Original Article: Physical Anthropology

Interpreting diachronic changes and infra-contextual comparisons. The bioarchaeological archive of San Biagio in Cittiglio (Varese, Northern Italy)

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Abstract

Aim. The medieval and post-medieval cemetery of San Biagio in Cittiglio constitutes a context of archaeological and bioarchaeological interest that is significant for the knowledge of the population that once lived in the ancient region of Valcuvia (Lombardy, Varese province). The Romanesque church, originally built during the early Middle Ages and subsequently modified, is characterized by the presence of a well-structured cemetery context. The investigations conducted so far allowed us to examine the archaeological stratigraphy and bring to light the different phases of use of the cemetery areas.

Material and Methods. During the study, an almost well-preserved sample emerged, albeit affected by different sources of selection today difficult to reconstruct, which make this osteoarchaeological sample a fraction of the original subset of the population. The sample analyzed was well represented by all categories of individuals, with a disproportion between adults and subadults, who died particularly in infancy between 0 and 3 years of age. This characteristic led us to think that the sample had been the subject of several processes of selection which resulted in the over-representation of subadults and the under-representation of adults.

Results. The diachronic aspect of the cemetery, whose use extends from the 10th to the 17th century, allowed us to carry out comparative analyzes between two chronological subgroups divided according to the local and regional history of the site.

Discussion and Conclusion. The diachronic perspective has revealed the possible existence of differences in health status and dietary practices between the High Middle Ages and the Late and Post-Medieval Ages, highlighting how the social and political differences we are aware of thanks to historical documents can also be reflected from biological characteristics extracted from the anthropological record.

Key words: Bioarchaeology, chronological comparison, human remains, health status, diachronic osteological variations

Introduction

According to the available historical documentation, we know that at least until the 13th century Cittiglio was a *castrum*, a term which in the Late Middle Ages generically denoted a legal and territorial center endowed with its own physiognomy, which distinguished it from the wider organization of the *civitas* and the minor settlements in the area. The castles in this area were born as garrisons between the 10th and 12th centuries to protect limited territorial areas and played a significant role during the war between Como and Milan, the so-called ten-years' war (1118-1127). During this conflict, the territory of Valcuvia was attacked several times by the Milanese and was the scene of raids by Crema's allies. These castles were the center of territorial lordships, originating from royal concessions or from the extension of rights by the large owners, which responded to the need for protection, ensured the administration of justice and the protection of trade ("Verbanus", 2009).

During the 1400s the enfeoffment of Valcuvia, and therefore also of Cittiglio, by the Cotta family began, an action that took hold thanks to the Sforza lordship of the Duchy of Milan. Thus, with a notarial instrument, Francesco Sforza granted Pietro Cotta the feudal investiture of the parish church and valley of Cuvio, thus giving rise to the feud of Valcuvia ("Comune di Cuvio sec. XIV – 1757").

The church of San Biagio in Cittiglio, is a typical example of Romanesque architecture, attested from the 9th century and come down to the present day through multiple phases of structural modification. Initially built as a very small private chapel serving the needs of the fortified town, the Romanesque building was later erected on the first foundation. Initially dedicated to Sant'Andrea and San Biagio at least until 1421, as a document attesting to its dedication to both saints, the heading to Sant'Andrea was then eliminated in an unknown period. In the 14th century the church was extended to the west to incorporate the body of the funerary atrium, a covered space for cemetery uses initially placed outside the Romanesque facade. In the 17th century the orientation of the church was reversed with the demolition of the apse and the construction of the new entrance to the east, on the opposite side from the ancient one (Licata et al., 2019).

The excavations inside the church, that started in 2006 and aimed at the knowledge of the architectural and cemetery phases, have made it possible to investigate the structure of the funerary atrium which revealed phases of cemetery use between the 11th and 16th centuries. Inside the atrium for funerary use, 22 burials and a common ossuary (SU 157) were unearthed (Licata et al., 2019; Tesi, 2022).

The churchyard pertaining to the church, located to the east of the current entrance, was investigated by archaeological investigations in the years 2016-2020, allowing us to distinguish different phases of use of the area as a cemetery space dating from the 10th to the 17th centuries. The investigations have made it possible to bring to light 61 tombs and a large common ossuary (SU 423) (Licata et al., 2019; Tesi, 2022).

The general aim of this research is the bioarchaeological analysis of the cemetery sample of San Biagio in Cittiglio, in order to obtain anthropological data and provide information on the population that occupied the territory of Valcuvia in the medieval and post-medieval period. An important aspect of the sample is constituted by the diachrony of a sepulchral use which lasted for hundreds of years from the 10th to the 17th centuries, which defines this site as a small biological archive of the region and allows for infra-contextual comparisons between the subgroups of individuals pertinent to different chronological phases of use of the cemetery. One of the main purposes of this contribution, in fact, was also to verify any biological variation between the medieval and post-medieval groupages, conducting a diachronic approach on a sample formed over a large chronological period.

Here we therefore present a preliminary study conducted on the anthropological record retrieved from the funerary areas of the cemetery of San Biagio in Cittiglio, which has been divided into two chronological subsections based on the local and regional history of the site. Since the dating is based almost exclusively on stratigraphic data and characterized by rather wide chronological intervals, it was decided to compare only some biological aspects of the sample, divided into two distinct macro-groups based on their relevance to the High Middle Ages or the Late Middle Ages and Post-Middle Ages. This distinction is based not only on the chronologies offered by the site, but also on the knowledge of the historical and political changes to which Cittiglio and the Valcuvia region were subjected. These changes constitute a political-social watershed in the history of the territory which could be confirmed in the palaeobiological data offered by the human remains buried in the cemetery sites. It was therefore decided to compare the data derived from the anthropological analysis to verify whether these two moments of strong governmental and territorial changes of the site identify differences reflected in the biological characteristics of the individuals of the time.

Materials and methods

The archaeological investigations of the funerary areas have identified a total of 83 tombs. However, some of these burials have been exclusively documented and not recovered for stratigraphic reasons or geographic

localization in the area, while others have not returned bone remains due to translations that occurred in antiquity. The number of tombs was therefore reduced to the investigated burials that contained human remains that could be subjected to anthropological study. In particular, the individuals buried in 18 tombs retrieved in the funerary atrium and those deposed in 54 burials recovered in the eastern churchyard were analyzed.

Sex was estimated through morphological methods based on the observation of some dimorphic characteristics of the pelvic girdle and coxal bone (Acsádi-Nemeskéri, 1970; Ferembach et al. 1979; Bruzek, 2002), features of the pubic bone (Phenice, 1969), and of the auricular surface of the ileum (Bruzek et al., 1996). The dimorphism of some cranial features was also evaluated (Acsádi-Nemeskéri, 1970; Buikstra-Ubelaker, 1994). In the absence of the skull and pelvis districts, especially in cases of partial or minimal conservation of the individuals, it was necessary to refer to metric techniques and multivariate discriminant analyzes (Spradley-Jantz, 2011; Moore et al., 2016). In some cases, it was possible to integrate the skeletal data with the molecular determination of sex thanks to paleogenetic analyzes.

As regards the age-at-death, the sample was divided into age groups based on the classification of Buikstra-Ubelaker (1994). In cases where skeletal conservation did not allow reliable estimates, individuals were classified as generically adults (Ad).

The estimation of the age-at-death in adult individuals was carried out by evaluating mainly the degree of articular degeneration of the auricular surface of the ileum (Lovejoy et al., 1985; Buckberry-Chamberlain, 2002; Osborne et al., 2004), the surface of the pubic symphysis (Brooks-Suchey, 1990; Hartnett, 2010a), and changes in the surface and margins of the sternal extremity of the ribs (Iscan et al., 1985; Hartnett, 2010b).

In fetal and infantile subjects, metric methods have mostly been applied, based on the measurement of the length of the diaphyses of the long bones and the size of some primary non-obliterated bone elements, such as the pars basilaris of the occipital, the body of the sphenoid, or the pelvic bones (Maresh, 1970; Fazekas-Kòsa, 1978; Scheuer et al., 1980; Molleson-Cox, 1993; Scheuer-Black, 2000; Carneiro et al., 2016). For the measurements of the bone elements of juvenile subjects, reference was made to the standard of Fazekas-Kòsa (1978) and the modified one of Buikstra-Ubelaker (1994). For these subjects it was also necessary to proceed with the observation of the degree of fusion of the primary elements, thus those skeletal portions that ossify in the first months or years of life (Scheuer-Black, 2000).

In subadult children and adolescents, methods that consider the degree of obliteration between epiphysis and metaphysis (Scheuer-Black, 2000) and metric methods based on the measurements of the shaft of long bones (Maresh, 1970; Stloukal-Hanakova, 1978; Molleson-Cox, 1993; Scheuer-Black, 2000) have been applied.

Dental methods for estimating the age at death of subadults provide the most accurate and reliable assessment, by observing the degree of mineralization of the deciduous and/or permanent teeth (Moorrees et al., 1963; Gustafson-Koch, 1974; Smith, 1991; Beyer Olsen-Risnes, 1994; Liversidge, 1998; Hillson, 2009; AlQahtani et al., 2010). For late adolescents and young adults, the method of Mincer et al. (1993) was also applied for estimating the age-at-death through the degree of mineralization of the third molar.

Anthropometric post-cranial measurements were also collected, referring to the standard by Martin and Saller (1956-1959). The analysis of the robustness of entheses and enthesopathies at the level of the post-cranial skeleton was conducted referring to the methods of Mariotti et al., (2007). The individual entheses recorded were grouped based on the functional complex/skeletal district to which they belong, and the movements performed.

For the analysis of dental features and affections, the method by Belcastro et al. (2004), which allows the standardized recording of data with an alphanumerical code, was applied.

After a general analysis of the whole sample, comprising all the individuals pertaining to the entire period of use of the cemetery, it was divided into two chronological subsections relating to the medieval and post-medieval periods. This operation allowed us to proceed to a diachronic and infra-contextual comparison of the groups, aimed at identifying possible biological changes between the two sections.

Results

During this research, the remains found in total in 72 tombs were analyzed, of which 18 located inside the religious building and 54 in the external churchyard. In all, 102 skeletal units (SK) were identified within the burials referable to single individuals, complete or partial, and to scattered and mixed human remains related to reductions or altered burials (Tesi, 2022).

In the 72 graves and the related 102 USK investigated, 96 single individuals were identified, of which 44 adults and 52 subjects in developmental age. Among adult individuals, 10 are young adults (YAd), 14 mature adults (MAd), 5 elderly adults (OAd) and 15 adults in general (Ad); the sub-adult sample consists of 9 individuals in fetal / perinatal age (F), 27 infant subjects (I), 12 children (C) and 4 adolescents (AO), as can be seen in Table 1.

As regards the macro-class of adults, the determination of sex was possible in 40 of the 44 individuals analyzed: of these 21 are females and 19 are males, while 4 adults are of undeterminable sex due to partiality or scarce skeletal conservation (Table 1).

The sample immediately appears marked by a disproportion between the two macro-age groups, with an under-representation of adults (45.8%) compared to subadults (54.2%) (Table 1). This data is particularly significant as generally in cemetery contexts the subadult component is underrepresented due to differential burial conditions, for social and ritual reasons, but also for taphonomic influences and methodological and investigative limitations. Within the identified age groups, the most significant appears to be infants, represented by 28.1%, while the less frequent ones are that of adolescents (4.2%) and elderly adults (5.2%) (Table 1).

The fetal component is also of particular interest, generally under-represented for religious and cultural reasons, as well as for taphonomic limitations. At this site, 9 burials of individuals in fetal age were found between 28 and 40 weeks of gestation. Two cases were particularly significant, revealing the uncommon practice of burial within superimposed brick tiles (Licata et al., 2018; Tesi et al., 2021). By dividing the fetal individuals analyzed into weeks of gestational age, deaths are more frequent in the full-term phase of pregnancy (n. 7) and in particular around the 38th week (n. 4).

The diachronic approach

The entire sample thus composed was divided into two distinct groups on a chronological basis and was therefore distributed as follows: one section made up of subjects pertaining to the phases of the High Middle Ages, called IM, and a second group made up of individuals from the Late Medieval (LM) and Post-Medieval (PM) phases, called IIM.

Table 2 shows the division between the two chronological groups from which the tombs that do

Table 1. Summary of the distribution of the sample as a whole by sex and age class.

		M	F	ND	TOT	%
Subadults	**F**	0	0	9	**9**	*9,4*
	I	1	2	24	**27**	*28,1*
	C	2	0	10	**12**	*12,5*
	AO	2	2	0	**4**	*4,2*
	Tot.	5	4	43	**52**	*54,2*
Adults	**Yad**	5	5	0	**10**	*10,4*
	Mad	7	7	0	**14**	*14,6*
	Oad	2	3	0	**5**	*5,2*
	Ad	5	6	4	**15**	*15,6*
	Tot.	19	21	4	**44**	*45,8*
TOT.		**24**	**25**	**47**	**96**	
%		*25,0*	*26,0*	*49,0*	**100,0**	

Table 2. List of tombs divided by the related macro-period (IM: High Middle Ages; IIM: Late and Post-Middle Ages)

Tomb	SK	Sex	Age-at-death	Dating	Period
1	115a	ND	1,5-2,5 y	3rd q. XI c.	IM
2	147b	ND	2,5-3,5 y	3rd q. XI c.	IM
3	149	ND	~ 2 y	last q. XI c.	IM
4	151b1	ND	6-7 y	3rd q. XI c.	IM
	151b2	ND	28-34 w	3rd q. XI c.	IM
5	153	ND	1-1,5 y	3rd q. XI c.	IM
	153a	ND	1-1,5 y	3rd q. XI c.	IM
6	155b	M	1-1,5 y	last q. XI c.	IM
7 , 8	157			early XVII c.	IIM
9	159b	M	4,5-5,5 y	XIII c.	IM
	159b1	ND	7,5 m +/- 3 m	XIII c.	IM
	159b2	ND	1,5-2,5 y	XIII c.	IM
10	162	M	40-55 y	3rd q. XI c.	IM
11	164	M	43-55 y	XV- mid XVI c.	IIM
13	168b	M	19-24 y	XI-XIV c.	IM
14	170b	M	6,5 y +/-1 y	XV- mid XVI c.	IIM
15	172b	F	> 30 y	XV- mid XVI c.	IIM
16	174b1	F	25-35 y	XV- mid XVI c.	IIM
	174b2	ND	1-2 y	XV- mid XVI c.	IIM
17	176b	F	1-1,5 y	3rd q. XI c.	IM
	176b1	ND	/	3rd q. XI c.	IM
18	178b	F	4,5 m +/- 3 m	last q. XI c.	IM
19	180b	ND	11,5-12,5 y	3rd q. XI c.	IM
20	196	F	25-35 y	XI-XIV c.	IM
23	241 c1			XIV-XVI c.	IIM
	241 c2	M	30-45 y	XIV-XVI c.	IIM
	241 c3	M	40-55 y	XV-early XVII c.	IIM
25	256	NDet	ND	early XVII c.	IIM
26	258	ND	1-1,5 y	XV-early XVII c.	IIM
27	260	ND	37-40 w	XV-early XVII c.	IIM
28	263a	F	ND	XV-early XVII c.	IIM
29	265a	M	45-60 y	XV-early XVII c.	IIM
30	267	M	30-40 y	XV-early XVII c.	IIM
31	269b	F	40-55 y	XIV-XV c.	IIM
32	272	M	20-30 y	XIV-XV c.	IIM
33	275b	M	25-37 y	XIV-XV c.	IIM
	275c	ND	38 w	XIV-XV c.	IIM
	275d	M?	ND	XIV-XV c.	IIM
34	280b1	F	25-35 y	XIV-XV c.	IIM
	280b2-a	F	55-70 y	XIV-XV c.	IIM
	280b2-b	F??	11-15 y	XIV-XV c.	IIM

Table 2. List of tombs divided by the related macro-period (IM: High Middle Ages; IIM: Late and Post-Middle Ages)

	280b2-c	F??		XIV-XV c.	IIM
	280b3-a	NDet		XIV-XV c.	IIM
	280b3-b	ND	10-12 y	XIV-XV c.	IIM
35	283a,b	M+F?		XIV-XV c.	IIM
36	286	ND	36-40 w	XV-early XVII c.	IIM
37	289b	M	14-17 y	X-XI c.	IM
40	303	ND	3,5-4,5 y	XV – XVI c.	IIM
41	305 a	M	20-30 y	XV – XVI c.	IIM
	305 b	F	>45 y	XV – XVI c.	IIM
43	309 A	ND	1,5-2 ,5 y	XIV-XV c.	IIM
44	311	F?	ND	XIV-XV c.	IIM
45	315	M	35-50 y	XIII – XIV c.	IM
46	318	NDet	ND	XIV-XV c.	IIM
47	322/1	ND	4,5 m +/- 3 m	XIII – XIV c.	IM
	322/2	ND	40 w	XIII – XIV c.	IM
48	325	ND	1 y +/- 4 m	XIV-XV c.	IIM
49	329	Ndet		XIV-XV c.	IIM
50	337	ND	11,5-12,5 y	XIII – XIV c.	IM
51	349	M	25-35 y	X – XI c.	IM
52	353	M	55-75 y	XII– XIII c.	IM
53	357	F	30-35 y	XV – XVI c.	IIM
54	361	F	40-45 y	X – XI c.	IM
55	341	ND	2 y +/- 8 m	XII– XIII c.	IM
	343	F	> 30 y	X – XI c.	IM
56	372	F	30-40 y	XIV – XV c.	IIM
57	374	M??	>20 y	X – XI c.	IM
	375	F??	>20 y	X – XI c.	IM
58	377	F	50-70 y	XIII – XIV c.	IM
60	382a	2F, 2M		XIII – XIV c.	IM
	382			XIII – XIV c.	IM
61	389	ND	11-12 y	XIV – XV c.	IIM
62	392	ND	10,5 m-1,5 y	XIV – XV c.	IIM
63	397	ND	30-32 w	XIV – XV c.	IIM
65	404	2M	Ind.1: 18-24 y; Ind.2: 45-60 y	XIII – XIV c.	IM
66	408	ND	1,5-2 y	XII– XIII c.	IM
67	410a	F	30-50 y	XII– XIII c.	IM
	410b	M	ND	XII– XIII c.	IM
	418	F	35-45 y	X – XI c.	IM
68	413	F??	ND	XIII – XIV c.	IM
69	435	M	35-50 y	XIV – XV c.	IIM
71	444	ND	2-3 y	XII– XIII c.	IM

Table 2. List of tombs divided by the related macro-period (IM: High Middle Ages; IIM: Late and Post-Middle Ages)

72	449	ND	3-4 y	XIII – XIV c.	IM
	449b	ND	~ 1 y	XIII – XIV c.	IM
73	430	ND	38-40 w	XII-XIII c.	IM
74	459	ND	11,5-12,5 y	XII– XIII c.	IM
	467	ND	10,5 y +/- 1 y	XII– XIII c.	IM
76	487	ND	Full term	XIII-XIV c.	IM
77	480	M	ND	XII– XIII c.	IM
78	483	ND	1,5 y +/- 6 m	XIV-XV c.	IIM
80	496	F	17-20 y	XIV-XV c.	IIM
81	503	M??	13-15 y	XIV-XV c.	IIM
82	500	F?	ND	XIII-XIV c.	IM
	500a	M?	ND	XIII-XIV c.	IM
83	509	ND	2-3 y	XIII-XIV c.	IM

not present reliable stratigraphic and chronological data have been excluded.

As regards the composition of the samples, the IM group is represented by 18 adults and 29 sub-adults, while the IIM is made up of 25 adults and 17 sub-adults. The adult sample within the IM is made up of 9 males and 9 females, with a sex ratio of 1; within the IIM there are 10 males, 11 females and 4 undeterminable, with a sex ratio equal to 0,9. Both sexes and all age groups are represented in the two groups. IM is more represented by subadults than IIM, which on the other hand has a greater number of adults (Table 3).

Regarding the anthropometry of the post-cranium, the stature of males and females relevant to the two periods was calculated. Observing the summary table of the stature (Table 4), in both sexes the average values are slightly higher in IIM than in IM, with an average difference of 2.5 cm in males and 2.0 cm in females.

Some evaluations were also conducted on the variations of the functional muscle complexes in the two periods, as an expression of the biomechanical load to which the individuals in the two chronological groups were subjected. Observing the graphs in Figure 1, it can be observed that the average degrees of development of the various functional complexes of the upper and lower limbs are generally higher in subjects belonging to the High Middle Ages group than in those of the later period group. This is particularly evident for the upper limbs and especially for male subjects. In the lower limbs the same trend is observed in the male sex, albeit with a slighter deviation in the hip and knee complexes, while for the foot there is a greater disparity between the two periods. The differences in the degrees of development in males are particularly evident in the foot and forearm complexes, which present the greatest differences. In the female gender a similar

Table 3. Composition of IM and IIM groups by adult and subadult age classes and percentage distribution of the classes within the samples.

Age Class	IM	%IM	IIM	%IIM
F	4	8,5	4	9,5
I	18	38,3	6	14,3
C	6	12,8	4	9,5
AO	1	2,1	3	7,1
TOT. Subad.	29	61,7	17	40,5
YAd	4	8,5	6	14,3
MAd	6	12,8	8	19,0
OAd	2	4,3	3	7,1
Ad	6	12,8	8	19,0
TOT. Ad	18	38,3	25	59,5
TOT.	47		42	

Table 4. Averages of male and female stature in the two chronological groups. SD: Standard Deviation; IIM-IM: differences between the mean values in the two groups (cm).

	Mean M	SD M	Mean F	SD F
IM	**166,8**	6,1	**154,9**	3,6
IIM	**169,3**	2,8	**156,8**	3,6
IIM-IM	2,5		2,0	

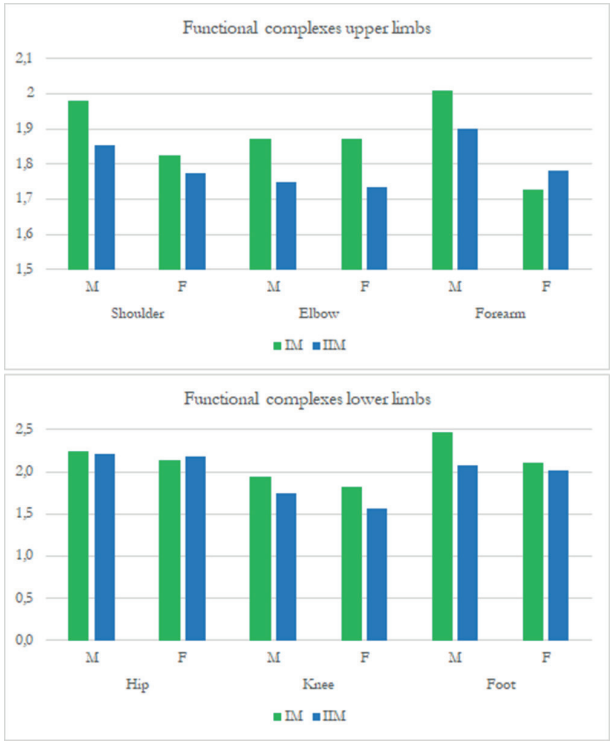

Figure 1. Variations in the mean degrees of development of the functional complexes of the upper (above) and lower (below) limbs of both sexes in the two separate chronological periods.

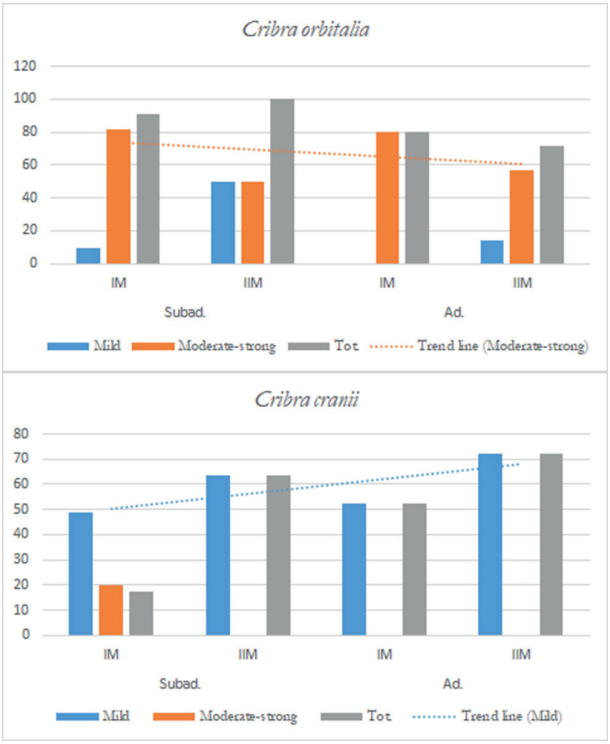

Figure 2. Cranial porosity of mild and moderate-strong degrees in the separated adult and subadult samples pertaining to the two chronological macro-groups. Dotted line: trend line indicating the increase of the mild degree of porosity (below) and the decrease in moderate-strong degrees (above).

trend is observed in some districts, including shoulder, elbow, knee, and slight differences in the complex of the foot. In the forearm, on the other hand, a slight trend reversal is observed, while in the complex of the hip the differences are minimal. For women, therefore, the hypothesis of variations in muscle stress between the two periods is less suitable, even if slight discrepancies can be observed in some districts.

The diachronic analysis of the prevalence of skeletal disorders was also conducted. In particular, the distribution of skeletal stress indicators in the two groups was examined, to highlight any changes in the physiological stress affecting the individuals in the two chronological moments.

As can be seen in Figure 2, the trend in both macro-age classes is towards a general increase in the mild degrees of cranial porosity (*cribra orbitalia* and *cribra cranii*) and a decrease in the incidence of moderate and severe cases in the transition from IM to IIM. Porosity of the cranial vault of moderate and strong degrees is found exclusively in subadults in the first period, while it is absent in the second period and in adults in general. *Cribra orbitalia* of severe and moderate degrees, on the other hand, are recorded in both chronological macro-groups and in both macro-age groups; however, a general trend towards an increase in mild degrees and a decrease in severe ones in the chronological transition between the two groups is observed. The total tends to increase in both classes and for both types of porosity as it takes into account the increase in mild cases.

Furthermore, the diachronic variation in patterns of dental disease was investigated to highlight any differences related to lifestyle and food consumption between the two periods. First, the prevalence of caries in adult subjects pertaining to the two chronological groups was investigated. Based on the analysis carried out, it can be observed that the percentages of teeth affected by caries undergo a decrease in the transition from the first to the second period (Figure 3, graph above). In fact, the rates of affected teeth are higher

in IM in almost all types of teeth (except for I1 which does not show caries in any subject, and for M2 which shows an increase in the IIM group), while they decrease by several percentage points in IIM. Caries is generally more frequent on the posterior teeth in both periods. The rates of affected individuals in the two periods are almost similar, while the number of decayed teeth per individual varies.

As regards caries in subjects in the developmental age, the opposite trend is observed: the frequency of caries in fact increases in the transition from the first to the second period in both dentitions (Figure 3, below). In particular, the greatest increase in the caries rate between the two groups was recorded in the anterior deciduous and posterior permanent teeth. Caries on the anterior permanent teeth is absent in the first period and recorded in the following period, while only in the posterior deciduous dentition there is a slight decrease in the second group compared to the first.

Finally, the presence of enamel hypoplasia was evaluated in the two groups to compare the extent of growth disturbances at different chronological moments. In adult subjects of both sexes, it is observed that the hypoplastic defects show a slight decrease in the transition from the first to the second period. The graph above in Figure 4 shows that in the first period both the number of teeth and the number of subjects affected by hypoplasia are higher. In the IIM group there is a slight decrease in the number of teeth with hypoplasia and a decrease in the number of affected individuals. No differences between the two sexes were observed, except for a slightly higher rate of hypoplasia in men than in women in the first period.

Regarding hypoplasia in the sub-adult sample, an opposite trend to adults is observed, just like in caries: in immature subjects, in fact, there is an increase in hypoplasia and enamel defects between the first and second chronological group in both dentitions (Figure 4, graph below). These results are in line with what emerged from the analysis of caries rates which, in contrast with the adult sample, seem to increase in a later medieval period.

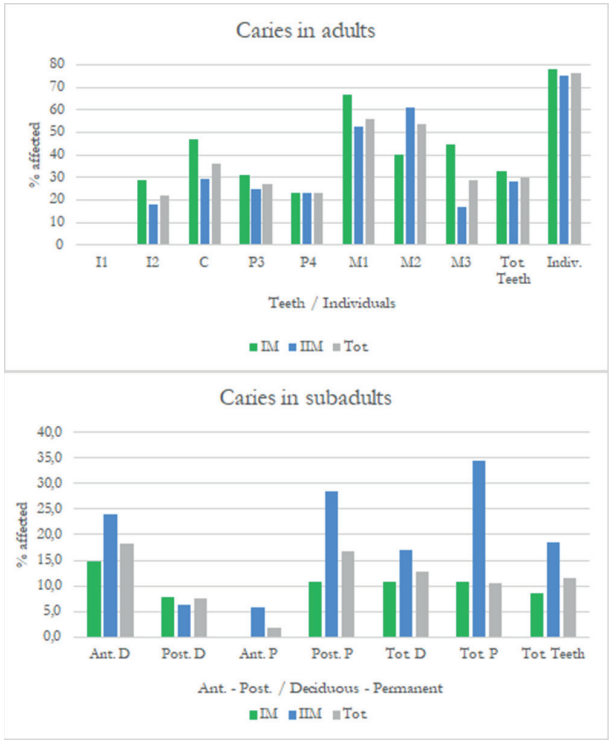

Figure 3. Frequency of dental caries in the different types of teeth in adults (graph above) pertaining to the two chronological groups, and caries rates in subadult subjects of the two chronological groups in the two dentitions (graph below).

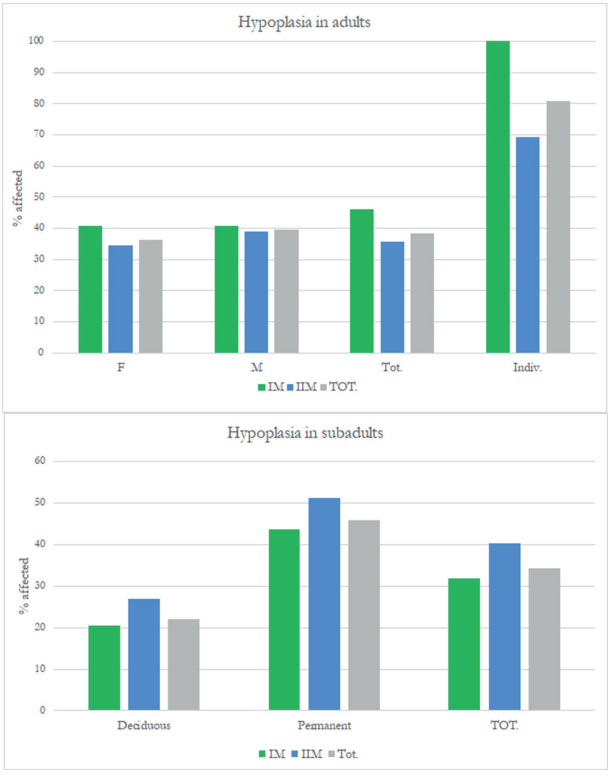

Figure 5. Percentages of teeth affected by hypoplasia in male and female adults (graph above), and in subadults of the two chronological groups (graph below).

Discussion

The investigated context shows a long and articulated phase of cemetery use characterized by an intense stratification and by multiple phases of burial, modification, and reuse of the sepulchral structures. The areas that can be archaeologically investigated today, however, certainly do not outline the entire existing archaeological record, since the number of burials pertaining to each phase of use appears rather small compared to the long period to which they refer. Furthermore, the skeletal sample shows some important bias which suggest that the population investigated, small for the long chronological period covered, is the result of multiple and successive selections that took place during time, also perhaps due to the urban transformations of the site. However, the presence of a good number of individuals in fetal age, generally underrepresented for religious and cultural reasons, as well as for taphonomic and conservative limitations, turns out to be of particular interest for this site (Tesi et al., 2021).

The diachronic approach applied to a sample extended over a wide chronological period allowed us to highlight the biological and epidemiological differences between the two temporal subgroups identified in the site. The political and socio-cultural change that occurs between the two periods during the Middle Ages finds some reflections in the biological characteristics of the individuals. In this regard, although the small sample size limits conclusive assumptions, some considerations can be made.

Between the first and second period, a general slight improvement in the living conditions of the subjects can be traced, evidenced by an increase in stature of about 2 cm in both sexes from the first to the second group (Sparacello et al., 2017). This seems to align with what is reported in the literature, according to which from the High Medieval period to the end of the Middle Ages there would be an increase in stature in both sexes (Barbiera and Dalla-Zuanna, 2009).

The variation in muscle development between the two periods seems to confirm the trend observed in the stature, suggesting that work in the High Medieval period was more onerous than for individuals in the Late Medieval and Post-Medieval group. In any case, it will be necessary to carry out further analyzes by integrating the sample with skeletal series from coeval sites in the same area.

Furthermore, at an epidemiological level, there is a decrease in the incidence of moderate and severe degrees of cranial porosity, related to nutritional and vitamin deficiencies, infections, and chronic anemias, parallel to an increase in the milder degrees. Based on this evidence, it can be hypothesized, still considering the limitation of the sample, a slight improvement in the lifestyle associated with physiological stress and problems of nutritional and vitamin deficiencies (related to the onset of chronic anemia), in the transition from High Medieval to Late Medieval and Post-Medieval periods. This hypothesis also finds support in the increase in height of about 2 cm found in the transition from the IM to IIM group in both sexes. It can therefore be hypothesized that at least a part of individuals in the Late and Post-Middle Ages had access to more or better resources than the subjects of the previous period and that this resulted in a lower incidence of serious cases of hematological problems connected to infections and nutritional deficiencies. The lower incidence of severe cases of vault porosity in adults compared to subadults may simply indicate a tendency for these individuals to heal as they progress to adulthood, due to increased resistance or better access to resources. *Cribra orbitalia*, on the other hand, seem widespread in both periods and in both age groups, indicating that presumably they present a more complex etiology or are associated with further deficiency and stress problems. If this can be interpreted as an improvement in the quality of life, it will have to be further investigated on a larger scale involving a larger cohort of subjects and a greater number of coeval bioarchaeological sites in the same area.

Furthermore, at least for the adult sample, a decrease in the rate of caries is observed in both sexes and for all types of teeth. Among various etiologies (including the association with other dental problems), caries is indicative of the carbohydrate component of the diet, suggesting that the Middle Ages (MI) diet included relatively higher proportions of carbohydrates (Hillson, 2000) than to the following period and probably a greater quantity of vegetables, since these are more cariogenic and abrasive foods than animal proteins (Jordana et al., 2010). Furthermore, the

possible association with other dental diseases must be taken into account, since the correlation between caries and wear and between caries and enamel hypoplasia has been documented (Jordana et al., 2010). A slight decrease in the later period is also recorded in the incidence of enamel hypoplasia. These findings are in line with the previous elaborations, suggesting that in a later period there was a slight change in the lifestyle of the subjects, leading to a lower incidence of stress episodes and dental affections.

On the other hand, as far as subadults are concerned, in the transition from the High Middle Ages to the Late and Post-Medieval Ages, there was an increase in the rates of caries and enamel defects. Although this picture goes against the adult trend previously discussed, the incidence of caries could relate to changes in dietary practices, suggesting a transition to a more cariogenic diet, or to a greater influence of other dental affections (Jordana et al., 2010). This hypothesis aligns with what is reported in the literature for Medieval and Post-Medieval English samples, according to which caries rates in deciduous teeth start to increase in the 15th century with the introduction of refined foods and the diffusion of sugar cane (Moore-Corbett, 1973; Giuffra et al., 2020).

The increased rates of hypoplasia in subadults from the High Middle Ages to the Late and Post-Middle Ages will need to be further investigated on more complete samples and in the light of additional pathological evidence and correlation with other skeletal indicators of stress. At present, nutritional changes, perhaps towards a less varied and more carbohydrate-based diet, and different social and cultural habits such as weaning practices may be considered as possible explanations for the increased hypoplasia found in immature individuals. Although the small sample size limits generalization, the results are consistent with those of caries rates in subadults, suggesting that an answer may be sought in the different dietary practices of the two periods. Furthermore, as known, a correlation between caries and hypoplasia has been documented in the literature (Jordana et al., 2010), therefore the increase in both rates could also be related to reciprocal influences of the dental diseases. In any case, it will be necessary to carry out an integrated analysis on a larger and more complete sample to answer all the questions and unravel the hypotheses that arose in this preliminary diachronic comparison.

From a future study perspective, it will be interesting to further conduct this type of diachronic research integrating other biological variables, such as parity features that have been recorded for the whole sample (Tesi et al., 2021), in order to identify possible differences in the female biological history between the two periods.

Moreover, paleopathological analysis of the whole sample allowed us to recognize various conditions (Licata et al., 2019; Tesi et al., 2019; Tesi et al., 2022; Tesi, 2022) that could be of interest also in a diachronic perspective aimed at the reconstruction of the health status of the individuals and its related changes between the two chronological periods.

Conclusions

The reading of the anthropological record has made it possible to hypothesize that it has been subjected to different sources of selection over time, currently difficult to reconstruct. It is evident that to date the original limits of the cemetery are not understood, which probably extended beyond the area being investigated. The hypotheses about the partiality of the archaeological record arise from a reflection on the structure of the sample itself, unbalanced towards the subadult component and insufficient from a numerical point of view with respect to the long phases of cemetery use.

The results of the diachronic comparison carried out on the individuals retrieved from the cemetery areas of the site show a slight improvement in living conditions in the later phase of the Middle Ages compared to the High Middle Ages, attested by an increase in stature of about 2 cm in both sexes and by a decrease in severe degrees of cranial porosity, caries, and dental hypoplasia. In subadult subjects, on the other hand, the increase in caries and hypoplasia is observed in contrast, evidence that can relate to a change in nutritional practices and with a diet more based on the consumption of refined and cariogenic products.

These hypotheses will have to be further investigated on a larger and more complete sample, in the

light of the completion of the archaeological investigations in the site, and through the integration with other osteoarchaeological samples from other regional contexts. Only in that case will it be possible to obtain information on the changes in the health status of the subjects between historical periods characterized by profound political and social transformations.

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