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A dental metric open access dataset. Odontological applications in anthropological studies

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Abstract. Teeth due to their peculiar structure and composition are the most durable elements of animal bodies and therefore the most common osteological remains in collections. The abundance of teeth in collections means that they are subject to extensive research that today constitutes a well-defined discipline called Odontology. Fortunately, through appropriate anatomical and comparative studies teeth can be informative about phylogenetic history and evolutionary mechanisms of species. Variations in teeth, including dimensional variations, are commonly used in physical anthropology as a powerful diagnostic tool. This paper aims to provide a free database of adult human tooth measurements. The database consists of a series of maxilla and mandible mesiodistal and buccolingual diameters (711 measures) taken on the premolars and molars from 19 Sicilian sites that belong to the Mesolithic up to modern times. It is not our intention, at this time, to provide an extensive ontological study. Instead, we illustrate with a simple example of how the database can be used. The example shows the database is reliable and reproducible.

Keywords: human teeth, buccolingual, mesiodistal, comparative studies.

Introduction

Teeth – Studies and Structure

Teeth are the most common remains found in both fossil and sub-fossil collections because due to their structure and enamel compositions they are the most durable parts of animal bodies. Other parts of the body are more quickly subject to environmental and biological degradation. The abundance

of teeth, has led in the last 30 years to a well-defined discipline called Odontology (Alt *et. al.*, 1998).

It is well known that the morphology of teeth is influenced by their functions; among other things nutritional processes, aesthetic functions as well as attack and defense (Gingerich, 1974; Walker *et al.*, 1978). In the mammals, dentition plays an important every phase of nutritional processes (Hillson, 1986) and the human species (Brothwell, 2014) is not an exception to this rule (Hillson, 1986; Aiello and Dean, 1990). There are different both between and within species in tooth number, form, size, and shape. These differences represent opportunities for an incredible range of biological and evolutionary studies. As a result teeth can be considered as «*index fossilis'*» and are commonly used as markers in paleontology, paleozoology, and physical anthropology (Dental Anthropology).

Odontology in Anthropological Studies

Because tooth form and size is considered adaptative, an important part of the odontological studies is to identify and quantify variations among different human populations at both the micro and macroevolutionary level. Further, odontology takes into consideration makes it possible to sytematically study variation both qualitative (discontinuous characters-nonmetric-presence or absence) and quantitative (continuous characters-metric-dimension scale). Dimensional variation in teeth are commonly used in physical anthropology as a powerful diagnostic tool in «Comparative Population Studies» (Moggi *et al.*, 2003-2006; Smith *et al.*, 2015). Such studies are especially important when they focus on the interaction between genetics, environment, stochastic forces and migratory flows in a diachronic context (Alvesalo, 1971; Modi *et al.*, 2020; Goose *et al.*, 1982; Riga *et al.*, 2014). Tooth size and dimensions are in fact under a polygenic control and are also influenced by several factors such as the gestation time, the body size and weight at birth and all the forces mentioned before (Smith *et al.*, 2012; Garn *et. al.*, 1980).

Metric investigation of teeth has proven to be a useful tool to characterize human groups and have been used to display the biological distance between past and contemporaneous populations. Dimensional teeth analyses are applicable both on large continental-scale and in more limited areas (Lauria *et al.*, 2013), providing a useful diachronic investigation. Odontological traits are widely considered extremely useful population markers (Nichol, 1989; Scott *et al.*, 1997; Rathmann *et al.*, 2017-2020).

Aim of the paper

The aim of this report is to present a free database of adult human tooth measures consisting of a series of, upper and lower jaws, mesiodistal and buccolingual diameters taken on premolars and molars (Tab. 1). The database consists of a set of 711 measures in millimeters taken on the teeth. The database can be freely used by researchers for further studies and future publications provided that it is properly cited.

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Site	Inventory	Jaws	Side	MD_P1	BL_P1	MD_P2	BL_P2	MD_M1	BL_M1	MD_M2	BL_M2	MD_M3	BL_M3
Uzzo	Uzzo XI	UJ	R	0,00	0,00	0,00	0,00	10,31	11,55	9,72	12,03	7,96	11,50
Uzzo	Uzzo IVB	UJ	R	6,39	9,88	7,09	9,62	0,00	11,83	0,00	0,00	0,00	0,00
Uzzo	Uzzo IVB	UJ	L	6,37	9,76	6,60	9,62	9,38	11,72	9,49	11,97	7,83	11,04
Uzzo	Uzzo IVA	UJ	R	6,13	9,33	5,80	9,29	9,89	11,55	8,94	11,56	6,76	8,80
Uzzo	Uzzo IVA	UJ	L	6,05	9,22	6,24	9,42	8,78	11,71	0,00	0,00	0,00	0,00
Uzzo	Uzzo VIII	UJ	R	5,97	8,84	0,00	9,76	0,00	0,00	0,00	0,00	0,00	0,00
Uzzo	Uzzo V	UJ	R	0,00	9,52	0,00	10,60	0,00	0,00	11,81	10,28	0,00	0,00
Uzzo	Uzzo V	UJ	L	0,00	0,00	0,00	0,00	10,88	11,89	0,00	0,00	0,00	0,00
Uzzo	Uzzo VII	UJ	R	6,67	8,32	6,38	9,01	10,56	11,14	10,34	10,90	11,53	9,50
Uzzo	Uzzo VII	UJ	L	6,94	7,93	6,50	8,71	11,31	11,13	0,00	0,00	0,00	0,00
Roccazzello	BNU 377	UJ	R	6,11	7,37	5,71	7,77	9,08	10,60	9,62	9,64	7,21	9,67
Roccazzello	BNU 377	UJ	L	5,96	7,68	0,00	0,00	10,10	10,72	8,74	10,67	8,89	9,88
Roccazzello	BNU 382-d4	UJ	L	0,00	0,00	6,43	8,11	9,69	9,70	8,06	9,24	8,40	9,55
Roccazzello	BNU 382-d4	UJ	R	0,00	0,00	0,00	0,00	9,45	9,91	0,00	8,64	8,59	8,86
Roccazzello	BNU 382-d1	UJ	R	0,00	7,27	6,32	7,65	10,00	10,46	9,41	10,08	0,00	0,00
Roccazzello	BNU 382-1	UJ	L	0,00	0,00	0,00	0,00	9,75	10,33	9,29	9,21	0,00	0,00
Roccazzello	BNU 382-1	UJ	R	0,00	0,00	0,00	0,00	10,17	10,53	0,00	0,00	0,00	0,00
Roccazzello	BNU 382-2	UJ	R	6,03	7,71	6,29	7,72	10,12	923,00	8,56	9.28	0,00	0,00
Roccazzello	BNU 382-2	UJ	L	0,00	0,00	6,05	10,13	10,06	8,96	8,09	0,00	0,00	0,00
Roccazzello	BNU 382-d5	UJ	L	6,11	7,61	0,00	0,00	9,81	10,23	8,13	11,69	0,00	0,00
Roccazzello	BNU 382-d5	UJ	R	6,68	7,58	6,31	7,98	10,20	10,49	7,92	11,12	0,00	0,00
Roccazzello	BNU 382-d2	UJ	L	0,00	0,00	5,74	8,36	9,48	9,91	8,72	9,73	7,29	9,67
Roccazzello	BNU 382-4	UJ	R	5,53	6,68	6,28	7,73	0,00	0,00	0,00	0,00	0,00	0,00
Roccazzello	BNU 382-5	UJ	L	7,05	9,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Roccazzello	BNU 382-5	UJ	R	0,00	9,11	6,21	8,68	0,00	0,00	0,00	0,00	0,00	0,00
Roccazzello	BNU 382-6	UJ	R	0,00	6,95	7,11	8,14	0,00	0,00	0,00	0,00	0,00	0,00
Roccazzello	BNU 382-7	UJ	L	0,00	0,00	0,00	0,00	10,60	10,32	9,69	11,15	9,39	11,78
Roccazzello	BNU 382-7	UJ	R	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Roccazzello	BNU 382-5	UJ	L	0,00	0,00	0,00	0,00	8,36	9,69	9,96	10,95	0,00	10,17
Roccazzello	BNU 382-5	UJ	R	0,00	0,00	0,00	8,86	8,29	9,71	9,60	10,66	0,00	0,00
Roccazzello	BNU 382	UJ	L	5,60	8,48	5,31	9,78	10,99	11,74	9,47	12,11	13,45	11,32
Roccazzello	BNU 382	UJ	R	6,30	9,51	6,35	10,32	10,43	11,91	8,70	12,74	9,07	11,82
Vecchiuzzo	Mascella 2	UJ	A	6,11	7,84	5,77	7,59	11,41	10,30	8,62	9,58	0,00	0,00
Vecchiuzzo	Mascella 6	UJ	A	0,00	0,00	0,00	0,00	8,63	9,98	8,20	9,07	9,82	10,48
Marcita	T.C M 27	UJ	L	0,00	0,00	0,00	0,00	9,64	9,25	0,00	0,00	0,00	0,00
Marcita	T.C M 1	UJ	L	0,00	0,00	0,00	0,00	10,16	11,15	0,00	0,00	0,00	0,00
Marcita	T.C M 1	UJ	R	6,28	8,37	6,80	9,13	10,30	11,30	0,00	0,00	0,00	0,00

Tab. 1. *Incipit of the Dental Metrics Dataset (data reported in millimetres).*
Key: UJ= Upper Jaw-Maxilla; LJ= Lower Jaw-Mandible; A= Averages of left and right teeth; R= Right Side; L= Left Side; P1_MD= First Premolar Mesiodistal Diameter; P1_BL= First Premolar Buccolingual Diameter; P2_MD= Second Premolar Mesiodistal Diameter; P2_BL= Second Premolar Buccolingual Diameter; M1_MD= First Molar Mesiodistal Diameter; M1_BL= First Molar Buccolingual Diameter; M2_MD= Second Molar Mesiodistal Diameter; M2_BL= Second Molar Buccolingual Diameter; M3_MD= Third Molar Mesiodistal Diameter; M3_BL= Third Molar Buccolingual Diameter.

It is not our intention to present a full odontological analysis. Instead, a few examples on a part of the database were done in order to illustrate its potential for biological anthropology, as well as to test its reliability and

reproducibility. Only the lower jaws carrying all the premolars and all the molars were used to evaluate all the variables (teeth and diameters) with attention to maximizing the number of sampled populations. Moreover, the selected sample allowed a quick reproducible analysis, which illustrates the potential of the database while at the same time providing an odontological study.

Materials and Methods

Materials

The sample, taken from the database, consists of 711 tooth measurements from upper and lower jaws (Maxilla-Mandible) (Tab. 1) (premolars and molars) belonging to the Mesolithic up to Modern Age in Sicily (Tab. 2).

Main Sicilian Prehistoric and Historic Periods
B.C.E. Before Cristhian Era – C.E. Cristhian Era
Prehistory
• Upper-Paleolithic: 38.000-8.000
• Mesolithic: 8.000-6.000 B.C.E.
• Neolithic: 6.000.-4.000 B.C.E.
• Eneolithic/Copper Age: 4.000-2.500 B.C.E.
• Bronze Age: 2.500-1.100 B.C.E.
Early Bronze Age: 2.500-2.000 B.C.E. Middle Bronze Age: 2.000-1.500 B.C.E. Late Bronze Age: 1.500-1.100 B.C.E.
• Iron Age: 1.100-700 B.C.E.
History
• Antiquity: 700 B.C.E. – 100 C.E.
Colonial Period: 700-600 B.C.E. Classical Period: 600-400 B.C.E. Hellenistic (Greek Period): 400-200 B.C.E. Roman Republic Period: 200 B.C.E. – 100 C.E.
• Late Antiquity (Roman Empire Period): 100-476 C.E.
• Middle Ages: 476-1.492 C.E.
Byzantine Period: 476-1.000 C.E. Islamic Period: 1.000-1.300 C.E. Norman/Swabian Period. 1.300-1.492 C.E.
• Modern Ages: 1.492-1.789 C.E.
• Contemporary: 1.789 C.E. to Nowadays

Tab. 2. *Main Sicilian Prehistorical and Historical Periods.*

For practical reasons, Tab. 1 reports only inception of the entire dataset that is full free copyable and paste able from the paper version downloadable ResearchGate, Accademia Edu, IRIS UniPa or LinkedIn. Alternatively, an .xls file can be obtained by sending an email request to the institutional address of the author (gabriele.lauria03@unipa.it). The links and the extended URL are available on the dedicated section «Datasets» below.

Considering the aim of the paper and the availability of findings 19 Sicilian sites were selected (Tab. 3 and Fig. 1).

Site	Dating	Periods
B.C.E. Before Cristhian Era – C.E Cristhian Era		
Grotta dell'Uzzo	9.000 B.C.E	Mesolithic
Roccazzello	3.500-2.300 B.C.E.	Eneolithic
Grotta del Vecchiuzzo	3.500-2.300 B.C.E.	Eneolithic
Marcita	2.300-700 B.C.E	Bronze
Partanna-Stretto	2.300-700 B.C.E	Bronze
Partanna-Fossato	2.300-700 B.C.E	Bronze
Polizzello	1.200-1.100 B.C.E	Iron
Baucina	500-600 B.C.E	Antiquity
Mozia	800-400 B.C.E	Antiquity
Birgi	700-100 B.C.E	Antiquity
Lilibeo	700-100 B.C.E	Antiquity
Palermo-Caserma Tukory	600-300 B.C.E	Antiquity
Lipari	200 C.E.	Antiquity
Selinunte-Manuzza	400-300 B.C.E	Antiquity
Marsala	300-100 B.C.E	Antiquity
Licata	100-476 C.E.	Late Antiquity
Palermo-Castel San Pietro	1.000-1.300 C.E.	Middle Ages
Monte Maranfusa	1.200-1.300 C.E.	Middle Ages
Alia	1.800 C.E.	Contemporary

Tab. 3. *List of the sampled Site, Dating and Period.*

The samples were selected after the evaluation of the works of Becker, 1985; 1995; 1998; 2000; Bechtold *et. al.*, 1999; Belvedere *et. al.*, 2017; Borgognini *et. al.*, 1993; Borgognini and Repetto, 1986; Cangialosi *et al.*, 2022; Castellana,

1992; Conte *et. al*., 2007; Costantini, 1989; Di Salvo, 1984; 1987; 1991; 1998; 2004; Di Stefano, 1995; 1998; Di Stefano *et al*., 1997; De Miro, 1988; Fama' and Toti, 2019; Ficarra *et al*., 2022; Germana' and Di Salvo, 1994; Griffo, 1997; Hods, 2010; La Duca, 2000; Larocca, 2011; La Torre and Raffa, 2016; Lauria and Messina, 2013; Lauria *et. al*., 2017; Mannino, 2016; Messina *et. al*., 2008; Nicoletti and Tusa, 2012; Peripoli *et al*., 2023; Schimmenti and Di Salvo, 1997.

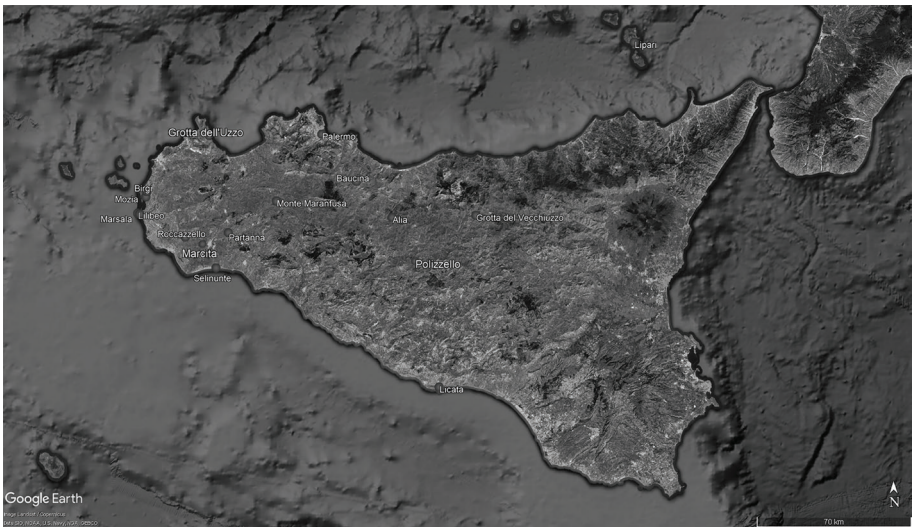


Fig. 1. *Sample Sites Map (from Google Earth content for purposes of research and education).*

Tab. 4 reports the bibliographic studies considered for each site. Premolars and molars were chosen because these distal teeth tend to better reflect variations due to adaptation to the environment and are also more useful in classifying groups (Kenyhercz, 2014).

Considering that premolars and molars dimensions are highly correlated (Moorrees *et al*., 1964) all the teeth (of the two dental arcades) of the two jaws, with also the isolated teeth attributable to a single specimen, were measured. Teeth not attributable to a single specimen, that could compromise the minimum number of individuals, were discarded. Teeth affected by any wear or attrition, diseases and all the biological stress were also not included.

Site	Inventory	Jaws	Side		MD_P1	BL_P1	MD_P2	BL_P2	MD_M1	BL_M1	MD_M2	BL_M2	MD_M3	BL_M3
Uzzo	IB	UJ	A	**1**	7,21	6,10	6,81	8,87	10,41	11,07	10,32	11,06	10,44	9,91
Uzzo	XI	UJ	A	**2**	7,12	8,21	6,90	8,57	11,27	11,13	10,92	10,98	10,51	9,60
Uzzo	XI	UJ	R	**3**	6,24	7,82	6,07	7,73	9,83	10,95	9,45	9,88	9,65	8,90
Uzzo	IVB	UJ	L	**4**	6,68	7,66	6,15	7,97	10,93	11,51	10,11	10,26	9,98	10,52
Uzzo	IVA	UJ	L	**5**	7,03	7,72	6,00	7,83	9,91	10,74	9,22	10,30	9,98	9,83
Uzzo	V	UJ	R	**6**	6,05	8,55	7,07	9,11	10,20	11,28	9,96	10,92	9,70	9,59
Stretto	BNU-382-3	UJ	L	**7**	6,36	7,30	6,78	7,51	10,10	10,04	7,99	9,04	9,83	9,18
Marcita	T.C. M14	UJ	L	**8**	6,49	7,76	6,68	8,40	10,96	10,06	10,20	9,96	10,43	9,53
Marcita	T.C. M9	UJ	L	**9**	5,84	6.63	5,18	7,17	10,36	10,52	9,16	9,77	9,95	9,55
Marcita	T.C. M27	UJ	L	**10**	5,66	6,66	5,50	6,83	8,96	9,44	9,44	9.5	10,02	8,92
Marcita	T.C. M32	UJ	L	**11**	6,65	7,44	6,94	7,88	10,50	9,83	10,65	9,77	10,73	9,54
Polizzello	PoM	UJ	L	**12**	7,80	6,52	6,80	7,35	10,59	9,96	10,38	8,90	8,87	7,48
Baucina	BauMF-451	UJ	R	**13**	6,24	6,38	7,57	6,39	9,89	9,70	10,20	9,69	9,94	9,41
Baucina	LT1-39	UJ	A	**14**	7,04	8,36	7,16	8,60	10,99	11,52	10,48	11,45	11,70	12,00
Baucina	LT3-569	UJ	R	**15**	6,35	6,37	5,36	6,69	11,48	10,63	9,29	9,57	10,62	9,84
Mozia	Mo15	UJ	A	**16**	6,87	8,44	6,84	8,77	11,10	10,99	10,29	10,94	11,06	11,03
Mozia	Mo1	UJ	L	**17**	4,50	6,74	5,63	7,76	9,75	9,95	9,88	9,58	9,41	9,15
Mozia	Mo2	UJ	R	**18**	6,26	7,14	6,86	8,07	10,83	11,11	9,83	9,88	11,14	10,47
Mozia	Mo8	UJ	R	**19**	6,00	6,20	6,22	7,36	9,57	9,61	9,01	9,49	9,67	8,70
Mozia	Mo17	UJ	R	**20**	5,57	7,53	5,91	7,90	10,70	10,40	9,62	9,32	11,04	9,95
Mozia	Mo14	UJ	R	**21**	6,90	7,54	7,13	8,28	9,33	10,80	9,83	10,30	11,08	10,26
Mozia	Mo21	UJ	A	**22**	5,21	6,49	5,16	7,06	10,76	10,09	8,85	9,15	10,33	9,47
Mozia	Mo22	UJ	R	**23**	6,29	6,57	5,40	7,20	10,71	10,72	10,28	10,31	9,84	10,10
Birgi	Bi2	UJ	L	**24**	5,46	5,98	4,83	6,42	9,16	8,73	8,15	8,44	8,32	7,88
Tukory	T46	UJ	L	**25**	6,67	6,61	7,22	7,64	10,26	10,80	9,88	9,44	9,17	8,14
Tukory	T5/1	UJ	R	**26**	6,83	7,08	6,30	8,30	10,77	10,50	10,00	9,60	10,80	9,37
Tukory	T17	UJ	A	**27**	6,56	8,66	7,16	8,91	11,69	10,28	10,96	10,42	8,77	10,59
Marsala	Fi	UJ	L	**28**	6,78	7,78	6,48	7,70	10,89	10,47	10,10	8,80	10,71	9,52
Marsala	Ossario	UJ	L	**29**	6,18	7,57	6,80	8,47	11,96	10,60	11,01	9,63	10,81	9,36
Marsala	Eta	UJ	A	**30**	6,27	7,12	6,46	7,96	11,31	10,86	10,14	10,03	10,18	9,38
Manuzza	T.11	UJ	A	**31**	7,60	7,31	8,05	8,76	10,35	10,64	11,47	10,42	11,26	11,04
Manuzza	T.12	UJ	R	**32**	6,34	6,30	6,59	7,07	10,11	10,26	10,18	9,28	8,32	9,78
C.S. Pietro	CSP4	UJ	R	**33**	5,86	8,29	5,39	8,44	10,12	11,17	8,48	10,14	7,51	9,62
Maranfusa	Loc.5341	UJ	R	**34**	6,47	7,31	6,73	7,72	9,49	9,91	9,24	10,05	10,15	9,67
Alia	A18	UJ	L	**35**	5,60	7,63	5,54	7,91	8,94	9,42	8,54	9,22	7,33	8,58
Alia	A58	UJ	R	**36**	5,35	8,46	5,03	8,56	9,23	10,08	9,21	9,82	8,45	9,64
Alia	AG01	UJ	A	**37**	6,16	6,70	6,75	7,39	9,45	9,43	9,12	9,40	9,71	8,91
Alia	N1	UJ	R	**38**	5,15	7,96	4,80	7,16	8,75	9,50	7,27	9,28	7,08	9,10
Alia	A81	UJ	L	**39**	5,65	8,62	4,79	8,22	8,93	9,32	8,58	9,21	7,61	8,85
Alia	A40	UJ	A	**40**	6,41	7,48	5,82	8,05	9,55	10,02	9,49	10,07	7,33	8,19
Period														
Mesolithic		UJ	A	**1**	6,72	7,68	6,50	8,35	10,43	11,11	10,00	10,57	10,04	9,72
Bronze		UJ	A	**2**	6,20	7,29	6,22	7,56	10,18	9,98	9,49	9,64	10,19	9,34
Iron		UJ	A	**3**	6,86	6,91	6,72	7,26	10,74	10,45	10,09	9,90	10,28	9,68
Antiquity		UJ	A	**4**	6,25	7,12	6,41	7,86	10,54	10,40	9,97	9,71	10,11	9,66
Middle Ages		UJ	A	**5**	6,17	7,80	6,06	8,08	9,81	10,54	8,86	10,10	8,83	9,65
Contemporary		UJ	A	**6**	5,72	7,81	5,45	7,88	9,14	9,63	8,70	9,50	7,92	8,88
Site														
Uzzo		UJ	A	**1**	6,72	7,68	6,50	8,35	10,43	11,11	10,00	10,57	10,04	9,72
Marcita		UJ	A	**2**	6,16	7,29	6,08	7,57	10,20	9,96	9,86	9,83	10,28	9,39
Baucina		UJ	A	**3**	6,54	7,04	6,70	7,23	10,79	10,62	9,99	10,24	10,75	10,42
Mozia		UJ	A	**4**	5,95	7,08	6,14	7,80	10,34	10,46	9,70	9,87	10,45	9,89
Tukory		UJ	A	**5**	6,69	7,45	6,89	8,28	10,91	10,53	10,28	9,82	9,58	9,37
Marsala		UJ	A	**6**	6,41	7,49	6,58	8,04	11,39	10,64	10,42	9,49	10,57	9,42
Manuzza		UJ	A	**7**	6,97	6,81	7,32	7,91	10,23	10,45	10,83	9,85	9,79	10,41
Alia		UJ	A	**8**	5,72	7,81	5,45	7,88	9,14	9,63	8,70	9,50	7,92	8,88

Tab. 4. *Dental Metrics Database Used for the Examples Analyses (data reported in millimeters). Key: UJ= Upper Jaw-Maxilla; LJ= Lower Jaw-Mandible; A= Averages of left and right teeth; R= Right Side; L= Left Side; P1_MD= First Premolar Mesiodistal Diameter; P1_BL= First Premolar Buccolingual Diameter; P2_MD= Second Premolar Mesiodistal Diameter; P2_BL= Second Premolar Buccolingual Diameter; M1_MD= First Molar Mesiodistal Diameter; M1_BL= First Molar Buccolingual Diameter; M2_MD= Second Molar Mesiodistal Diameter; M2_BL= Second Molar Buccolingual Diameter; M3_MD= Third Molar Mesiodistal Diameter; M3_BL= Third Molar Buccolingual Diameter.*

Methods

Tooth dimensions were quantified by considering the dental metrics of crown width and length (Pilloud *et al*., 2016). Dental metric data were so collected measuring dental crown Mesiodistal (MD) and Buccolingual (BL) diameter (Kieser *et. al*., 1990) of Premolars and Molars by a sliding digital caliper.

The MD diameter is the maximum diameter of the tooth crown in the mesiodistal plane (Fig. 2a) (parallel the occlusal and buccal surface) (Moorrees *et al*., 1964; Mayhall, 1992; Hemphill, 2015). The BL dimeter is the maximum diameter in the buccolingual (or labiolingual) plane. It is perpendicular to the mesiodistal plane (Fig. 2b) (Moorrees *et al*., 1964; Mayhall, 1992).

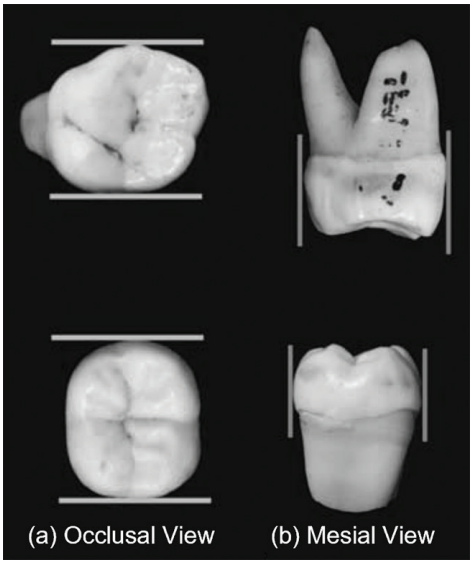


Fig. 2. *Mesiodistal (MD) Diameters (a); Buccolingual (BL) Diameters (b). Photos Copyrights Pilloud and Hefner, 2016.*

Measurements have been performed using MASEL Digital Dental Caliper 4". These two measures were preferred because they reflect the genotypic/phenotypic correlation, also are easier to define (even in case of malocclusion) and are not influenced by the contact with other facets (Buikstra *et al*., 1994).

For maximum precision standard dental metrics were used and instruments were carefully calibrated. Each measure has been taken three times (by the authors) and the averages of each measure of each tooth is reported. The database report (Tab. 1) in the first column the Archaeological

Site (in chronological order), in the second the Inventory of each Specimens (officially given the during excavation fields and reported in all the excavation related documents), in the third the indication if the measure has been taken on the Mandible or the Maxilla, in the fourth the information if the entries is related to the Left Side, to the Right side or if is the Average between the two sides.

All the values are reported in millimeters (the entries 0,00 indicate that the value was not measured due to missing tooth). The key adopted in the database summarize the specimen's information, the measure and the tooth and as listed below:

UJ= Upper Jaw-Maxilla
LJ= Lower Jaw-Mandible
L= Left Side
R= Right Side
A= Average between Left and Right Side
P1_MD= First Premolar Mesiodistal Diameter
P1_BL= First Premolar Buccolingual Diameter
P2_MD= Second Premolar Mesiodistal Diameter
P2_BL= Second Premolar Buccolingual Diameter
M1_MD= First Molar Mesiodistal Diameter
M1_BL= First Molar Buccolingual Diameter
M2_MD= Second Molar Mesiodistal Diameter
M2_BL= Second Molar Buccolingual Diameter
M3_MD= Third Molar Mesiodistal Diameter
M3_BL= Third Molar Buccolingual Diameter

Considering that the analyze of all the sample and evaluations of each measure for each single type of teeth is not the purpose of the paper (and impossible for practical reasons) the premolars and the molars of the inferior jaws (Tab. 4) were selected for illustrative purposes only.

Data were analyzed using the software PAST (Hammer *et al.*, 2001) performing Statistical Multivariate procedures commonly used in skeletal biology, to investigate the patterns between the groups (Hammer *et al.*, 2008), evaluating the measures of the single specimens and the averages for each site (Tab. 4). Through PAST all the dental metrics, selected for the sample, were initially subjected to a log/shape ratio (logarithmic scale transformation; Clauset *et. al.*, 2009; Claude, 2013) to obtain the same yield of Procrustes analysis (without the possibility to visualize shape differences). After that, with the same software, using the transformed measures the Screeplot, the Loadings and the related Principal Component Analyses (PCA) were

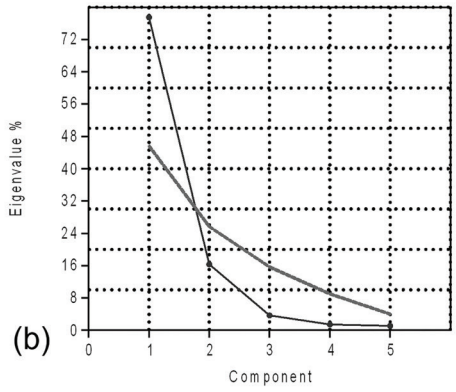
generated (Le Maître *et al.*, 2019). The Screeplot allowed an evaluation of the significance of the principal components, the Loadings evaluated the impact of each variable on the analysis and the PCA (symmetric matrix of variance-covariance; Davis, 1986) and provided an exploratory analysis of the specimens between the groups.

Results

Both the analyses conducted on measures of the single specimens and of the averages for each site provided plausible and well-defined results. The variation of the Eigenvalue and the % of Variance (Fig. 3;) showed that the values decreased gradually denoting that the variations were distributed mainly along PC1 axe and more gradually on the other vectors.

PC	Eigenvalue	% variance
1	0,00582845	77,504
2	0,00122759	16,324
3	0,000275585	3,6646
4	0,000107525	1,4298
5	8,10013E-05	1,0771

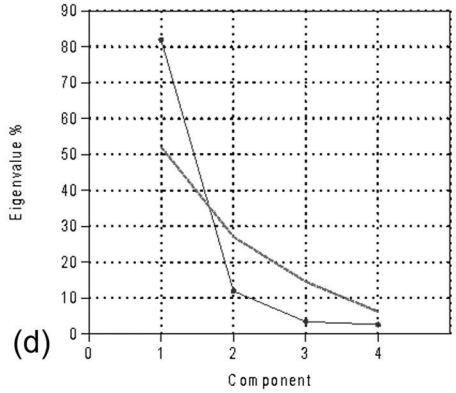
(a)



(b)

PC	Eigenvalue	% variance
1	0,007478	81,952
2	0,001092	11,969
3	0,000315	3,4548
4	0,00024	2,625

(c)



(d)

Fig. 3. *Eigenvalue and % of Variance of covered by the Principal Components of the Specimens (a); PCA Scree Plot with Broken Stick of the Specimens (b); Eigenvalue and % of Variance of covered by the Principal Components of the Averages for each Site (c); PCA Scree Plot with Broken Stick of the Averages for each Site (d).*

The «Loadings» (Fig. 4a) of PC1 showed how much each variable contributed to the components displaying that the MD diameter has a major influence compared to the BL one. In particular, P2 and M3 Mesiodistal diameters had the largest impact.

The PCAs showed (Fig. 4b-c) a clear separation between the Contemporary Sample (separated by the PC1 axe) from the other sample. On the opposite side of the graph, we found the Mesolithic Hunter-Gatherers specimens showed low variability. The Bronze and Iron periods showed a significant and clear separation from the other groups. The following period of Antiquity (in temporal conjunction with Iron) partially overlapped the antecedent period, but indicated large increase in variability in latter periods. Finally, it was noticed that the prehistoric samples occupied a heterogeneous morphospace compared to the homogeneous morphospace of the historical sample.

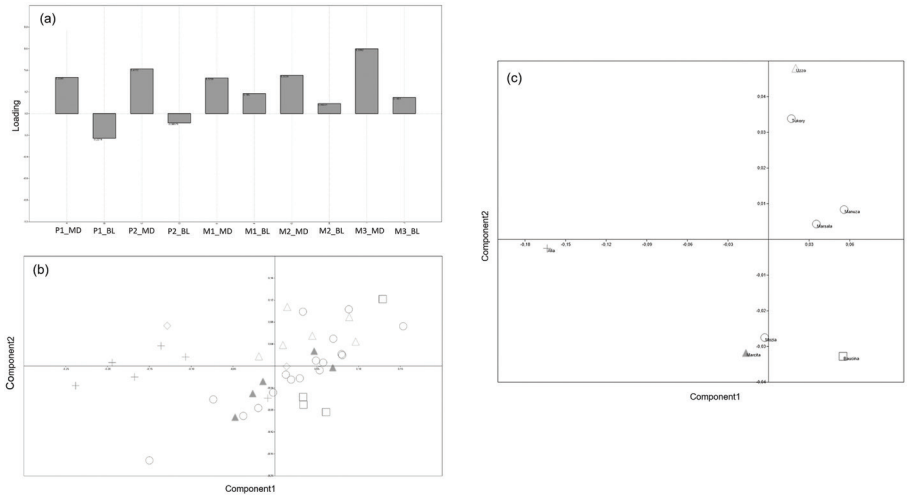


Fig. 4. *Dental Metrics Loadings of PC1 (a); PCA (Log) - Specimens (b); PCA (Log) - Averages for each Site (c). Key: Δ Mesolithic; ▲ Bronze Age; □ Iron Age; ○ Antiquity; ◊ Middle Ages; + Contemporary Age.*

Discussion and Conclusion

This paper presented database of adult human tooth measurements which is freely available and requires only appropriate citation. The paper also presented an example of the potential use and the reliability, of the database. Fig. 3 and 4 shows that PC1 reduces sharply suggesting that PC1 is a good indicator of the variability in dental metrics. As expected, the last

tooth of each type is usually more variable due to the mechanisms of dental development. Further, the MD diameter has more influence on the analysis compared to BL diameter and P2 and M3 Mesiodistal diameters have the largest impact on the analysis. PCA (Fig. 3b-c) displayed a clear separation between the Contemporary and all previous groups.

On opposite side of the graphs, it is possible to find the Mesolithic Hunter-Gatherers specimens, which show low variability. Both Bronze Age and Iron Age samples show a clear separation from the other groups determined by variation in tooth sizes and dimensions. This variation, in fact, exactly coincides with the first stable human migrations from the continent and the consequent «Populations Influx» (Lauria and Sineo, 2023).

The environmental factors of the diet variation that occurred between the Mesolithic Hunter-Gatherers and the following populations of Farmers-Shepherds were probably important factors. The variability produced is most likely a combinations of the genetic influence of the first settlers and the variation in diet.

The following period of Antiquity (in temporal conjunction with the Iron Age) provide another example of the discriminatory power of the dental metrics. The Antiquity group partially overlaps the antecedent group of the Iron age indicating a larger variability that increase in the latter periods. This variability was likely influenced by the intense period of Phoenician, Greek and Roman colonization. Unfortunately, the small sample size of specimens from the Middle Ages did not allow a profound analysis. Finally, the heterogeneous morphospace of the prehistoric sample, opposed to the homogeneous morphospace of the historical period, highlights a slow degree of morphological differentiation interrupted by a probable significative increase in genetic variability as a result of the «Human Flow».

Datasets

Table 1 and Table 4 are full free copyable and pasteable on the paper version downloadable on author's profiles' of:

ResearchGate (https://www.researchgate.net/profile/Gabriele-Lauria).
Accademia Edu (https://unipa.academia.edu/GabrieleLauria).
IRIS UniPA (https://iris.unipa.it/cris/rp/rp18034).
LinkedIn
(https://www.linkedin.com/in/gabriele-lauria-91597736/?locale=en_US).

Alternatively, is possible have the .xls file sending an email to the institutional address of the author (gabriele.lauria03@unipa.it).

The two datasets are an intellectual property of the author and are at full free disposal with the proper citation of this paper. The author declare that he has no conflict of interest and no competing interest in the sharing of the data. The data reported in the present study is based on the measures of skeletal findings available by excavations and institutional permits.

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