Introduction

The Little Ice Age (LIA) is a global climatic phenomenon characterized by the cooling of the Earth after the Medieval Warm Period (ca. 1000–1300 AD) was particularly pronounced between the 15th and the 19th century CE (Mann 2002). In Europe this period was characterized by the average temperature drop of about 0.6 °C resulting in extended period of mountain glacier expansion (see references in Mann 2002). The global temperature decrease probably affected food plant cultivation, which had a significant impact on general health and diet. Therefore, the aim of this study is to investigate possible differences in oral health and dietary habits caused by climatic changes brought by the LIA in late medieval and early modern inhabitants of continental Croatia.

Material and methods

The analysed skeletal/dental material consists of two composite samples: the pre-LIA series (end 3rd- to beginning 10th CE) comprised of six sites (Sisk, Istra, Karlovac, Stipac, Žumberak, Torčec), while the LIA sample (beginning 16th- to beginning 19th CE) comprised of five sites (Sisk, Torčec, Veče, Zvoline, and Žumberak). In order to assess possible differences in oral health and dietary habits between these two temporally distinct series, three dento-archaeological pathologies were analyzed: caries, alveolar tooth loss, and alveolar abscesses. The dietary profile was additionally assessed by analyzing carbon and nitrogen stable isotope analysis from both collagen.

All conventional broad-spectrum analyses were carried out at the Institute for Anthropological Research in Zagreb and the Anthropological Centre of the Croatian Academy of Sciences and Arts in Zagreb. Carbon and nitrogen stable isotope analyses were conducted at the Dorothy Garrod Laboratory for Stable Isotopes in Human and Animal, Durham University, UK. The samples from Sisk (24) and Žumberak (15) (LIA period burials) were processed in Cambridge, while the samples from Torčec (6) (pre-LIA burial) were processed in Belfast.

The frequencies (%) of the studied attributes were calculated by using the formula: total number of teeth (or alveolar) affected by studied change/total number of analysed teeth (or alveolar) × 100. The observed differences between the sexes and the samples were evaluated with the chi-square test, and statistical significance was defined by probability levels of P < 0.05.

Results

The pre-LIA series consists of 270 adult individuals (76 females and 94 males), and the LIA series consists of 208 adults (84 females and 124 males). (Fig. 2). The age distributions between two composite series do not show any statistical differences. The first sample numbers a total of 2860 teeth and 3649 tooth sockets, and the second one consists of a total of 3322 teeth and 4686 alveoli.

The total frequency of caries in the pre-LIA sample is 11.4% (205/1820), while in the LIA series this is 11.8% (460/3922), and the difference is statistically significant (χ² = 8.114, df = 1, P = 0.004). (Fig. 3). The pre-LIA sample males exhibit significantly higher caries frequency in comparison to females (12.9% vs. 9.5% vs. 9.9% vs. 1.44%, χ² = 6.72, df = 1, P = 0.006).

When AMTL frequencies between the two series are compared it is obvious that the LIA sample exhibits higher frequencies for both sexes. Therefore, significant difference is observed in a total of 543 teeth, with this frequency in males being higher statistically significant (χ² = 16.899, df = 1, P = 0.001) (Fig. 5). In the LIA series females show significantly higher AMTL prevalence in comparison to males (23.5% of 432/1840 vs. 19.7% or 564/2856, χ² = 13.18, df = 1, P = 0.000).

The total frequency of alveolar abscesses is slightly higher in the LIA sample (4.7% or 222/4696 vs. 4.4% or 151/3649), but this difference is not significant. In the pre-LIA males series exhibit significantly higher frequency of the pathology when compared to females (5.1% or 108/2131 vs. 3.4% or 33/1516, χ² = 5.816, df = 1, P = 0.016).

The bulk collagen stable isotope data clearly shows that diets at two contemporaneous LIA sites (Zumberak and Sisk) were different, with individuals in Zumberak consuming less animal protein and less LIA plants (likely millet, possibly maize) than those in Sisk (Fig. 6). On the other hand, the pre-LIA samples from Torče show almost identical values to those from the later Žumberak series suggesting a similar diet in all social strata of this period.