Eruption Time of Permanent Teeth in Pakistani Children

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Abstract
Background: To determine the mean eruption time of permanent teeth of Pakistani children and to evaluate the effects of gender, type of schools, height, weight and body mass index on it.
Methods: This cross sectional study was conducted from September 2007 to April 2008. 4370 children of 'just erupted' teeth were obtained from 102 randomly selected schools from 18 towns of Karachi, using systematic random sampling procedure. The dental examination was carried out for the selected child. Height, weight and date of birth were also obtained. Two sample 't' test and paired 't' test were employed to compare the mean time of eruption between gender and type of schools (private/ public), and upper and lower jaws. Pearson and partial correlations were used to determine the significant relationship between eruption time with height, weight and BMI.
Results: The right first molars of upper and lower jaws showed the minimum eruption time. Second molars were the last tooth to emerge. Only 3 teeth showed significant difference of eruption time between the genders. None of contralateral teeth showed any statistical significant difference. All the mandible teeth, except the premolars, erupted earlier than maxillary teeth. Private schools children showed early eruption than the public schools children. The Pearson and partial correlation were significant positively correlated with height. Eruption time of all the teeth, except one, showed positive correlation with weight.
Conclusion: The eruption time of Pakistani children are different in many aspects with to other nationalities.

Keywords: Eruption time, Permanent teeth, Children, Pakistan

Introduction

Parents consider tooth eruption as an important event in the child's development, and they have often showed their concern about the timing of eruption of teeth. Mostly the information on the age of permanent teeth emergence used in clinical and academic situations in Pakistan is based on American and European standards (1, 2). However, it has been suggested in the literature that standards for tooth emergence should be derived from the population in which they are to be applied because factors related to emergence may vary considerably in both dentitions (3). Similarly, adequate knowledge of timing of permanent tooth emergence is essential for diagnosis and treatment planning in Pediatric Dentistry and Orthodontics (4). Furthermore, information on tooth emergence is also used to supplement other maturity indicators in the diagnosis of certain growth disturbances, and in forensic dentistry to estimate the chronological age of children with unknown birth records (4, 5). Therefore, the specific standards of the time of emergence of teeth characterize an important resource for general dental practitioners, orthodontists and pedodontists.

Many studies are conducted in different population and among different ethnic groups all over the world (4,6-18). However, no study is reported from Pakistan, except one for primary teeth (17) and one for permanent teeth, conducted only for boys in pre-partition time (18). Therefore, there was a need to conduct such a study to establish proper norms for time of eruption of Pakistani children. The objective of

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the study was to establish a norm for the mean eruption time of permanent teeth, except the third molars, of Pakistani children. Furthermore, to find out the effect of gender, type of schools (private/public), height, weight and body mass index on the eruption time.

Materials and Methods

This cross sectional study was conducted from September 2007 to April 2008. Karachi City is divided into 18 administrative towns. In year 2007, 3948 public and 2560 private schools were registered in the city schooling system. However, for the better administrations, a public school is divided into primary, secondary and high schools sections separated for each gender, and are registered as different schools. Therefore, if we choose a high school, the attached primary and secondary school will automatically be included in the sample. In private schools listing, the system is just opposite. Not only one registered school covers all the primary, secondary and high school sections for both the gender, it also covers many campuses, located at different areas. Therefore, by looking the school lists with this complex setting, it was determined that the number of cases in private and public schools should be divided in the ratio of 3:1. Four thousand cases were planned to obtain for the study. Ten percent more is added into this sum to make sure that minimum committed number is obtained. Literature indicates that about 15-20% of the total children have at least one tooth just erupted. Therefore, we were expecting to examine about 25,000 children to obtained 4,400 cases of just erupted teeth. Assuming that each school enrolls on average 250 children, we were needed to visit about 100 schools to obtain the required number of cases. Furthermore, it was also decided to collect at least 150 cases for every tooth to make sure that mean eruption time for each tooth will be calculate on the basis of a reasonably good number of cases. The expected total was divided into different towns according to the proportion of schools. Schools were randomly selected from the list of schools, using systematic random sampling procedure.

Letters were posted at the addresses mentioned in the list of schools to obtain the permission from the administration. Since the response rate was very poor, the author has visited by himself to the selected schools to explain the purpose of the projects and got the permission from the administration. Time and dates were arranged with administration. A schedule calendar was prepared for the investigation team. A team of 2 dentists (1 male & 1 female) and 2 assistants (1 male & 1 female) visited each school on the assigned day and time. Every present student of the class was examined for general checkup. If a child had just erupted tooth, that child was taken away from the class room. The criterion of the just erupted teeth was defined as: a tooth deemed to have emerged if any part of it was visible in the mouth. The dental examination was carried out by field examiners using the dental examination kit under fluorescent light. The height was measured in centimeter, using wall-mounted ruler on the child's head with their back and knees completely straight, and their feet together. The weight was measured in kilogram using a commercial digital scale after removal of the shoes only. The date of birth was obtained from the school records. The clinicians were trained and calibrated by showing many clinical pictures of just erupted, unerupted or erupted teeth. No casts or subjects were used for inter or intra examiner calibration. Because it s very easy to distinguish among the above three different conditions for a tooth. Virtanen (19) indicated that the criteria for tooth emergence are so clear that evaluation of the error of the method is not necessary. The data were analyzed using SPSS statistical software. Two sample '*t*' test was employed to compare the mean time of eruption between gender (male/female) and type of schools (private/ public), while paired '*t*' test was used to compare the mean time of eruption upper and

lower jaws. Pearson and partial correlations were used to determine the significant relationship between eruption time with height, weight and BMI of the children.

Results

Descriptive Statistics

The total number of private and public schools included in this study were 76 and 26, respectively. About 25,000 children were screened from these 102 schools. Out of those, 4394 children of 'just erupted' teeth (cases) were obtained for the study. Twenty four of them were non-Pakistani. Therefore, the analysis was carried out only for 4370 Pakistani children. Fifty five percent of the sample was male and 80.3% of children were studying in grade 1 to grade 5. The mean age of the children was 9.31±2.27 years (R: 2.5 – 17.7 years).

Table 1 shows the descriptive statistics (number of cases, mean, median, standard deviation, and 95% confidence interval of mean) of eruption time of both the jaws and *P*-value for antagonist teeth (upper and lower corresponding teeth). The minimum mean eruption time was 6.5±1.1 years of right first molar of mandibular jaw (# 46). The maximum eruption time of 11.8 years was for the 2nd molars of maxillary jaw. All the mandible teeth, except the premolars, erupted earlier than maxillary teeth. The difference of mean eruption time all the contra-lateral (left and right) teeth did not show any statistical significance. Table 2 discusses the mean eruption time for male and female children. There was no significant difference of eruption time between gender in all the studied teeth, except tooth #15, # 25 and # 43. Females showed significantly late eruption in mandible second

premolars (#15 and #25) and early eruption in right mandible canine (#43). Table 3 depicts the mean eruption time among private and public schoolchildren. Twenty five teeth, out of 28, of the of private schools children showed early eruption than the public schools and 17 of them: tooth type (#17, #15, #13, #21, #22, #23, #25, #26, #27, #47, #44, #42 #31, #32, #34, #35 and #37), were statistically significant. Table 4 shows the Pearson and Partial correlations of eruption age with height of the patients. The Pearson correlation was significant positively correlated with height for all the teeth (*P*<0.0001), except tooth #31 and #35 (*P*=0.057 and 0,076, respectively). The Partial correlation of eruption time with height, controlled for weight, for all the teeth was also significant positively correlated (*P*<0.0001), except tooth #31 and #35. Table 5 shows the Pearson and Partial correlations of eruption time with weight. Eruption time of all the teeth, except tooth # 42, showed positive correlation with weight. However, only 15 of them showed statistically significant for non-zero correlation. Only five teeth (#17, #26, #42, #41, #32) showed significantly non-zero partial correlation of weight, controlling with height. All of them showed negative sign. Table 6 shows the Pearson correlation between the eruption time and Body Mass Index (BMI). Only 7 teeth (#16, #26, #45, #44, #43, #41, and #32) showed significant correlation.

Table 7 and Table 8 give the information of eruption time of female and male children of Australia (6), Iran (10), India (13, 18), Ghana (20), Nigeria (21), USA (22), Belgium (23), Finland (24) and this study.

Table 1: Descriptive statistics of eruption time of all the teeth, except third molars, in maxillary jaw

Tooth No	No of Cases	Mean	Median	SD	95% CI of mean	Tooth No	No of Cases	Mean	Median	SD	95% CI of mean	P-value*
17	228	11.8	11.8	1.6	(11.6,12.0)	47	428	11.3	11.2	1.6	(11.2 , 11.5)	< 0.0001
16	157	6.6	6.4	1.2	(6.4,6.8)	46	239	6.5	6.4	1.1	(6.4 , 6.6)	0.278
15	191	10.4	10.3	1.5	(10.2,10.6)	45	166	10.7	10.7	1.7	(10.5 , 11.0)	0.067
14	286	10.1	10.0	1.4	(9.9,10.2)	44	287	10.5	10.3	1.6	(10.3 , 10.7)	0.001
13	597	10.9	10.8	1.5	(10.8,11.0)	43	359	10.2	10.2	1.7	(10.1 , 10.4)	< 0.0001
12	337	8.4	8.3	1.3	(8.2,8.5)	42	308	7.8	7.7	1.2	(7.8 , 7.9)	< 0.0001
11	326	7.5	7.4	1.5	(7.4,7.7)	41	216	6.9	6.8	1.1	(6.7 , 7.0)	< 0.0001
21	324	7.5	7.3	1.4	(7.3,7.6)	31	193	7.0	7.0	1.2	(6.9 , 7.2)	< 0.0001
22	323	8.4	8.3	1.3	(8.3,8.5)	32	293	7.9	7.8	1.3	(7.8 , 8.1)	< 0.0001
23	570	10.9	10.9	1.4	(10.8,11.0)	33	353	10.1	9.9	1.6	(9.9 , 10.3)	< 0.0001
24	305	10.1	10.1	1.5	(10.0,10.3)	34	279	10.3	10.3	1.4	(10.1 , 10.4)	0.222
25	229	10.3	10.2	1.4	(10.1,10.5)	35	162	10.6	10.6	1.5	(10.3 , 10.8)	0.054
26	159	6.7	6.6	1.0	(6.6,6.9)	36	220	6.6	6.3	1.1	(6.4 , 6.7)	0.157
27	230	11.8	11.7	1.5	(11.6,12.0	37	415	11.4	11.3	1.6	(11.2 , 11.5)	0.001

Table 2: Comparison of eruption time among gender

Tooth type	Male		Female		P-value	Tooth type	Male		Female		P-value
	n	$\overline{X} \pm SD$	n	$\overline{X} \pm SD$			n	$\overline{X} \pm SD$	n	$\overline{X} \pm SD$	
17	137	11.6 ± 1.6	91	12.0 ± 1.5	0.865	47	248	11.4 ± 1.5	180	11.2 ± 1.6	0.393
16	85	6.6 ± 1.2	72	6.6 ± 1.2	0.952	46	130	6.6 ± 1.3	109	6.4 ± 1.0	0.189
15	118	10.2 ± 1.5	73	10.8 ± 1.5	0.008	45	88	10.7 ± 1.9	78	10.8 ± 1.4	0.619
14	158	10.1 ± 1.3	128	10.1 ± 1.5	0.940	44	155	10.5 ± 1.6	132	10.4 ± 1.5	0.521
13	396	11.0 ± 1.5	201	10.7 ± 1.5	0.065	43	203	10.4 ± 1.8	155	10.0 ± 1.5	0.009
12	177	8.4 ± 1.1	160	8.4 ± 1.5	0.625	42	188	7.8 ± 1.2	120	7.7 ± 1.1	0.488
11	192	7.5 ± 1.3	134	7.5 ± 1.7	0.985	41	121	6.8 ± 1.1	95	7.0 ± 1.2	0.316
21	187	7.5 ± 1.1	137	7.5 ± 1.6	0.919	31	122	7.0 ± 1.2	71	7.1 ± 1.4	0.558
22	180	8.5 ± 1.2	143	8.3 ± 1.4	0.398	32	172	7.9 ± 1.1	121	8.0 ± 1.5	0.287
23	385	10.9 ± 1.4	185	10.9 ± 1.4	0.959	33	201	10.2 ± 1.5	151	10.0 ± 1.6	0.074
24	165	10.1 ± 1.4	140	10.1 ± 1.6	0.990	34	154	10.3 ± 1.4	125	10.3 ± 1.5	0.978
25	137	10.0 ± 1.3	92	10.7 ± 1.5	0.001	35	97	10.5 ± 1.4	65	10.7 ± 1.7	0.339
26	85	6.7 ± 1.1	74	6.7 ± 1.0	0.972	36	124	6.6 ± 1.2	96	6.5 ± 1.0	0.259
27	141	11.7 ± 1.5	89	12.0 ± 1.5	0.170	37	238	11.3 ± 1.7	177	11.5 ± 1.6	0.093

Table 3: Comparison of eruption time among type of schools

	Private		Public		P-value	Tooth type	Private		Public		P-value
	n	$\bar{X} \pm SD$	n	$\bar{X} \pm SD$			n	$\bar{X} \pm SD$	n	$\bar{X} \pm SD$	
17	166	11.5 ± 1.5	62	12.5 ± 1.6	<0.0001	47	333	11.2 ± 1.4	95	11.6 ± 1.9	0.039
16	110	6.5 ± 1.2	47	6.9 ± 1.4	0.066	46	195	6.5 ± 1.1	44	6.4 ± 1.4	0.440
15	125	10.1 ± 1.3	66	11.0 ± 1.7	<0.0001	45	116	10.6 ± 1.7	50	11.0 ± 1.7	0.225
14	207	10.0 ± 1.3	79	10.2 ± 1.6	0.329	44	201	10.4 ± 1.5	86	10.8 ± 1.7	0.040
13	457	10.8 ± 1.3	140	11.3 ± 1.9	0.002	43	265	10.3 ± 1.7	94	10.0 ± 1.6	0.142
12	232	8.4 ± 1.2	105	8.5 ± 1.4	0.571	42	240	7.7 ± 1.2	68	8.1 ± 1.2	0.013
11	256	7.4 ± 1.3	70	7.8 ± 1.9	0.167	41	155	6.8 ± 1.2	61	7.0 ± 1.1	0.371
21	243	7.4 ± 1.3	81	7.8 ± 1.5	0.021	31	140	6.9 ± 1.1	53	7.3 ± 1.5	0.038
22	216	8.2 ± 1.0	107	8.7 ± 1.6	0.005	32	233	7.8 ± 1.1	60	8.4 ± 1.6	0.003
23	445	10.8 ± 1.3	125	11.3 ± 1.7	0.002	33	256	10.1 ± 1.6	97	10.2 ± 1.6	0.455
24	218	10.1 ± 1.5	87	10.3 ± 1.4	0.378	34	199	10.1 ± 1.3	80	10.6 ± 1.6	0.010
25	157	10.0 ± 1.3	72	10.8 ± 1.6	<0.0001	35	116	10.4 ± 1.5	46	11.1 ± 1.5	0.009
26	111	6.5 ± 0.8	48	7.1 ± 1.4	0.033	36	170	6.6 ± 1.1	50	6.5 ± 1.3	0.717
27	172	11.6 ± 1.4	58	12.6 ± 1.6	<0.0001	37	318	11.3 ± 1.5	97	11.7 ± 2.0	0.009

Table 4: Pearson and partial correlation of eruption time with height of the children

Tooth Type	No. of Cases	Pearson Correlation		Partial Correlation		Tooth Type	No. of Cases	Pearson Correlation		Partial Correlation	
		r	P-value	r	P-value			r	P-value	r	P-value
17	229	0.319	<0.0001	0.342	<0.0001	47	429	0.365	<0.0001	0.318	<0.0001
16	157	0.499	<0.0001	0.254	<0.0001	46	239	0.333	<0.0001	0.263	<0.0001
15	194	0.249	0.001	0.227	0.002	45	168	0.336	<0.0001	0.206	0.008
14	289	0.385	<0.0001	0.306	<0.0001	44	297	0.304	<0.0001	0.187	0.002
13	559	0.210	<0.0001	0.209	<0.0001	43	408	0.459	<0.0001	0.336	<0.0001
12	337	0.245	<0.0001	0.202	<0.0001	42	308	0.149	0.009	0.188	0.001
11	326	0.207	<0.0001	0.222	<0.0001	41	215	0.266	<0.0001	0.316	<0.0001
21	324	0.205	<0.0001	0.217	<0.0001	31	193	0.137	0.057	0.109	0.134
22	324	0.170	0.002	0.182	0.001	32	294	0.271	<0.0001	0.324	<0.0001
23	529	0.173	<0.0001	0.150	<0.0001	33	393	0.368	<0.0001	0.268	<0.0001
24	313	0.357	<0.0001	0.292	<0.0001	34	282	0.270	<0.0001	0.250	<0.0001
25	234	0.275	<0.0001	0.224	0.001	35	162	0.140	0.076	0.072	0.363
26	158	0.285	<0.0001	0.365	<0.0001	36	222	0.310	<0.0001	0.226	0.001
27	230	0.234	<0.0001	0.256	<0.0001	37	417	0.314	<0.0001	0.266	<0.0001

Table 5: Pearson and partial correlation of eruption time with weight of the children

Tooth Type	No. of Cases	Pearson Correlation		Partial Correlation		Tooth Type	No. of Cases	Pearson Correlation		Partial Correlation	
		r	*P*-value	r	*P*-value			r	*P*-value	r	*P*-value
17	229	0.080	0.230	-0.154	0.022	47	429	0.201	<0.0001	-0.070	0.152
16	157	0.452	<0.001	0.101	0.213	46	239	0.212	0.001	0.021	0.745
15	194	0.118	0.105	-0.056	0.443	45	168	0.276	<0.0001	0.052	0.510
14	289	0.250	<0.001	-0.501	0.400	44	297	0.246	<0.0001	0.034	0.574
13	559	0.076	0.063	-0.075	0.070	43	408	0.333	<0.0001	-0.019	0.718
12	337	0.143	0.009	-0.011	0.084	42	308	-0.004	0.949	-0.116	0.042
11	326	0.050	0.368	-0.096	0.085	41	215	0.034	0.619	-0.180	0.008
21	324	0.053	0.345	-0.089	0.111	31	193	0.087	0.229	-0.021	0.771
22	324	0.049	0.382	-0.078	0.162	32	294	0.048	0.411	-0.190	0.001
23	529	0.094	0.026	-0.033	0.431	33	393	0.263	<0.0001	-0.013	0.805
24	313	0.224	<0.001	-0.064	0.267	34	282	0.137	0.023	-0.086	0.154
25	234	0.168	0.011	-0.033	0.619	35	162	0.126	0.109	0.037	0.644
26	158	0.046	0.567	-0.242	0.002	36	222	0.225	0.001	0.060	0.380
27	230	0.053	0.425	-0.120	0.071	37	417	0.178	<0.0001	-0.034	0.494

Table 6: Pearson and partial correlation of eruption time with BMI of the children

Tooth Type	No. of Cases	Pearson Correlation		Tooth Type	No. of Cases	Pearson Correlation	
		r	*P*-value			r	*P*-value
17	229	-0.060	0.370	47	429	0.026	0.595
16	157	0.190	0.018	46	239	-0.085	0.188
15	194	-0.016	0.824	45	168	0.182	0.019
14	289	0.050	0.400	44	297	0.121	0.042
13	559	-0.036	0.383	43	408	0.127	0.016
12	337	-0.004	0.946	42	308	-0.097	0.089
11	326	-0.082	0.139	41	215	-0.206	0.002
21	324	-0.088	0.113	31	193	-0.005	0.940
22	324	-0.071	0.204	32	294	-0.142	0.015
23	529	0.008	0.845	33	393	0.100	0.060
24	313	0.030	0.597	34	282	-0.010	0.863
25	234	0.018	0.784	35	162	0.072	0.363
26	158	-0.212	0.007	36	222	-0.045	0.505
27	230	-0.060	0.365	37	417	0.016	0.749

Table 7: Mean eruption time of female children indifferent countries

Continent	Europe		Africa		USA (21)	Australia (6)	Asia		
Country	Belgium (22)	Finland (23)	Ghana (19)	Nigeria (20)			India (18)	Iran (10)	Pakistan
Year of publication	2003	1999	1967	1971	1978	2003	1946	2004	2009
MAXILLARY									
2nd Molar	11.98	11.9	10.9	11.4	12.1	12.3	11.95	12.5	12.0
1st Molar	6.17	6.1	5.0	5.8	6.4	6.5	6.9	6.71	6.65
2nd Premolar	11.35	11.6	10.0	10.3	11.2	11.7	11.5	12.5	10.75
1st Premolar	10.37	10.3	9.0	10.1	10.5	10.8	10.55	11.0	10.1
Canine	10.99	10.8	9.5	10.2	11.0	11.2	10.85	12.1	10.7
Lateral Incisor	7.88	7.6	7.25	8.0	8.17	8.17	7.5	8.8	8.35
Central Incisor	6.89	6.8	6.0	7.08	7.17	7.17	7.25	7.55	7.5
MANDIBLE									
2nd Molar	11.55	11.6	10.5	10.9	11.8	11.8	11.6	12.4	11.35
1st Molar	6.17	6.1	4.42	5.8	6.3	6.33	6.8	6.67	6.45
2nd Premolar	11.37	11.3	10.3	10.6	11.1	11.7	11.4	12.55	10.75
1st Premolar	10.25	10.3	9.2	9.9	10.4	10.6	10.1	11.05	10.35
Canine	9.74	9.7	8.9	9.9	9.9	10.1	10.5	10.25	9.95
Lateral Incisor	7.13	6.8	6.33	7.3	7.25	7.42	7.55	7.9	7.85
Central Incisor	6.14	5.9	5.08	5.8	6.1	6.33	7.25	6.5	7.05

Table 8: Mean eruption time of male children indifferent countries

Continent	Europe		Africa		USA (21)	Australia (6)	Asia		
Country Reference	Belgium (22)	Finland (23)	Ghana (19)	Nigeria (20)			India (13)	Iran (10)	Pakistan
Year of publication	2003	1999	1967	1971	1978	2003	2004	2004	2009
MAXILLARY									
2nd Molar	12.25	12.4	10.9	11.8	12.2	12.68	11.6	12.65	11.65
1st Molar	6.3	6.3	5	6.3	6.5	6.71	5.7	6.8	6.65
2nd Premolar	11.6	11.7	10.25	11.1	11.7	12.05	10.6	12.5	10.1
1st Premolar	10.7	10.9	9.25	10.6	11.1	11.28	9.7	11.95	10.1
Canine	11.5	11.3	9.95	11.0	11.5	11.81	9.9	11.8	10.95
Lateral Incisor	8.25	8.1	7.4	8.3	8.3	8.61	7.9	8.4	8.45
Central Incisor	7.1	6.8	6.15	7.5	7.2	7.43	6.95	6.75	7.5
MANDIBLE									
2nd Molar	11.8	12.0	10.55	11.3	12.0	12.15	12.3	11.3	12.9
1st Molar	6.3	6.2	4.7	6.0	6.5	6.63	6.6	5.6	6.8
2nd Premolar	11.7	11.6	10.45	10.9	11.6	12.11	11.8	10.9	12.8
1st Premolar	10.7	10.7	9.5	10.7	10.9	11.15	10.8	10.1	12.2
Canine	10.6	10.5	9.45	10.6	10.7	11.02	10.8	9.7	11.8
Lateral Incisor	7.4	7.1	6.25	7.3	7.5	7.77	7.8	7.3	8.4
Central Incisor	6.3	6.0	5.2	6.3	6.2	6.63	7.0	6.0	6.7

Discussion

In the literature, different population groups are targeted to determine the mean eruption time of permanent teeth. However, no reported data are available for Pakistani children, except an article published in pre-partition time for the mean eruption time of boys from Lahore (18). Due to unavailability of local data, the standards for eruption time being taught in dental colleges of Pakistan, are based on non-Pakistani population, especially American and European standards (1, 2). It is documented in the literature that significant variation exists in time of eruption and emergence sequence in different population (3). Therefore, it was a noteworthy and significant contribution to make an investigation of the standard values of eruption time of Pakistani children. This report presents baseline information for time of eruption of permanents teeth of Pakistani children. Furthermore, except the Iranian study (10), all the previous studies established the standard of eruption time on moderate or small sample sizes. This study was quit a comprehensive one and covered all the towns of Karachi, the largest metropolitan city of Pakistan.

About thirty three million children were enrolled in Pakistan up to the secondary schools (grade 1 to grade 10) in 2006 (25). Fifty seven percent of them were male children. In this study the percentage of male children was 55%, which was not very far from the national data of male percentage in the schools. In many parts of Pakistan, especially in rural areas, families do not send their daughters to school. Karachi is mostly urbanized and this type of negative attitude against females does not exist in this town, therefore, we were expecting higher percentage of females' enrolment.

The study was not a hospital based-study. Therefore no radiograph was available. Consequently, it was not possible to determine the congenitally missing teeth. Holman et al. (26) discussed the impact of congenitally missing teeth on the mean eruption time. They concluded that estimates of eruption time without considering congenitally teeth were biased upward (always less than 1%), and the standard deviations were consistently overestimated by 3-5%. However, for adequate sample sizes agenesis does not lead to substantially biased estimates. Since in this study the sample size was quit large, therefore the effect of congenitally missing teeth would not be significant.

This study did not show any trend of difference of eruption time between male and female children. None the study teeth, except maxillary second premolars (#15 & #25) and mandibular right canine (#43), showed any statistical significant difference among gender. These results of mostly insignificant differences and no clear-cut trends in the eruption time of male and female children did not agree with almost all the other studies, where they have shown that the girls have advanced eruption time than male children (4,5-7,12, 19, 27-29). However, these results did agree with few other studies (30, 31). This result of no significant eruption time between male and female children is most important finding of this study. Therefore, the eruption pattern among Pakistani children is very much distinct with other nationalities in this regard.

The mean eruption time of none of the contralateral (right and left) teeth were statistically significant. Therefore, the eruption time of contralateral teeth was symmetrical. This finding agreed to almost all the studies mentioned in the literature. Mean eruption time of all the mandible teeth, except the premolars and first molars, showed statistically significant early eruption than maxillary teeth. The largest difference between antagonist teeth was observed in canines and incisors. This trend of early eruption with significant differences of mandible teeth, except the premolars and first molars, agreed to other studies (6,7,10,15,19). How

ever, the study of Nanda (32) did not agree with this result.

The children from private schools showed early eruption than public schools. Seventeen teeth showed significantly earlier eruption in private schoolchildren. In Pakistan, the children of low socio-economic classes usually enroll in the public schools. Therefore, malnutrition could be a significant factor in delayed eruption. Triratana et al. (33) showed that the malnutrition children usually have delayed eruption than the children grow with normal healthy diet.

In our study, it was observed that eruption of teeth was positively related to somatic growth (height and weight) of the children and the results were in agreement with Billewicz (7) and Agarwal (13). All partial correlations between eruption times with heights (controlling the weights) were positively correlated with $P<0.05$, except tooth # 31 and #35 and these partial correlations were not very much different to the Pearson linear correlations (without controlling the weight). Pearson linear correlations of eruption times with weight were all positive and statistically significant. However, when partial correlations with weights were computed (controlling the height), all the values became negative except one tooth in maxillary jaw and five teeth in mandible jaw, and only five of those negative correlations were statistically significant. It infers that the children who are tall, it did not matter whether they are heavy weight or not, going to have delayed eruption. However, if they are heavy, it would be early eruption if they are not tall and delayed eruptions if they are tall. Due to these conflicting outcomes of the linear and partial correlation of height and weight with eruption time, the BMI showed 50% positive correlation and 50% negative correlations. Therefore, no prediction for the eruption time can be made on the basis of BMI.

The difference of eruption of time in different populations are linked to many attributes, like genetics factors (34), environmental factors including the socioeconomic status and nutrition (5,7,9), and climate (35). It was also found that eruption times were also varied among the same ethnic groups (3,8,35) and also attributed to genetic variations (8). Information showed that the eruption time of Pakistani children is delayed than African children, while they showed early eruption than Iranian children.

In reading of reported differences in the eruption time, the readers should be careful for the definition of emergence and eruption, sampling methods, sample sizes, age groups, number of cases in each group, eating habits and socio-economic effects.

In conclusion, the following conclusions were obtained from this study:

- On average the first erupted tooth was the right maxillary first molar, emerged at the age of 6.5 years and the last tooth was mandible 2nd molar, emerged at the age of 11.8 years,
- There is no significant difference of eruption time between gender in all the studied teeth, except tooth #15, # 25 and #43.
- There was no significant difference between the contralateral teeth of right and left side,
- All the mandible teeth, except the premolars, erupted earlier than maxillary teeth.
- Ninety percent of the teeth of private schools children showed early eruption than the public schools.
- The children who are tall, it did not matter whether they are heavy weight or not, showed delayed eruption. However, if they are heavy, it would be early eruption if they are not tall and delayed eruptions if they are tall.
- There was no systematic relationship between the eruption time and Body Mass Index (BMI),

In general, the study showed that the eruption time of Pakistani children are different in few respects and agreed in others, when

comparing with the information reported in the literature of other countries.

Ethical Considerations

Ethical issue principles including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors.

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