

Orofacial Analysis on the Adriatic Islands: 1. The Island of Hvar as a Model for Odontogenetic Researches

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ABSTRACT

This paper presents a preliminary orofacial analysis of a subadult population of Hvar, a Croatian island in the Adriatic. Its population represents one of the last genetic isolates in Europe and has therefore been the object of intensive crossdisciplinary research over the last 30 years. We focussed on the coefficient of endogamy on the one hand and malocclusal-related caries on the other hand, and expected differences in the latter between subgroups of the population. We analyzed 224 dental casts from children all over the island and found multiple caries in approximal surfaces in 55 percent of the children, but no significant differences between the subpopulations. Instead, significantly more caries affection was found in the boys than in the girls. The percentage of general caries affection is fairly high, even when compared to other isolated populations; it may be due to environmental influence. This would be consistent with the other results, which have putatively been caused by complex environmental influences and not solely by genetic components.

Introduction

In this paper, we examine the dental status of a subadult population of Hvar, a Croatian island, in order to augment the previous research of the island's demographic parameters. As a part of the Middle Dalmatian population, those living in

Hvar, or its neighboring islands of Brač and Korčula and the peninsula of Peleješac, as well as the northern Adriatic islands of Krk, Lošinj, Olib, Silba and Cres have been studied holistically for over thirty years. Heretofore, the characterization and quantification of the dental status has been lacking. Since the very is-

sue of determining the dental status can be considered a reliable indicator of both the socio-economic situation and the genetic structure of a population, an analysis of the orofacial system should be of significant interest.

The population of Hvar, as well as of the other middle Dalmatian islands, represents one of the last genetic isolates in Europe and can therefore be considered an ideal model for the multidisciplinary research of evolutionary processes. Migration analyses showed that between 1900 and 1981 only 8% of the present subadult population had parents born outside the island¹. A coefficient of endogamy of 0.76 indicates the very limited gene pool. Studies showed that the coefficient of inbreeding from isonymous marriages in some villages was as high as 0.39 and the coefficient of kinship 0.10. The coefficient of kinship for the whole island was 0.041; the only higher coefficient ever found was 0.092 in Amish, Nebraska, USA². Due to ethnohistorical and cultural differences, the proportion of isonymous marriages ranges from 5%–35%³.

Brief ethnohistory of the island

A detailed description of the ethnohistorical processes that had a major impact in shaping the island's population structure have been reported elsewhere^{3–15}. The settling of the island Hvar is marked by two major waves of immigration: the first one between the 6th and 8th Century, when the Croats (Slavs) settled throughout the entire island (creating the population *substratum*), and the second wave when the peoples from the mainland Balkans (especially from the Dinaric mountain chain) settled predominantly in the eastern region of the island mainly due the Turkish wars of the 16th and 18th Centuries, and especially the Candian war of the mid-17th Century¹⁶. These latter immigrants created a *superstratum* of newly arrived inhabitants,

who thereby could potentially become a genetic admixture to the then endemic population. Instead, these two major waves of immigration have resulted in two island subpopulations: one that settled mostly in the western part of the island, speaking the so-called »čakavian« dialect of the Croatian language and the other one, speaking the »štokavian« dialect, settled mostly in the eastern part^{12,17,18}. Even today, these two subpopulations have largely remained reproductively isolated due to various ethnohistorical, economic and geographic reasons; they indeed represent two distinct strata^{4,5,8,10,11,16,19}.

During these ongoing encompassing anthropological investigations of the rural populations of the eastern Adriatic islands of Croatia, various measures of interpopulation distances are used to assess the population structure. Studies have revealed significant differences in: the ethnohistorical and demographic characteristics of the island subpopulations^{8,15}, their migration trends¹³, their quantitative and qualitative dermatoglyphic traits of the digito-palmar complex^{4–7}, their morphological^{9,20} and physiological²¹ traits; their basic and cultural vocabulary^{12,17,18} the morphometric features of their metacarpal bones²², and, furthermore, their differences as shown by erythrocytes antigen analyses²³, serogenetical polymorphism²⁴ isolation by distance¹⁴, isonymy³ and VNTR DNA analyses²⁵.

A systematic analysis of the orofacial system has not yet been carried out. We restrict our analysis to the incidence of malocclusal-related caries and the relation with the coefficient of endogamy. We expect that a high proportion of endogamy could correspond to a low rate of heterozygosity, leading to developmental instability^{26,27}, manifesting itself in – among other things – a high incidence of malocclusion. Therefore, we expect to

find a fairly high proportion of malocclusal-related caries problems in the two subpopulations, and we hypothesize that the subpopulation with the higher degree in endogamy suffers a significantly higher incidence in malocclusion and approximal surface caries. These preliminary results will be a model for further dental, intermaxillar, anthropometrical, morphometric and other analyses constituting the study of genetic epidemiology of the orofacial system on Hvar and other Croatian islands.

Materials and Methods

In 1999 a team from the Institute for Anthropological Research, Zagreb, conducted a survey of school children on Hvar, Croatia. The sample consisted of 224 dental casts of children from all over the island, representing about 90% of the cohort of the Eastern population ($N = 31$) and about 20% of the cohort of the western population ($N = 193$). The children, aged 7–14 years had a sex distribution of 126 boys (56%) and 98 girls (44%). The age distribution was almost uniform for both groups.

Upper and lower alginate impressions were taken and poured in dental stone. The sample was divided into the three groups of dental development: primary dentition only, mixed dentition, or secondary dentition only. For this study, the children were divided into two groups, ac-

ording to the incidence of untreated caries: a caries »affected« and a »non-affected« group. In order to incorporate caries as an environmental factor in the etiology of malocclusion, only multiple caries on approximal surfaces were considered. Following Brin et al.²⁸ caries-affected occlusion was defined as a multiple mesial or distal carious lesion or a premature extraction with resultant tooth gap loss.

The criterion for the regional classification of the children was the place of birth of their grandparents.

After compiling descriptive statistics, significance testing between the groups was done using the Chi-Square-test.

Results

In the total sample, caries-affected children predominated: 54.5% had multiple caries on the approximal surfaces. The sex distribution was asymmetric: 60% of the boys had caries versus 48% for the girls ($P < 0.05$).

We found no significant difference in the frequency of caries distribution among the two subpopulations. In the eastern part, 68% of the children had caries afflictions, as statistically expected by Pearson's Chi-Square-test, and among the western population only 52.3% showed caries affliction, also as expected (Table 1).

TABLE 1
CARIES OCCURENCE BY SUBPOPULATIONS

Subpopulation	N (Fraction of total)	Caries status	
		Affected (fraction)	Not affected (fraction)
Eastern	31 (14%)	21 (68%)	10 (32%)
Std. Residual		1.0	-1.0
Western	193 (86%)	101 (52%)	92 (48%)
Std. Residual		-0.4	0.4
Total	224 (100%)	122 (55%)	102 (45%)

TABLE 2
 CARIES OCCURENCE AND TYPE OF DENTITION BY AGE OF THE CHILDREN

Age (months)	Caries				Dentition					
	Affected		Non-affected		Deciduous		Mixed		Permanent	
	n	%	n	%	n	%	n	%	n	%
81–90	10	77	3	23	13	100	0	0	0	0
91–100	18	95	1	5	14	74	5	26	0	0
101–110	24	75	8	25	18	56	14	44	0	0
111–120	18	82	4	18	5	23	17	77	0	0
121–130	12	52	11	48	2	9	14	61	7	30
131–140	6	29	15	71	2	10	3	14	16	76
141–150	10	48	11	52	0	0	7	33	14	67
151–160	7	32	15	68	0	0	3	14	19	86
161–170	7	30	16	70	0	0	1	4	22	96
171–180	10	36	18	64	0	0	0	0	28	100

Table 2 shows the distribution of caries and the distribution of dentition in the different age groups which is graphed in Figures 1a and b.

Discussion

Investigative models based on oral health status are not unknown in interdisciplinary and multidisciplinary studies. One such study was established on the Koster islands, where assessment of health criteria could be followed by preventive medical, odontological and psychosocial measures if the need should arise²⁹. Populations (by necessity: small) having a specific ethnohistory – be it due to migration, epidemic specificity, or socio-cultural barriers – are rare. The island of Hvar represents an exceptionally well-characterized, genetically isolated population³⁰.

Most of the previous analyses of the Hvar population were based on migrational^{8,13}, socio-cultural^{12,17}, anthropometric^{9,20}, physiological²¹, dermatoglyphic^{6–8,31,32}, radiogrammetric¹ or genetic distances¹. All such analyses clearly demonstrated the division of the island vil-

lages into two basic clusters: one from the western and the other from the eastern part. Juxtaposing these results with the incidence of caries in schoolchildren, no difference between the eastern and the western part of the island could be detected. The environmental component seems to have at least as much influence on the dental status as any hypothesized one. However, a tendency of less occlusal problems and therefore less caries in the western part is suggested by the data, even if there is no identifiable parameter such as the degree of preventive or proactive measures. The dental status results suggest the predominance of very complex and important interactions between ethnohistorical, political, economic, sociocultural, epidemiological, and aspects of the peculiar island demography.

Another finding was the decrease in caries with age; a finding which could be related to the change from deciduous to permanent dentition. The increase of caries-affected children is maximal with the eruption of the first molar. The proportion of incidences decreases with the onset of mixed dentition. The decrease of

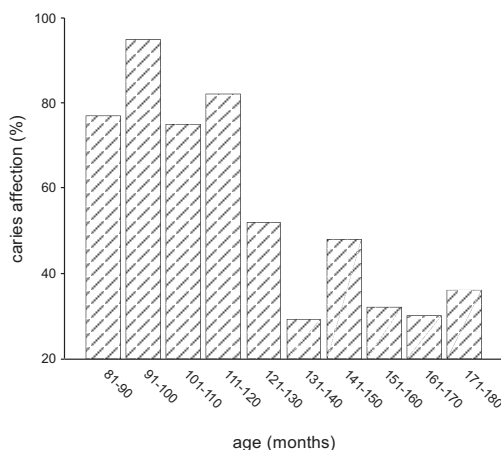


Fig. 1a. Caries affection classified by the age of the children.

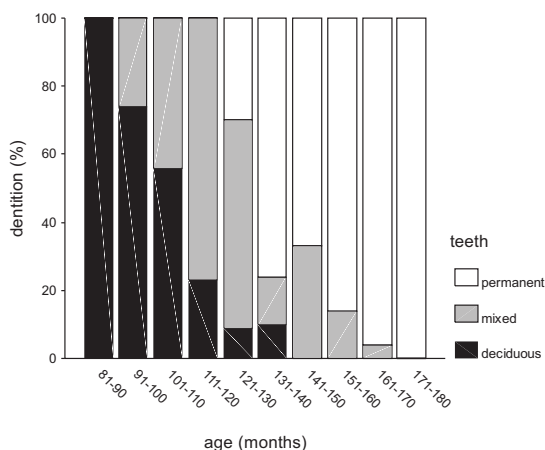


Fig. 1b. Type of dentition classified by the age of the children.

caries with age is not a real improvement in the dental status of the population, however, but just an artifact, a statistical fluke, which is only related to the emergence of new teeth.

An interesting result is the sex difference in the occurrence of caries. Boys showed significantly more approximal-surface caries than did girls. This can be interpreted as an environmental influence. Possibly, in mate choice, attracti-

veness is a more important factor for women than for men. Thus, women are encouraged to – and do – care more about their appearance. Despite an apparently different motivation, this concern does favorably affect their personal hygiene and may, particularly in rural communities, result in these observed differences.

As already noted, interproximal caries is an important factor in connection with the occlusal situation³³. The population

studied showed 54.5% affected cases, which seems to be a relatively high percentage even for isolated populations, since Bassat et al.³⁴, using the same definition, found only 24.9% caries-affected children in a group of Ashkenazi Jews. Inadequate prevention is probably the main reason for this result. Broad screening studies on the prevalence of dental caries should be undertaken periodically all over the Adriatic islands, resulting, no doubt, in a systematic planning and implementation of oral health services. As general health is largely dependent on what may be considered the »health« of the environment and oral health may mirror general health, dentistry has a key responsibility in the international action program for a sustainable development (Agenda 21, UNCED, 1992). Consequently, traditional curricula in, for example, odontology should be supplemented with interdisciplinary courses with a focus on more multifactorial view of the human condition³⁵.

The very similar environmental factors (food, medical and oral health services, education, etc.) confirm that the island of Hvar is a good model for researching the genetic and environmental factors in ethiology and how different health parameters progress.

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OROFACIJALNE ANALIZE NA JADRANSKIM OTOCIMA:

1. OTOK HVAR KAO MODEL ZA ODONTOGENETIČKA ISTRAŽIVANJA

S A Ž E T A K

Ovaj rad je uvodno orofacijalno istraživanje populacije školske dobi otoka Hvara, Hrvatska. Navedena populacija jedan je od posljednjih genetičkih izolata u Europi, pa je stoga već 30 godina predmet međudisciplinarnih istraživanja. Uspoređivali smo karijes kao etiološki čimbenik malokluzija s koeficijentom endogamije i istraživali razlike između dviju subpopulacijskih skupina. Analizirali smo 224 sadrena modela djece s cijelog otoka i pronašli višestruko kariozna zubala s aproksimalnim karijesima u 55% slučajeva, no nismo utvrdili značajne razlike među navedenim populacijama. Međutim, utvrđena je statistički značajno veća učestalost karijesa kod dječaka nego kod djevojčica. Ukupni udio karijesa je relativno visok, čak i u usporedbi sa sličnim izoliranim populacijama, vjerojatno uslijed vanjskih čimbenika. Dobiveni rezultati u skladu su s postavkama koje podupiru okolišnu teoriju nastanka karijesa u odnosu na genetičku komponentu.