



Dental maturation in British children: are Demirjian's standards applicable?

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Summary. *Objective.* The objective of this study was to determine if the standards of dental maturation of Demirjian *et al.* (1973, 1976) are applicable to British children.

Design. The design was cross-sectional, retrospective.

Sample and method. The sample comprised 521 London children of Bangladeshi and white Caucasian (English, Welsh and Scottish) origin aged between 4 and 9 years. Dental age was assessed by crown and root stages of seven mandibular teeth from rotational pantomographs. Dental age was compared to chronological age using a *t*-test.

Results. Differences in dental maturation between the two ethnic groups were not significant. British children as a group were dentally advanced compared to the Canadian standards. The mean (\pm standard deviation) advancement in girls was 0.51 ± 0.79 years and in boys was 0.73 ± 0.73 years.

Conclusions. The standards of dental maturation described by Demirjian *et al.* (1973, 1976) may not be suitable for British children.

Introduction

Dental growth standards are used to assess the maturity of individuals as well as comparing growth between different groups of children. One widely used method is that of Demirjian, Goldstein & Tanner, first described in 1973 based on a large number of Canadian children [1,2]. The method evaluates the development of seven mandibular permanent teeth from a rotational pantomograph and calculates dental age. The difference between dental age and known chronological age is of interest, indicating an advancement or delay compared to the standard. Recent investigations using this method on several ethnic and geographical groups suggest a positive secular change in dental formation [3–15] as well as ethnic differences [16–18]. The aims of this study were (a) to compare

dental development of two ethnic groups of British children and (b) to compare dental development between British children and the Canadian standards [1,2].

Methods

The sample comprised 521 children of white Caucasian and Bangladeshi origin aged between 4 and 9 years (average age 6.45 ± 1.42 years) (see Fig. 1). The Hospital defines white Caucasian as English, Welsh or Scottish. Good quality radiographs of healthy children were selected from routine and emergency patients attending the Department of Paediatric Dentistry of the Royal London Hospital. Decimal age was calculated to two decimal points using Eveleth & Tanner [19]. After training and calibration, all radiographs were assessed by the second author without knowledge of age, gender or ethnic group. Dental age (DA) was calculated from tables [2] and compared to chronological age (CA) for boys and girls separately. The difference between

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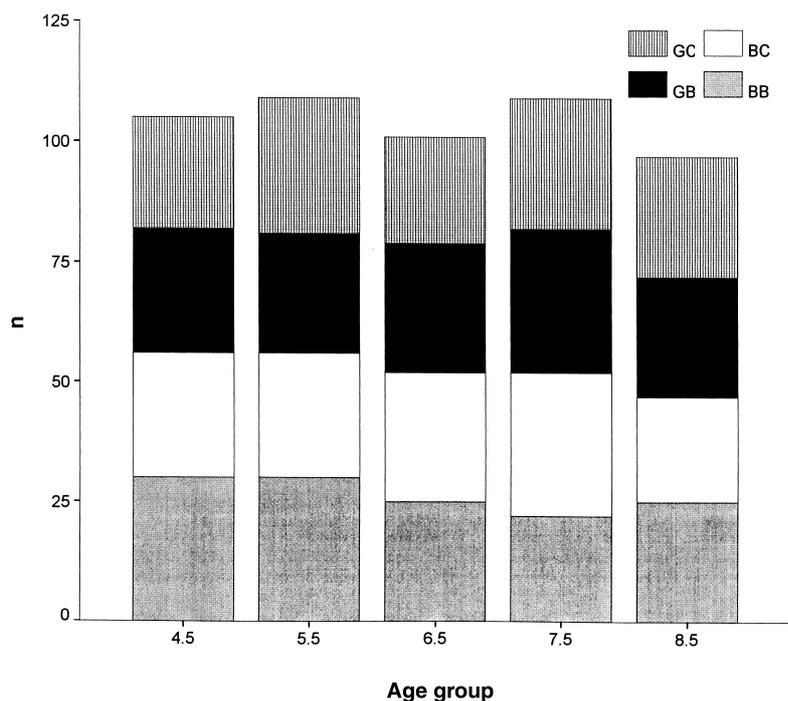


Fig. 1. Age, sex and ethnic distribution of sample. n = sample size, 4.5 = age group from 4.00 to 4.99 years, GC = girls white Caucasian, GB = girls Bangladeshi, BC = boys white Caucasian, BB = boys Bangladeshi.

DA and CA was tested using Student's *t*-test. Analyses were made for the entire group as well as for each cohort, i.e. age group with midpoint 4.5 = 4.00–4.99 years. First, DA–CA of each ethnic group was compared. Second, DA–CA for each ethnic group was compared to the Canadian standard. Third, data from both ethnic groups was combined and then compared to the standard. A regression line was fitted to the data for the whole group for each sex.

Intra-observer error was calculated by re-scoring 50 radiographs. The difference in dental age between the two readings was tested for significance with a paired *t*-test. Percentage agreement of the two readings was calculated and the remainder assessed for bias by counting the number of over and understage assessments.

Results

Intra-observer reproducibility was calculated by re-examining 50 radiographs. The difference between dental age and chronological age on the first and second readings was not significant. The percentage agreement at the second reading of stage assessments in a total of 350 teeth was 87%, with 22 one stage ahead and 25 one stage behind.

Comparison of the two ethnic groups in London

The mean difference between dental and chronological age of the two ethnic groups of children was not significantly different. This was true for the entire group as well as comparison of each cohort.

Comparison of each ethnic group separately to Canadian standard

When DA–CA for each ethnic group was compared to Demirjian's standard, both were significantly different ($P < 0.01$). Further analysis of each age cohort showed that most groups were significantly different (Table 1). The youngest white Caucasian girls (age group with midpoint 4.5 years) and the oldest Bangladeshi boys and girls (age group midpoint 8.5 years) were not significantly different from the Canadian standards.

Comparison of combined ethnic groups and Canadian standard

British children aged 4–8.99 years were found to be significantly advanced in dental maturation compared to the Canadian standard ($P < 0.01$). British girls were dentally advanced by 0.51 ± 0.79

Table 1. Dental maturation of white Caucasian and Bangladeshi children compared to Demirjian separately

Age group	White Caucasian				Bangladeshi			
	<i>n</i>	mean	sd	<i>P</i>	<i>n</i>	mean	sd	<i>P</i>
Girls								
4.5	23	0.36	0.97	ns	26	0.30	0.63	0.05
5.5	28	0.72	0.68	0.01	25	0.67	0.68	0.01
6.5	22	0.82	0.34	0.01	27	0.99	0.87	0.01
7.5	27	0.33	0.52	0.01	30	0.50	0.59	0.01
8.5	25	-0.04	0.71	ns	25	0.41	1.20	ns
Total	125	0.43	0.73	0.01	133	0.57	0.84	0.01
Boys								
4.5	26	1.10	0.67	0.01	30	0.91	0.87	0.01
5.5	26	0.88	0.56	0.01	30	1.08	0.68	0.01
6.5	27	0.71	0.57	0.01	25	0.77	0.45	0.01
7.5	30	0.39	0.45	0.01	22	0.56	0.63	0.01
8.5	22	0.62	1.06	0.05	25	0.20	0.79	ns
Total	131	0.73	0.71	0.01	132	0.73	0.76	0.01

Age groups: 4.5 = between 4.00 and 4.99 years, total = from 4.00 to 8.99 years. *n* = number of children, mean = mean difference between CA and DA in years, sd = standard deviation of mean difference, *P* = *P*-value <, ns = not significant.

Table 2. Dental maturation of British children compared to Demirjian's standards

Age group	<i>n</i>	mean	sd	se	<i>P</i>
Girls					
4.5	49	0.33	0.80	0.114	0.05
5.5	53	0.69	0.67	0.093	0.01
6.5	49	0.91	0.68	0.097	0.01
7.5	57	0.42	0.56	0.074	0.01
8.5	50	0.18	1.00	0.142	ns
Total	258	0.51	0.79	0.049	0.01
Boys					
4.5	56	1.00	0.78	0.105	0.01
5.5	56	0.99	0.63	0.084	0.01
6.5	52	0.74	0.51	0.071	0.01
7.5	52	0.46	0.53	0.074	0.01
8.5	47	0.40	0.94	0.138	0.05
Total	263	0.73	0.73	0.045	0.01

Age groups: 4.5 = between 4.00 and 4.99 years, total = from 4.00 to 8.99 years. *n* = number of children, mean = mean difference between CA and DA in years, sd = standard deviation of mean difference, *P* = *P*-value <, ns = not significant.

years and boys by 0.73 ± 0.73 years (Table 2). The difference between DA and CA is plotted against age for girls (Fig. 2) and boys (Fig. 3). Each dot represents one child; the smallest values (around zero) are children whose dental age is close to chronological age. Positive values are children who are dentally advanced; negative values delayed. The regression lines of the entire group of girls and also boys show a decreasing difference with age. Further analysis by age cohort suggests that the pattern of mean difference between DA and CA in girls is

different to that in boys (Fig. 4). The difference between DA and CA in boys decreased with age, while it peaked in the middle age group (6.00–6.99 years) for girls. All age cohort groups (except the oldest age group of girls) were significantly advanced in dental maturation compared to the standard.

Discussion

The first aim of this study was to compare dental development of two ethnic groups of children living in London. The developing dentition is known to be less sensitive to physiological insults (nutrition, endocrine) than the skeleton [20–24]. Growth of infants and young children from ethnic groups of the Indian subcontinent living in other parts of the UK is similar to national reference data [25–28]. In addition, growth of older local Bangladeshi children is also similar to the UK growth standards (personal communication, G. Snodgrass). The lack of any significant difference in dental maturation using Demirjian's method between white Caucasian and Bangladeshi children living in London for this age group is therefore unsurprising. Analysis of age cohorts show some groups to be dissimilar, which may reflect sampling.

The use of Demirjian's maturity scale has demonstrated differences between several worldwide groups [3–15] as well as between geographical areas or cities within the same country [16–18]. A number of other tooth formation standards have

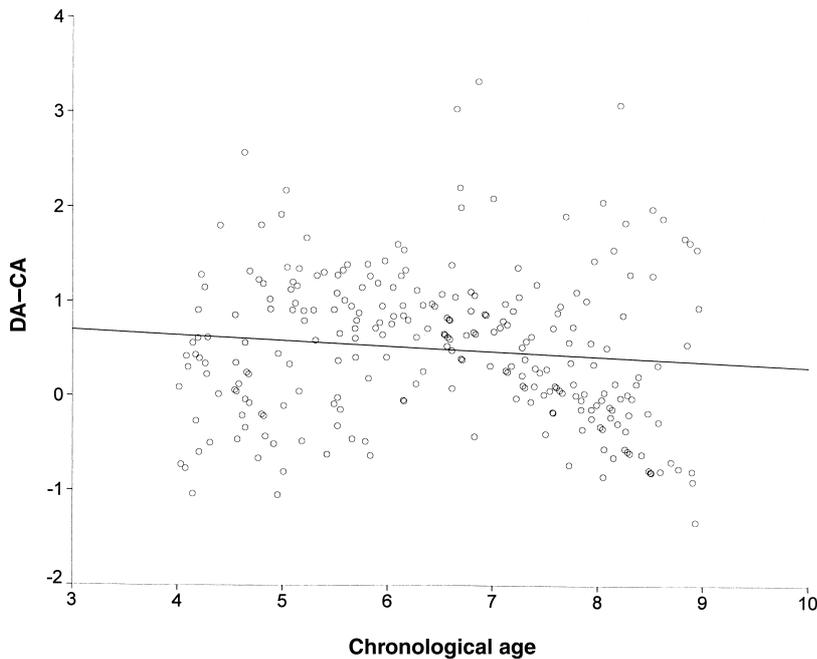


Fig. 2. Scatterplot of mean difference between dental age and chronological age for girls. DA-CA = difference between dental age and chronological age in years. Regression line for entire age group.

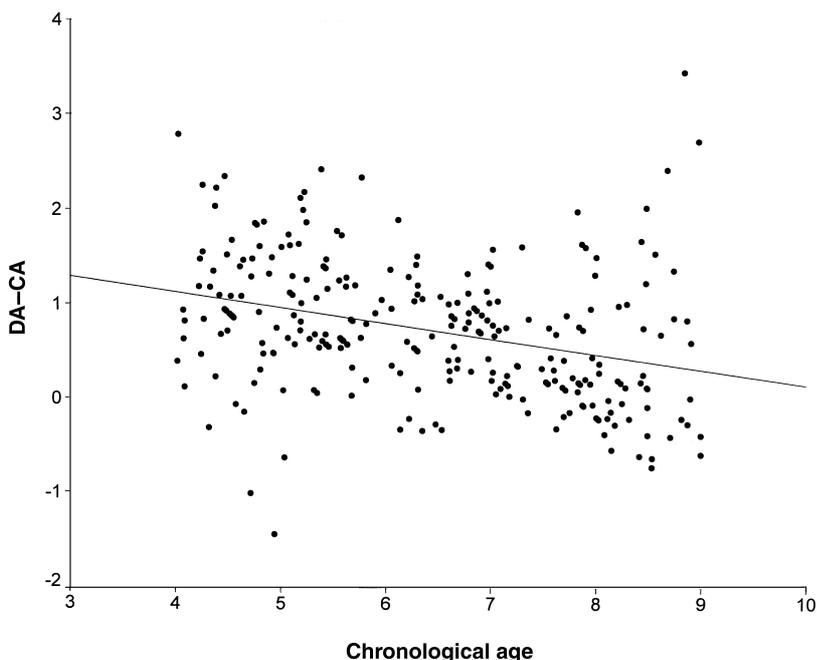


Fig. 3. Scatterplot of mean difference between dental age and chronological age for boys. DA-CA = difference between dental age and chronological age in years. Regression line for entire age group.

also been used to compare the developing dentition of one group of children to a standard [29–33]. However, differences between groups reflect not only the populations under study but also the accuracy of the method used to quantify dental growth, the method of age calculation or age groups, the age and sex distribution of both the standard and the study group as well as the

statistical methodology and type of study (cross-sectional or longitudinal). The interpretation of results from differing dental growth standards is hindered by these factors. This is overcome by direct comparison [16,17,34] or by calculating age-of-attainment data for each group [35,36].

The whole dentition may be advanced or delayed and a dental maturity scale obscures possible

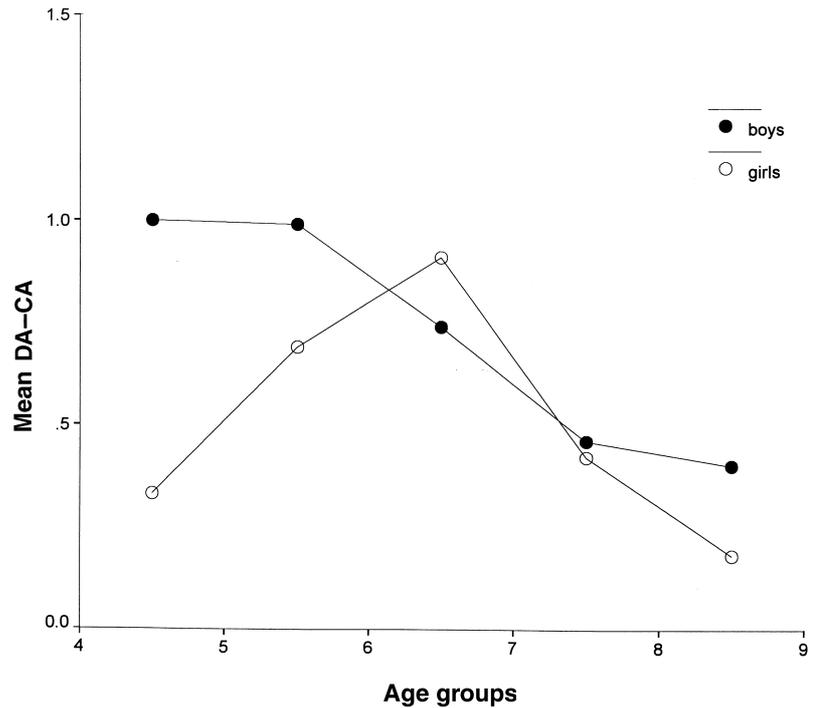


Fig. 4. Mean difference for girls and boys for each age cohort. Age = age cohorts with midpoint of age group: 4.5 = 4.00–4.99 years, mean DA-CA = difference between dental age and chronological age in years.

differences between individual teeth or tooth types. Development of the second and third molars relative to first permanent molars differs between Australian aboriginals and Northern European standards [34]. More recent analysis of relative development of individual teeth provides another avenue in measuring patterns of different ethnic groups [37].

The second aim of this study was to appraise the accuracy (and thus suitability) of this method for assessing dental maturation in British children. The accuracy of any method of assessing maturation is dependent on several factors; the most important of these is the precision of stage assessment. The method of Demirjian has high precision [38,39] with radiographic illustration, line drawings as well as several detailed descriptive criteria for each stage. British children for this age group were significantly advanced in dental maturation; a finding that mirrors recent findings [3–15]. This may be partly explained by a positive secular trend during the last 25 years. An interesting finding is that advancement in dental maturation appears to decrease between 4 and 9 years of age. Although the sample size of each age cohort was small, further analysis of the data for girls suggests a more complex pattern indicating that further investigation of tooth formation in British children is warranted. These results question the suitability of Demirjian's standards for British

children on a population level and supports the need for population specific standards.

Résumé. *But.* Le but de cette étude a été de déterminer si les standards de maturation dentaire de Demirjian et co. (1973, 1976) sont applicables aux enfants britanniques.

Protocole. Le protocole a été une rétrospective transversale.

Echantillons et Méthodes. L'échantillon a été de 521 enfants du Bangladesh et d'origine blanche caucasienne (Anglais, Gallois et Ecosseis) âgés de 4 à 8,99 années. L'âge dentaire a été déterminé d'après les étapes de développement des couronnes et des racines de 7 dents mandibulaires d'après les radiographies panoramiques. L'âge dentaire a été comparé à l'âge chronologique à l'aide du t-test.

Résultats. Les différences de maturation dentaire entre les deux groupes ethniques n'étaient pas significatives. Les enfants britanniques en tant que groupe étaient en avance du point de vue dentaire comparé avec les standards caucasiens. L'avance moyenne (\pm la déviation standard) chez les filles était de $0,51 \pm 0,79$ années et chez les garçons de $0,73 \pm 0,73$ années.

Conclusions. Les standards de maturation dentaire décrits par Demirjian et co. (1973, 1976) pourraient ne pas être applicables aux enfants britanniques.

Zusammenfassung. Ziele. Bestimmung ob die Reifungsstandarte von Demirjian *et al.* (1973, 1976) noch für britische Kinder anwenbar sind.

Design. Retrospektive- kreuzsektionale Studie.

Sample & Methode. 521 Kinder aus London aus Bangladesch und weisse Kinder (Englisch Welsh und Skottisch). von 400 bis 8,99 Jahre alt. Das Zahnalter wurde bestimmt mittels Kronen und Wurzelstadien von 7 mandibularen Zähne anhand von pantomographischen Röntgenbilder. Das Zahnalter wurde mit dem chronologischen Alter mittels des z-Test verglichen.

Resultate. Die Unterschiede der Zahnreifung zwischen den beiden ethnischen Gruppen war signifikant. Die britischen Kinder waren reifer verglichen mit den kanadischen Standarte. Die mittlere Standart Deviation war bei den Mädchen $0,51 \pm 0,79$ und bei den Buben $0,73 \pm 0,73$.

Schlussfolgerungen. Die Standarte der Zahnreifung nach Demirjian *et al* sind nicht mehr anwendbar für britische Kinder.

Resumen. *Objetivo.* El objetivo de este estudio fue determinar si el modelo de maduración dental de Demirjian y col. (1973, 1976) es aplicable a los niños ingleses.

Diseño. El diseño fue transversal, retrospectivo.

Muestra y método. La muestra fue de 521 niños londinenses de Bangladesh y blancos caucásicos de origen (inglés, galés y escocés) de entre 4,00 y 8,99 años de edad. La edad dental se valoró por los estadios de corona y raíz de 7 dientes de la arcada inferior a partir de pantomografías rotacionales. La edad dental se comparó con la edad cronológica usando el test de la t.

Resultados. Las diferencias en la maduración dental entre los dos grupos étnicos no fue significativa. Los niños ingleses como grupo estaban adelantados dentalmente comparados con los estándares canadienses. La media (\pm desviación estándar) de adelanto en niñas fue de $0,51 \pm 0,79$ años y en niños fue de $0,73 \pm 0,73$ años.

Conclusiones. Los estándares de maduración dental descritos por Demirjian y col. (1973, 1976) pueden no ser aplicables para los niños británicos.

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