1990, 42).

Same as in the case of cribra orbitalia, the frequency of enamel hypoplasia is somewhat higher in females (46.9% vs 42.9%). The authors that detected higher values in females (Goodman et al. 1987; Guatelli-Steinberg, Lukacs 1999; Gurri et al. 1996; May et al. 1993; Šlaus 2000, 202, Pl. 8) suggest that this might be a consequence of cultural differences – in most archaeological populations boys were better protected from stress than girls, that is, girls were less favoured than boys, particularly during breastfeeding, when boys receive better parental care and diet (Guatelli-Steinberg, Lukacs 1999).

In contrast to iron deficiency anemia – the main cause

Čak štoviše, odrasle osobe kod kojih je uočena hipoplazija u prosjeku žive 1,2 godine duže od osoba koje nisu zahvaćene tim poremećajem. Veći broj autora uočio je da česte epizode stresa, koje uzrokuju hipoplaziju zubne cakline, značajno utječu na doživljenu starost (Duray 1996; Goodman et al. 1980; Keenleyside 1998; Pasarić 2008, 75; Šlaus 2000, 201), što se objašnjava činjenicom da su osobe koje su bile izložene jakom stresu tijekom ranog djetinjstva biološki oštećene i imaju smanjenu sposobnost da se odupru stresnim epizodama kasnije u životu. Situaciju sličnu ovoj iz kontinentalne Hrvatske uočio je jedino Boldsen (2007, 64, T. 3) na srednjovjekovnom nalazištu Tirup u Danskoj (12.-14. st), gdje žene koje pokazuju znakove hipoplazije zubne cakline žive duže za čak 5,2 godine od žena kod kojih taj poremećaj nije prisutan.

U kompozitnom uzorku iz kontinentalne Hrvatske nije uočena pozitivna korelacija između *cribrae orbitaliae* i hipoplazije zubne cakline. Do danas je svega nekoliko autora pokušalo utvrditi međusobnu povezanost tih poremećaja u arheološkim populacijama, a rezultati proizašli iz njihovih istraživanja su proturječni. Tako je pozitivna korelacija *cribrae orbitaliae* i hipoplazije zubne cakline zabilježena u rimskodobnom uzorku iz Riminija u Italiji (Facchini et al. 2004, 131), kod mlađih osoba sa srednjovjekovnog nalazišta Borovce u Slovačkoj (Obertová, Thurzo 2007, 287), te u kompozitnom avaroslavenskom uzorku iz kontinentalne Hrvatske (Pasarić 2008, 86). Stuart-Macadam (1985, 395, T. 4) uočila je povišenu učestalost hipoplazije zubne cakline kod osoba kod kojih je prisutna *cribra orbitalia* na rimskodobnom nalazištu Poundbury Camp u Engleskoj. Ona tvrdi da su, iako ne postoji izravna međuzavisnost između tih patoloških promjena, djeca s neprimjerenom prehranom i oslabljenim imunitetom znatno podložnija uzročnicima tih poremećaja. Za razliku od tih istraživanja, Marcsik i Baglyas (1989) nisu uočili značajnu korelaciju između *cribrae orbitaliae* i hipoplazije zubne cakline na avarskom groblju Szeged – Makkoserdö u Mađarskoj, a slična situacija prisutna je na kasnosrednjovjekovnom nalazištu Kołobrzeg u Poljskoj (Kozak, Krenz-Niedbala 2002, 78), u kompozitnom uzorku iz Španjolske (Turbón et al. 1991/1992), u rimskodobnom uzorku s nalazišta Zadar – Relja (Novak 2008, 140, T. 32) te na kasnosrednjovjekovnom nalazištu Dugopolje (Novak, Šlaus 2007, 458). Turbón et al. (1991/1992) zaključili su da ne postoji izravna povezanost između te dvije patologije, tj. one odražavaju različite prehrambene aspekte: *cribra orbitalia* više se vezuje uz nedostatak željeza, dok se hipoplazija zubne cakline povezuje uz razinu kalcija u organizmu. Očito je da ta problematika nije ni izbliza riješena, pa su stoga prijeko potrebna dodatna istraživanja kako bi se razjasnio odnos *cribrae orbitaliae* i hipoplazije zubne cakline.

Zarazne bolesti koje se očituju pojavom nespecifičnog periostitisa prisutne su u ukupnom uzorku u visokom postotku – čak 48,4% analiziranih kostura pokazuje znakove nespecifičnog periostitisa. Statistički značajna razlika prisutna je u učestalosti periostitisa između djece i odraslih, a periostitis se nešto češće pojavljuje kod žena u odnosu na

of cribra orbitalia – the causes of enamel hypoplasia did not have a significant influence on the age reached. What is more, the adults that exhibited signs of hypoplasia lived 1.2 years longer on the average than those unaffected by that disorder. A number of authors observed that frequent episodes of stress, which cause enamel hypoplasia, have a marked bearing on the age reached (Duray 1996; Goodman et al. 1980; Keenleyside 1998; Pasarić 2008, 75; Šlaus 2000, 201). This is explained by the fact that the individuals exposed to intense stress in early childhood were biologically damaged and had a diminished ability to resist episodes of stress later in their life. A situation similar to that from continental Croatia was observed only by Boldsen (2007, 64, Pl. 3) at the medieval site of Tirup in Danmark (12th-14th cent.), where women that exhibit signs of enamel hypoplasia live as much as 5.2 years longer than those without that disorder.

The composite sample from continental Croatia did not show positive correlation between cribra orbitalia and enamel hypoplasia. Until now only a few authors tried to determine correlation of these disorders in archaeological populations, with contradictory results. For instance, positive correlation of cribra orbitalia and enamel hypoplasia was registered in a Roman age sample from Rimini in Italy (Facchini et al. 2004, 131), among younger individuals from the medieval site of Borovce in Slovakia (Obertová, Thurzo 2007, 287), and in the composite Avar and Slavic sample from continental Croatia (Pasarić 2008, 86). Stuart-Macadam (1985, 395, Pl. 4) observed higher frequency of enamel hypoplasia in individuals with cribra orbitalia at the Roman age site of Poundbury Camp in England. She claims that, even though there is no direct interdependence between these pathological changes, children with inadequate diet and weakened immune system were much more readily affected by the causes of these disorders. In contrast to these studies, Marcsik and Baglyas (1989) did not notice a significant correlation between cribra orbitalia and enamel hypoplasia at the Avar cemetery of Szeged – Makkoserdö in Hungary, and a similar situation was present at the medieval site of Kołobrzeg in Poland (Kozak, Krenz-Niedbala 2002, 78), in the composite sample from Spain (Turbón et al. 1991/1992), in a Roman age sample from Zadar – Relja (Novak 2008, 140, Pl. 32) and at the late medieval site of Dugopolje (Novak, Šlaus 2007, 458). Turbón et al. (1991/1992) concluded that no direct connection exists between these two pathologies, i.e. they reflect different dietary aspects: cribra orbitalia is more connected to iron deficiency, while enamel hypoplasia is linked with the calcium level in the organism. We are evidently not even near the solution for this body of issues, and additional studies are necessary if we wish to understand the relationship between cribra orbitalia and enamel hypoplasia.

The ratio of infectious diseases manifested by the presence of non-specific periostitis in the total sample is high – as much as 48.4% of analyzed skeletons exhibit signs of non-specific periostitis. There is a statistically significant difference in the frequency of periostitis between children and adults, and periostitis appears somewhat more frequently in females than in males. The frequency of periosti-

muškarce. Učestalosti periostitisa u hrvatskim srednjovjekovnim i novovjekovnim populacijama kreću se od 20,1% u kompozitnom starohrvatskom uzorku (Šlaus 2006, 136, T. 27) do čak 61,7% u Koprivnu (Novak et al. 2007, 319). Izrazito visoka učestalost periostitisa kod djece u kompozitnom uzorku iz kontinentalne Hrvatske (ponajprije one u najmlađim dobnim skupinama) koji se većinom pojavljuje u jakom, generaliziranom aktivnom stanju, sugerira kako je riječ o pojavi sistemskih bakterijskih infekcija, dok bi nešto viša učestalost periostitisa kod žena mogla biti posljedica upalnih procesa uzrokovanih komplikacijama tijekom poroda u nehigijenskim uvjetima.

U kompozitnom skeletnom uzorku iz kontinentalne Hrvatske prisutna je značajna pozitivna korelacija između *cribrae orbitaliae* i nespecifičnog periostitisa (P=0,016). Nekoliko autora analiziralo je prisutnost *cribrae orbitaliae* i njezinu povezanost s nespecifičnim zaraznim bolestima (periostitisom) (Lallo et al. 1977; Larsen, Hutchinson 1992; Mensforth et al. 1978). Mensforth et al. (1978) tvrde da pojava nespecifičnog periostitisa kod djece koja pokazuju i znakove *cribrae orbitaliae* u dobi između 0,5 i 2 godine sugerira da je većina slučajeva pothranjenosti kod tih osoba potaknuta i ubrzana pojavom zaraznih bolesti.

Podaci o prosječnoj starosti, učestalostima pokazatelja subadultnog stresa, nespecifičnih zaraznih bolesti i njihova međusobnog odnosa i utjecaja na kvalitetu života u srednjovjekovnih i novovjekovnih stanovnika kontinentalne Hrvatske, ne mogu se dobiti klasičnim arheološkim istraživanjima i proučavanjem pisanih povijesnih izvora i u tom pogledu antropološka analiza pokazala se nezaobilaznom znanstvenom metodom. Podaci izneseni u ovom radu svjedoče o lošim uvjetima života koji se ogledaju u visokoj učestalosti *cribrae orbitaliae*, hipoplazije zubne cakline i periostitisa kod djece i odraslih. To upućuje kako je većina pripadnika analiziranog uzorka tijekom djetinjstva proživjela razdoblja snažnog stresa koji je najvjerojatnije prouzročen zajedničkim djelovanjem parazitskih infekcija, neprimjerene prehrane, anemije, zaraznih bolesti i, općenito, vrlo niskim higijenskim i zdravstvenim standardom.

ZAKLJUČAK

Antropološka analiza srednjovjekovnoga i novovjekovnoga kompozitnoga skeletnog uzorka iz kontinentalne Hrvatske pružila je izuzetno vrijedne informacije o životnom standardu stanovnika ovog područja.

Usporedba između muškaraca i žena u analiziranom uzorku jasno je pokazala da su žene bile znatno podložnije riziku od bolesti i ranijeg umiranja od muškaraca. Značajno kraći životni vijek te viša učestalost *cribrae orbitaliae*, hipoplazije zubne cakline i periostitisa kod žena svjedoči o smanjenoj sposobnosti žena da se oporave od stresa, što je najvjerojatnije bila posljedica nemogućnosti mnogih žena da zadrže potrebne razine željeza u organizmu tijekom reproduktivnog razdoblja, kao i mogućega lošijeg tretmana ženske djece tijekom dojenja.

Usporedba kompozitnog uzorka iz kontinentalne Hrvatske s ostalim srednjovjekovnim i novovjekovnim skeletnim

tis in Croatian medieval and Early Modern populations is in the range between 20.1% in the composite early Croatian sample (Šlaus 2006, 136, Pl. 27) up to as much as 61.7% in Koprivno (Novak et al. 2007, 319). Exceptionally high frequency of periostitis in subadults in the composite sample from continental Croatia (primarily in those of the youngest age groups), which by and large appears in intense, generalized active form, suggests the phenomenon of systemic bacterial infections. Somewhat higher frequency of periostitis in females might be a consequence of inflammatory processes caused by complications during childbirth in unhygienic conditions.

There is a significant positive correlation between cribra orbitalia and non-specific periostitis (P=0.016) in the composite skeletal sample from continental Croatia. Several authors analyzed presence of cribra orbitalia and its connection with non-specific infectious diseases (periostitis) (Lallo et al. 1977; Larsen, Hutchinson 1992; Mensforth et al. 1978). Mensforth et al. (1978) claim that the appearance of non-specific periostitis in subadults between 0.5 and 2 years of age that at the same time exhibit signs of cribra orbitalia suggests that in most cases undernourishment in those individuals was incited and accelerated by infectious diseases.

Standard archaeological excavations and study of written historical sources cannot provide information on the average age, frequency of markers of subadult stress, non-specific infectious diseases and their correlation and influence on the quality of life in the medieval and Early Modern inhabitants of continental Croatia. In that respect, anthropological analysis proved to be an indispensable scientific method. The data presented in this paper bear testimony to the poor living conditions, manifested in the high frequency of cribra orbitalia, enamel hypoplasia and periostitis in subadults and adults. This indicates that most of the individuals from the analyzed sample lived during childhood through periods of intense stress, which was most likely caused by joint action of parasitical infections, inadequate diet, anemia, infectious diseases and, generally, very low hygienic and health standards.

CONCLUSION

Anthropological analysis of the medieval and Early Modern composite skeletal sample from continental Croatia provided exceptionally valuable information on the standard of life of the inhabitants of this area.

Comparison between males and females in the analyzed sample clearly showed that females were much more prone to risk of diseases and earlier death than males. A significantly shorter life span and higher frequency of cribra orbitalia, enamel hypoplasia and periostitis in females bear witness to the reduced capacity of females to recover from stress, which was most probably a consequence of the inability of many females to preserve the necessary level of iron in the organism during the reproductive period, as well as possible poorer treatment of female children during breastfeeding.

Comparison of the composite sample from continental

uzorcima s područja Hrvatske pokazala je da se analizirani uzorak prema većini svojih bioarheoloških obilježja ne razlikuje od ostalih populacija. Po svojim obilježjima kompozitni uzorak, analiziran u ovom radu, uklapa se u sliku koja svjedoči o visokoj smrtnosti, vrlo lošim uvjetima života i izrazito niskom zdravstvenom standardu, koji je najvjerojatnije bio posljedica sinergističkog djelovanja anemije izazvane nedostakom željeza, zaraznih bolesti, neprimjerene prehrane i parazitskih infekcija, što su tijekom ovog razdoblja harali kontinentalnom Hrvatskom.

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Croatia with the other medieval and Early Modern skeletal samples from Croatia has shown that the analyzed sample does not differ from other populations in most of its bioarchaeological characteristics. The composite sample analyzed in this paper fits by its features into the picture that bears testimony to high mortality, very poor conditions of life and extremely low health standards, which was most likely a consequence of synergic action of iron deficiency anemia, infectious diseases, inadequate diet and parasitical infections, which ravaged Croatia during that period.

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LITERATURA / BIBLIOGRAPHY

Acsjdi, G., Nemeskéri J., 1970, *History of human life span and mortality*, Budapest

Angel, J. L., 1968, Human remains at Karataş. Dodatak, u: Melnik M. J., Excavations at Karataş – Semayűk in Lycia 1967, *AJA* 72, Boston, 258-263.

Bass, W. M., 1987, *Human osteology. A laboratory and field manual of the human skeleton*, Columbia

Basta, S. S., Karyadi D., Scrimshaw N. S., 1979, Iron deficiency anemia and the productivity of adult males in Indonesia, *American Journal of Clinical Nutrition* 32, Bethesda, 916-925.

Belaj, J., 2005, Arheološka istraživanja lokaliteta Stari grad u Ivancu, *AIA* 1, Zagreb, 61-66.

Belaj, J., 2006, Sažeti prikaz arheoloških istraživanja crkve Sv. Martina u Prozorju do 2005. godine, *AIA* 2, Zagreb, 79-84.

Belaj, J., 2006a, Interpretiranje novovjekovnih nalaza iz grobova crkve Sv. Martina na Prozorju, *PrilInstArheolZagrebu* 23, Zagreb, 257-294.

Belaj, J., 2007, *Templari i ivanovci na zemlji Svetog Martina*, Dugo Selo.

Belaj, J., 2008, *Ivanec kroz slojeve prošlosti. Deset godina arheoloških istraživanja u Ivancu*, katalog izložbe, Ivanec.

Bernat, I., 1983, *Iron metabolism*, New York

Bhaskaram, P., 1988, Immunology of iron-deficient subjects, u: *Nutrition and immunology*, ur. R. K. Chandra, New York, 149-168.

Blakely, R. L., 1995, Social organisation at Etowah: A reconsideration of paleodemografic and paleonutritional evidence, *Southeastern Archaeology* 14, 46-59.

Boldsen, J. L., 2000, Demografisk struktur i landsbyden Tirup, *Hikuin* 27, Aarhus, 233-244.

Boldsen, J. L., 2007, Early childhood stress and adult age mortality – A study of dental enamel hypoplasia in the medieval Danish village of Tirup, *American Journal of Physical Anthropology* 132, Hoboken, 59-66.

Brooks, S., Suchey J. M., 1990, Skeletal age determination based on the os pubis: a comparison of the Acsjdi-Nemeskéri and Suchey-Brooks methods, *HumEvol* 5, Firenze, 227-238.

Buikstra, J., Cook D., 1980, Paleopathology: an *American Account*. *Annual Review of Anthropology* 9, Palo Alto, 433-470.

Carlson, D. S., Armelagos G. J., Van Gerven D. P., 1974, Factors influencing the etiology of cribra orbitalia in prehistoric Nubia, *Journal of Human Evolution* 3, Amsterdam, 405-410.

Cohen, M. N., Armelagos G. J., 1984, *Paleopathology at the Origins of Agriculture*, Orlando

Cybulski, J. S., 1977, Cribra orbitalia. A possible sign of anemia in early historic native populations of the British Columbia Coast, *American Journal of Physical Anthropology* 47, Hoboken, 31-40.

Dallman, P., 1987, Iron deficiency and the immune response, *American Journal of Clinical Nutrition* 46, Bethesda, 329-334.

Duray, S. M., 1996, Dental Indicators of Stress and Reduced Age at Death in Prehistoric Native Americans, *American Journal of Physical Anthropology* 99, Hoboken, 275-286.

El-Najjar, M. Y., 1976, Maize, malaria and the anemias in the Pre-Columbian New World, *Yearbook of Physical Anthropology* 20, Hoboken, 329-337.

Facchini, F. I., Rastelli E., Brasili P., 2004, Cribra orbitalia and cribra cranii in Roman Skeletal Remains from the Ravenna Area and Rimini (I-IV

Century AD), *International Journal of Osteoarchaeology* 14, Hoboken, 126-136.

Fairgrieve, S. I., Molto J. E., 2000, Cribra orbitalia in two temporally disjunct population samples from the Dakhleh Oasis, Egypt, *American Journal of Physical Anthropology* 111, Hoboken, 319-331.

Fazekas, I. G., Kósa F., 1978, *Forensic fetal osteology*, Budapest

Gilbert, B. M., McKern T. W., 1973, A method for aging the female os pubis, *American Journal of Physical Anthropology* 38, Hoboken, 31-38.

Goodman, A. H., 1988, The chronology of enamel hypoplasias in industrial population: A reppraisal of Sarnat and Schour (1941, 1942), *Human Biology* 60, Detroit, 781-791.

Goodman, A. H., Rose J. C., 1990, Assessment of systemic physiological perturbations from dental enamel hypoplasias and associated histological structures, *Yearbook of Physical Anthropology* 33, Hoboken, 59-110.

Goodman, A. H., Rose J. C., 1991, Dental enamel hypoplasias as indicators of nutritional status, u: *Advances in dental anthropology,* ur. M. Kelley, C. S. Larsen, New York, 279-294.

Goodman, A. H., Armelagos G. J., Rose J. C., 1980, Enamel hypoplasias as indicators of stress in three prehistoric populations from Illinois, *Human Biology* 52, Detroit, 515-528.

Goodman, A. H., Armelagos G. J., Rose J. C., 1984, The chronological distribution of enamel hypoplasias from prehistoric Dickson Mounds populations, *American Journal of Physical Anthropology* 65, Hoboken, 259-266.

Goodman, A. H., Allen L. H., Hernandez G. P., Amador A., Arrida L. V., Chavez A., Pelto G. H., 1987, Prevalence and Age at Development of Enamel Hypoplasias in Mexican Children, *American Journal of Physical Anthropology* 72, Hoboken, 7-119.

Goodman, A. H., Martinez C., Chavez A., 1991, Nutritional supplementation and the development of linear enamel hypoplasia in children from Solis, Mexico, *American Journal of Clinical Nutrition* 53, Bethesda, 773-781.

Gordon, J. E., Chitkara I. D., Wyon J. B., 1963, Weanling diarrhea, *American Journal of Medical Sciences* 245, Philadelphia, 345-377.

Guatelli-Steinberg, D., Lukacs J. R., 1999, Interpreting sex differences in enamel hypoplasia in human and non-human primates: developmental, environmental and cultural considerations, *Yearbook of Physical Anthropology* 42, Hoboken, 73-126.

Gurri, F. D., Balam, G., Moran E. F., 1996, Sex Differences in the Frequency and Distribution of Linear Enamel Hypoplasias among the Yucatec Maya, *American Journal of Physical Anthropology*, Supplement 22, Hoboken, 117.

Hengen, O. P., 1971, Cribra orbitalia: Pathogenesis and probable etiology, *Homo* 22, 57-75.

Hershkovitz, I., Ring, B., Speirs, M., Galili, E., Kislev, M., Edelson, G., Hershkovitz, A., 1991, Possible congenital hemolytic anemia in prehistoric coastal inhibitants of Israel, *American Journal of Physical Anthropology* 85, Hoboken, 7-13.

Hillson, S., 1996, *Dental Anthropology*, Cambridge

Huss-Ashmore, R., Goodman, A. H., Armelagos, G. J., 1982, Nutritional interference from paleopathology, u: *Advances in Archaeological Method and Theory, Vol. 5*, ur. M. Schiffer, New York, 395-474.

Işcan, M. Y., Loth, S. R., Wright, R. K., 1984, Age estimation from the rib by phase analysis: White males, Journal of Forensic Sciences 29, Colorado Springs, 1094-1104.

Işcan, M. Y., Loth, S. R., Wright, R. K., 1985, Age estimation from the rib by phase analysis: White females, *Journal of Forensic Sciences* 30, Colorado Springs, 853-863.

Jaffe, H. L., 1972, *Metabolic, degenerative and inflammatory diseases of bones and joints*, Philadelphia

Jakovljević, G., 1999, Zaštitna iskopavanja u Đurđicu i Tomašu, *MuzVjes* 21/22, Varaždin, 27-29.

Jakovljević, G., Šlaus, M., 2003, Rača i župna crkva Uznesenja Blažene Djevice Marije u Novoj Rači u svjetlu povijesnih i arheološko – antropoloških istraživanja, *IzdanjaHAD* 21, Zagreb, 121-144.

Jankauskas, J., 1995, Anthropoecology of the late medieval Alytus (Data on the 14th – 17th cc. burial ground), *Lietuvos Archeologija* 11, Vilnius, 34-45.

Jarošová, I., 2006, Nespecifický stres ve středověké populaci z Dolních Věstonic Vysoké Zahrady, *Ve službách archeologie* 7, Brno, 302-312.

Jerszyńska, B., 1991, Harris's line and cribra orbitalia as indicators of stress in prehistoric human populations, *Variability and evolution* 1, Poznań, 105-112.

Kelly, M. A., 1978, Phenice's visual sexing technique for the os pubis: a critique, *American Journal of Physical Anthropology* 48, Hoboken, 121-122.

Keenleyside, A., 1998, Skeletal Evidence of Health and Disease in Precontact Alaskan Eskimos and Aleuts, *American Journal of Physical Anthropology* 107, Hoboken, 51-70.

Kimura, K., 1982, Sex differences of the hip bone among several populations, *Okajimas Folia Anatomica Japonica* 58, Tokio, 266-273.

Krogman, W. M., Işcan, M. Y., 1986, *The human skeleton in forensic medicine*, Springfield

Kozak, J., Krenz-Niedbala, M., 2002, The occurence of cribra orbitalia and its association with enamel hypoplasia in a medieval population from Kołobrzeg, Poland, *Variability and evolution* 10, Poznań, 75-82.

Lallo, J. W., Armelagos, G. J., Mensforth, R. P., 1977, The role of diet, diseases and physiology in the origin of porotic hyperostosis, *Human Biology* 49, Detroit, 471-483.

Lanphear, K. M., 1990, Frequency and Distribution of Enamel Hypoplasias in a Historic Skeletal Sample, *American Journal of Physical Anthropology* 81, Hoboken, 35-43.

Larsen, C. S., 1987, Bioarchaeological Interpretations of Substinence Economy and Behavior from Human Skeletal Remains, u: *Advances in Archaeological Method and Theory, Vol. 10,* ur: M. B. Schiffer, New York, 339-445.

Larsen, C. S., 1997, *Bioarchaeology. Interpreting behavior from the human skeleton*, Cambridge

Larsen, C. S., Hutchinson, D. L., 1992, Dental evidence for physiological disruption: biocultural interpretations from the Eastern Spanish Borderlands, u: *Recent Contributions to the Study of Enamel Developmental Defects*, ur. A. H. Goodman, L. L. Capasso, Journal of Paleopathology, Monographic Publication 2, Chieti, 151-169.

Larsen, C. S., Ruff, C. B., Schoeninger, M. J., Hutchinson, D. L., 1992, Population decline and extinction in La Florida, u: *Disease and Demography in the Americas*, ur. J. W. Verano, D. H. Ubelaker, Washington, 25-39.

Lovejoy, C. O., Meindl, R. S., Pryzbeck, T. R., Mensforth ,R. P., 1985, Chronological metamorphosis of the auricular surface of the ilium: A new method for the determination of age at death, *American Journal of Physical Anthropology* 68, Hoboken, 15-28.

Lozoff, B., 1989, Iron and learning potential in childhood, 1989, *Bulletin of the New York Academy of Medicine* 65, New York, 1050-1066.

Lubocka, Z., 1999, Cribra orbitalia in early medieval population from Ostrow Lednicki (Poland), *Abstract of the 4th International Anthropological Congress of Aleš Hrdlička*, Prag, 94.

Lysell, L., Magnusson, B., Thilander, B., 1962, Time and order of eruption of the primary teeth: A longitudinal study, *Odontologisk Revy* 13, Malmö, 217-234.

Malville, N. J., 1997, Enamel Hypoplasia in Ancestral Puebloan Population from Southwestern Colorado: 1. Permanent Dentition, *American Journal of Physical Anthropology* 102, Hoboken, 351-367.

Marcsik, A., Bagylas, B., 1989, The frequency of enamel hypoplasia from the 8th century Hungary, *Journal of Paleopathology* 1, Chieti, 25-32.

Martin, D. L., Goodman, A. H., Armelagos, G. J., 1985, Skeletal pathologies as indicators of quality and quantity of diet, u: *The analysis of prehistoric diet*, ur. R. Gilbert, J. Mielke, New York, 227-279.

May, R. I., Goodman, A. H., Meindl, R. S., 1993, Response of Bone and Enamel Formation to Nutritional Supplementation and Morbidity among Malnourished Guatemalan Children, *American Journal of Physical Anthropology* 92, Hoboken, 37-51.

Mays, S., 1998, *The Archaeology of Human Bones*, London.

McKern, T. W., Stewart, T. D., 1957, *Skeletal age changes in young American males. Analyzed from the standpoint of age identification, Technical report EP-45*, Natick

Meindl, R. S., Lovejoy, C. O., 1985, Ectocranial suture closure: A revised method for the determination of skeletal age at death based on the lateral-anterior sutures, *American Journal of Physical Anthropology* 68, Hoboken, 57-66.

Mensforth, R. P., 1990, Paleodemography of the Carlston Annis (Bt–5) late archaic skeletal population, *American Journal of Physical Anthropology* 82, Hoboken, 81-99.

Mensforth, R. P., Lovejoy, C. O., Lallo, J. W., Armelagos, G. J., 1978, The role of constitutional factors, diet and infectious disease in the etiolo-

gy of porotic hyperostosis and periosteal reactions in prehistoric infants and children, *Medical Anthropology* 2, Washington, 1-59.
Mittler, D. M., Van Gerven, D. P., 1994, Developmental, diachronic and demographic analysis of cribra orbitalia in the medieval Christian populations of Kulubnarti, *American Journal of Physical Anthropology* 93, Hoboken, 287-297.
Moorrees, C. F. A., Fanning, E. A., Hunt, E. E., 1963, Age variation of formation stages for ten permanent teeth, *Journal of Dental Research* 42, Alexandria, 1490-1502.
Morris, E. R., 1987, Iron, u: *Trace elements in human and animal nutrition, Vol. 1*, ur. W. Mertz, San Diego, 79-142.
Novak, M. 2008, *Antropološka analiza antičke nekropole Zadar – Relja u kontekstu antičkih nekropola Hrvatske*, doktorska disertacija, Filozofski fakultet Sveučilišta u Zagrebu, Zagreb
Novak, M., Šlaus, M., 2007, Učestalost i distribucija *cribrae orbitaliae* u kasnosrednjovjekovnoj populaciji iz Dugopolja, *ShP* 34, Split, 451-476.
Novak, M., Šlaus, M., Pasarić, M., 2007, Bioarheološke osobine novovjekovne populacije s nalazišta Koprivno – Kod križa kraj Klisa, *OpuscA* 31, Zagreb, 303-346.
Obertová, Z., Thurzo M., 2007, Relationship between Cribra Orbitialia and Enamel Hypoplasia in the Early Medieval Slavic Population at Borovce, Slovakia, *International Journal of Osteoarchaeology* 18, Hoboken, 280-292.
Ortner, D. J., Putschar, W. G., 1985, *Identification of pathological conditions in human skeletal remains*, Washington
Owsley, D. W., Bass, W. M., 1979, A demographic analysis of skeletons from the larson site (39WW2), Walaworth County, South Dakote: Vital statistics, *American Journal of Physical Anthropology* 51, Hoboken, 145-154.
Pasarić, M., 2008, *Učestalost i distribucija* cribra orbitalia *u ranosrednjovjekovnim grobljima Dubravice, Radašinovci i Donje Polje*, magistarski rad, Filozofski fakultet Sveučilišta u Zagrebu, Zagreb
Pfeiffer, S., 1991, Estimation of age at death, u: *An investigation of a military cemetery from the war of 1812*, ur. S. Pfeiffer, S. R. Williamson, Toronto
Phenice, T. W., 1969, A newly developed visual method of sexing the os pubis, *American Journal of Physical Anthropology* 30, Hoboken, 297-301.
Pindborg, J. J., 1970, *Pathology of the dental hard tissues*, Philadelphia
Pindborg, J. J., 1982, Aetiology of developmental enamel defects not related to fluorosis, *International Dental Journal* 32, Suffolk, 123-34.
Piontek, J., Kozlowski, T., 2002, Frequency of Cribra Orbitalia in the Subadult Medieval Population from Gruczno, Poland, *International Journal of Osteoarchaeology* 12, Hoboken, 202-208.
Piontek, J., Jerszyńska, B., Nowak, O., 2001., Harris lines in subadult and adult skeletons from the mediaeval cemetery at Cedynia, Poland, *Variability and Evolution* 9, Poznań, 33-43.
Pollitt, E., 1987, Effects of iron deficiency on mental development: Methodological considerations and substantive findings, u: *Nutritional anthropology*, ur. F. Johnston, New York, 225-254.
Repetto, E., Canci, A., Borgognini Tarli, S. M., 1988, Skeletal Indicators of Health Conditions in the Bronze Age Sample from Toppo Daguzzo (Basilicata, Southern Italy), *Anthropologie* 26, Brno, 173-182.
Roberts, C., Manchester, K., 1995, *The Archaeology of Disease*, New York
Robledo, B., Trancho, G. J., Brothwell, D., 1995, Cribra orbitalia: health indicator in the late Roman population of Cannington (Sommerset, Great Britain), *Journal of Paleopathology* 9 (2), Chieti, 185-193.
Rowland, M. G. M., Rowland, S. G. J. G., 1986, Growth faltering in diarrhea, u: *Proceedings of the XII International Congress of Nutrition*, ur. T. G. Taylor, N. K. Jenkins, London, 115-119.
Rowland, M. G. M., Rowland, S. G. J. G., Cole, T. J., 1988, Impact of infection on the growth of children from 0 to 2 years in an urban West African Community, *American Journal of Clinical Nutrition* 47, Bethesda, 134-138.
Salvadei, L., Ricci, F., Manzi, G., 2001, Porotic hyperostosis as a marker of health and nutritional conditions during childhood: studies at the transition between Imperial Rome and the Early Middle Ages, *American Journal of Human Biology* 13, Hoboken, 709-717.
Scheuer, L., Black, S., 2000, *Developmental Juvenile Osteology*, San Diego.
Sekelj, Ivančan T., Tkalčec, T., 2003, Arheološko nalazište Torčec – Cirkvišće, *Podravina* 4, Koprivnica, 5-36.
Scrimshaw, N. S., 1991, Iron deficiency, *Scientific American* 265, New York, 46-52.
Stuart-Macadam, P., 1985, Porotic hyperostosis: representative of a childhood condition, *American Journal of Physical Anthropology* 66, Hoboken, 391-398.
Stuart-Macadam, P., 1991, Anaemia in Roman Britain: Poundbury Camp, u: *Health in Past Societies: Biocultural Interpretations of Human Skeletal Remains in Archaeological Contexts*, ur. H. Bush, M. Zvelebil, Oxford, 101-113.
Stuart-Macadam, P., 1992, Porotic hyperostosis: a new perspective, *American Journal of Physical Anthropology* 87, Hoboken, 39-47.
Suckling, G. W., 1989, Developmental defects of enamel – historical and present-day perspectives on their pathogenesis, *Advances in Dental Research* 3, Alexandria, 87-94.
Sullivan, A., 2005, Prevalence and etiology of acquired anemia in Medieval York, England, *American Journal of Physical Anthropology* 128, Hoboken, 252-272.
Sutherland, L. D., Suchey, J. M., 1991, Use of the ventral arc in pubic sex determination, *Journal of Forensic Sciences* 36, Colorado Springs, 501-511.
Šlaus, M., 1996, Antropološka analiza kasnosrednjovjekovne populacije iz Danila Gornjeg kraj Šibenika, *ARadRaspr* 12, Zagreb, 343-364.
Šlaus, M., 1997, Discriminant function sexing of fragmentary and complete femora from medieval sites in continental Croatia, *OpuscA* 21, Zagreb, 167-175.
Šlaus, M., 2000, Biocultural analysis of sex differences in mortality profiles and stress levels in the late Medieval population from Nova Rača, Croatia, *American Journal of Physical Anthropology* 111, Hoboken, 193-209.
Šlaus, M., 2002, *The bioarchaeology of continental Croatia. An analysis of human skeletal remains from the prehistoric to post-medieval periods*, BARIntSer 1021, Oxford
Šlaus, M., 2002a, Demography and pathology of the medieval population from Stenjevec, *OpuscA* 26, Zagreb, 257-273.
Šlaus, M., 2006, *Bioarheologija. Demografija, zdravlje, traume i prehrana starohrvatskih populacija*, Zagreb
Šlaus, M., Novak ,M., Bedić, Ž., Vyroubal V., 2007, Antropološka analiza kasnosrednjovjekovnog groblja kraj crkve svetog Franje na Opatovini u Zagrebu, *ARadRaspr* 15, Zagreb, 211-247.
Šlaus, M., Novak, M., Krznar, S., 2003, Paleodemografska i paleopatološka analiza ljudskog osteološkog materijala s kasnosrednjovjekovnog nalazišta Torčec – Cirkvišće kraj Koprivnice, *Podravina* 4, Koprivnica, 37-48.
Šlaus, M, Tomičić, Ž., 2005, Discriminant function sexing of fragmentary and complete tibiae from medieval Croatian sites, *Forensic Science International* 147, 147-152.
Taras, H., 2005, Nutrition and student performance at school, *Journal of School Health* 75, Hoboken, 199-213.
Tkalčec, T., 2002, Arheološko istraživanje crkve Sv. Martina u Maloj Črešnjevici kraj Pitomače u godini 2001, *ObavijestiHAD* 1 (2002), Zagreb, 99-103.
Tkalčec, T., 2006, Crkvari – crkva Sv. Lovre 2005, *AIA* 2, Zagreb, 23-28.
Tkalčec, T., 2007, Crkvari – crkva Sv. Lovre u 2006. godini, *AIA* 3, Zagreb, 21-25.
Todd, T. W., 1920, Age changes in the pubic bone. I: The white male pubis, *American Journal of Physical Anthropology* 3, Hoboken, 285-334.
Todd, T. W., 1921, Age changes in the pubic bone. III: The pubis of the white female. IV: The pubis of the female white – negro hybrid, *American Journal of Physical Anthropology* 4, Hoboken, 1-70.
Tomičić ,Ž., Dizdar, M., Jelinčić, K., 2008, *Kliškovac – Terezovac – Suhopolje. Od mjestopisa do arheološke spoznaje!*, katalog izložbe, Zagreb - Suhopolje
Tomičić, Ž., Jelinčić, K., 2007, Suhopolje – Kliškovac. Rezultati istraživanja 2006., *AIA* 3, Zagreb, 38-44.
Tomičić, Ž., Krznar, S., Osterman, J., Novak, M., 2004, Arheološko – konzervatorska istraživanja crkve Sv. Lovre kraj sela Crkvara u općini Orahovica (2003.), *ObavijestiHAD* 1 (2004), Zagreb, 156-162.
Tomičić, Ž., Tkalčec, T., 2005, Crkvari – crkva Sv. Lovre 2004, *AIA* 1, Zagreb, 14-24.
Turbón, D., Pérez-Pérez A., Trancho, G., Botella, M., 1991/1992, Cribra orbitalia and dental hypoplasia in prehistoric and historic Spanish populations, *Journal of Human Ecology* 2/3, Delhi, 281-294.
Ubelake,r D. H., 1992, Enamel hypoplasia in ancient Ecuador, u: *Recent Contributions to the Study of Enamel Developmental Defects*, ur. A. H. Goodman, L. L. Capasso, Journal of Paleopathology, Monographic Publication 2, Chieti, 207-217.

Wapler, U., Crubézy, E., Schultz, M., 2004, Is Cribra Orbitalia Synonymous with Anemia? Analysis and Interpretation of Cranial Pathology in Sudan, *American Journal of Physical Anthropology* 123, Hoboken, 333-339.

Walker, P., 1986, Porotic hyperostosis in a marine-dependent California Indian population, *American Journal of Physical Anthropology* 69, Hoboken, 345-354.

Weaver, D. S., 1980, Sex differences in the ilia of a known sex and age sample of fetal and infant skeletons, *American Journal of Physical Anthropology* 52, Hoboken, 191-195.

Welcker, H., 1888, Cribra orbitalia, ein ethnologisch – diagnostisches Merkmal am schadel mehrere Menschrassen, *Archiv für Anthropologie* 17, Braunschweig, 1-18.

Wood, L., 1996, Frequency and Chronological Distribution of Linear Enamel Hypoplasia in a North American Colonial Skeletal Sample, *American Journal of Physical Anthropology* 100, Hoboken, 233-247.

Woźniak, K., Łagocka, R., Lipski, M., Tomasik, M., Buczkowska-Radlińska, J., Chlubek, D., 2005, Changes in developmental defects of dental enamel within the space of centuries, *Durham Anthropology Journal* 12 (2-3), http://www.dur.ac.uk/anthropology.journal/vol12/iss2-3/wozniak/wozniak.html