Quantitative Evaluation of Variance in Secondary Dentition Eruption Among Ethnic Groups in Hawai'i

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Abstract: Though little scientific evidence existed to support the belief among dentists who treat Pacific Islander populations that many children of the region erupt secondary teeth earlier and at an eruption rate which exceeds Caucasian children. Based upon a data set created in Hawai'i during the 1998-1999 school year, of 26,097public school children, the opportunity presented itself to examine for variance in eruption timing and sequence. Hawai'i is an ethnic diverse community, with a majority population comprised of Asians and Pacific Islanders. Children, 5 through 9 years of age, were examined for gender and ethnic variance. In the aggregate, at all ages, girls erupted teeth earlier than boys, however, while generally true among individual tooth types, that variance was not always statistically significant. By ethnic group, African Americans exhibited earlier eruption by contrast with Caucasians, however, Caucasian children caught up by nine years of age. Native Hawaiian, Samoan and Tongan children exhibited earlier and high rates of secondary dentition eruption than Caucasian or African American children. Children of various Asian cohorts did not exhibit significant variance by contrast with Caucasians. Based upon these findings, the authors recommend that dietary fluoride supplementation of Native Hawaiian, Samoan and Tongan children begin at birth rather than 6 months of age and that these children be targeted for pit & fissure sealants as early as five years of age.(PHD, 2003; 10 (1), Pages 45-50)

Introduction

Hawai'i holds the distinction of being the only state in the nation where Asians and Pacific Islanders comprise the ethnic majority. Based upon the 2000 United States Census, 51.0 percent of the State population fall into this category. This is a decline from the 61.8 percent reported by the 1990 United States (U.S.) Census. Based upon the 2000 Census, Caucasians, at 24.3 percent of the total resident population represent the largest (unmixed) single ethnic group, followed by Japanese (16.6 percent), Filipinos (14.1 percent), Hispanics (7.2 percent), Chinese (4.6 percent) and Koreans (1.9 percent). Persons of mixed ethnic background account for 21.4 percent of Hawai'i's population. Native Hawaiians (pure and part Hawaiians) and (non-Asian) Pacific Islanders account 6.6 percent and 2.8 percent of Hawai'i's resident population, respectively.[1]

Children in Hawai'i have been shown to suffer from disproportionately high rates of dental caries by contrast with their U.S. mainland counterparts. Standardized oral health surveys have also demonstrated significant variance in caries prevalence, unmet treatment needs and preventive service utilization among Hawaii's ethnically diverse population.[2, 3, 4] Comprehensive Statewide oral health assessments of public school children have also found higher caries prevalence rates in the primary dentition of boys by contrast with girls and higher caries prevalence rates in the secondary dentition of girls by contrast with boys. This is a typical finding in community caries prevalence studies and is attributable, in part, to variance in eruption timing.[5, 6]

Anecdotal reports have suggested that there is significant variance among Hawai'i's ethnically and culturally diverse population in the sequence and rates of eruption of secondary teeth. A common belief among dental providers in Hawai'i is that children of Pacific Islander ancestry, erupt secondary teeth far earlier and more rapidly than Caucasian and Asian children. Baume noted that contemporary Polynesian children tend to erupt their permanent molars 1-2 years earlier than their European counterparts and a few reports have been published relating to variance in eruption sequencing and timing among Asian and American populations.[7, 8, 9, 10, 11, 12]

Through this project, standardized data sets were analyzed for a variety of indicators of secondary tooth eruption, including timing, sequencing and quantity over time in search of variance among ethnic groups. The identification of eruption variance among ethnic groups may be used in consideration of updating industry standards and policy associated with the placement of dental sealants and the implementation of dietary fluoride supplementation schedules. In addition, findings may contribute the knowledge base associated with comparative odontology.

Methods

This cross-sectional study is based upon an analysis of a computerized data set including 26,097 standardized oral health examinations conducted and collected by calibrated public health dental hygienists employed by the Hawai'i State Department of Health during the 1998-1999 school year. The data was analyzed for mean number of all erupted secondary teeth, mean number of erupted secondary teeth by tooth type and the proportion of children with at least one erupted tooth by tooth type; all by age and ethnic group. The data was analyzed for children ages 5, 6, 7, 8 and 9.

A determination of ethnic background was made by a combination of the subjective opinion of the dental hygienist observers and information solicited from children and school officials. With the exception of Native Hawaiian children, which included pure and part Hawaiian children regardless of blood quantum, and Southeast Asians, which collectively included Vietnamese, Laotian, Cambodian, Indonesian, Thai and other children of regional ancestral origin, the remaining ethnic categories were limited to children who were ethnically pure. For the purposes of most of this report, ethnically mixed children were excluded from the data set. That set included 562

African American children, 3,698 Caucasians, 615 Chinese, 486 Hispanics, 4,964 Filipinos, 223 Koreans, 1,536 Japanese, 7,526 Native Hawaiians, 1,060 Samoans, 284 Southeast Asians and 312 Tongans. Overall, the sample included 61 percent males and 39 percent females.

Teeth were identified as erupted when the clinical crown met observational criteria for standardized caries prevalence surveys. These criteria included exposure of the entire occlusal surface of posterior teeth (pre-molars and molars) and at least one-third of the anatomic crown of anterior teeth (incisors and cuspids). The age of children was identified as 'age in years at the child's last birthday'. Data was analyzed contrasting variables by gender and contrasting various ethnic groups against Caucasians as the benchmark for comparison. Variance was considered statistical significance where *pd" 0.05* and confidence intervals were calculated at 95 percent.

Results

As shown in Table 1, at all ages evaluated, girls had erupted a greater mean number of secondary teeth than boys and at all ages, that variance was statistically significant ($p< 0.001$). In this case, data presented include all boys and all girls in the available data set, including mixed race/mixed ethnic group children. Generally, variance in mean by tooth-type between girls and boys existed, with girls having more erupted secondary teeth than boys. Such findings are consistent with findings in previous reports.[10, 11]

An examination of the mean number of all erupted secondary teeth by age and ethnic group, shown in Table 2 and Figure 1, shows that African American, Native Hawaiian, Samoan and Tongan children had rates of secondary tooth eruption which exceeded those found in Caucasian children. For ages 5 through 9, children of Hispanic, Chinese, Korean and Japanese ancestry exhibited a mean variance, which varied with no discernible pattern, however, that variance was not statistically significant ($p>0.05$). Filipino children demonstrated a statistically lower mean number of teeth at 9 years of age. Likewise, Southeast Asian 6 year olds exhibited fewer secondary teeth than Caucasian 6 year olds. Significant variance between African Americans and Caucasians disappeared by 9 years of age. Eruption rates in African American children, which exceeded those found among Caucasians, were significantly lower than those found in Samoan and Tongan children, throughout the age group examined. While the mean rates among Native Hawaiians exceeded those found among African Americans, the difference was not statistically significant until age 9.

By comparison with the other ethnic groups examined, overall, children of Native Hawaiian, Samoan and Tongan ancestry demonstrated significantly higher rates of secondary tooth emergence than other children in Hawai'i. Tables 3, 4 and 5 show rates, which exceed African American, Caucasian and Asian groups. Data among Native Hawaiians, Samoans and Tongans reflect earlier emergence, as evident by higher proportions of children with at least one erupted tooth by tooth-type, shown in Table 6, combined with a higher rates of eruption, shown in Tables 2, 3, 4 and 5, with mean numbers of erupted secondary teeth which fail to converge in pre-adolescence with other ethnic groups. Depending upon tooth-type, either Samoan or Tongan children account for the highest proportion of children with erupted secondary teeth for each tooth-type presented, shown in Table 6. Fewer Caucasian children appear to have erupted secondary teeth in early childhood by contrast with African American children, however, they appear to catch up to and bypass African American children in later childhood.

Table 1 Variance Between Boys and Girls in Mean Number of Erupted Secondary Teeth, by Age in Years

	n	5 Year Olds	6 Year Olds	7 Year Olds	8 Year Olds	9 Year Olds
Boys	2,571	1.11 (1.03, 1.19)	4.79 (4.68, 4.91)	8.82 (8.71, 8.92)	11.63 (11.54, 11.72)	13.87 (13.59, 14.12)
Girls	2,539	1.62 (1.52, 1.71)	5.72 (5.60, 5.85)	9.82 (9.73, 9.92)	12.62 (12.50, 12.73)	15.20 (14.87, 15.53)
		$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

95% Confidence Level

Figure 1 Mean Number of Erupted Secondary Teeth Over Time

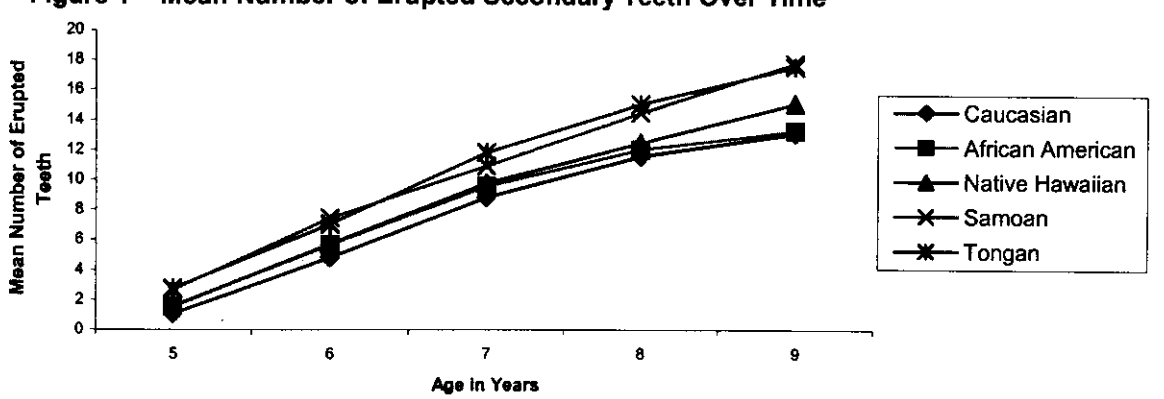

Table 2 Variance by Contrast With Caucasians Benchmark for Mean Number of Erupted Secondary Teeth

			Hispanic	Chinese	Korean	Japanese
5 Years of Age	Caucasians	1.08 (± 0.13)	1.36 (± 0.42) *	0.94 (± 0.28) *	1.05 (± 0.52) *	0.99 (± 0.20) *
6 Years of Age	Caucasians	4.81 (± 0.21)	4.75 (± 0.60) *	4.32 (± 0.53) *	5.44 (± 0.88) *	4.52 (± 0.34) *
7 Years of Age	Caucasians	8.83 (± 0.18)	8.39 (± 0.60) *	8.60 (± 0.50) *	9.26 (± 0.78) *	8.78 (± 0.31) *
8 Years of Age	Caucasians	11.58 (± 0.16)	11.48 (± 0.41) *	11.37 (± 0.39) *	12.17(± 0.68) *	11.77 (± 0.27) *
9 Years of Age	Caucasians	13.09 (± 0.40)	13.30 (± 1.02) *	12.84 (± 01.36) *	13.29 (± 2.05) *	13.82 (± 0.89) *

			African American	Filipino	Southeast Asian	Native Hawaiian	Samoan	Tongan
5 Years of Age	Caucasians	1.08 (± 0.13)	1.55 (± 0.40) *p < 0.02*	1.10 (± 0.12) *	1.24 (± 0.59) *	1.60 (± 0.13) *p < 0.001*	2.65 (± 0.38) *p < 0.001*	2.78 (± 0.77) *p < 0.001*
6 Years of Age	Caucasians	4.81 (± 0.21)	5.64 (± 0.56) *p < 0.005*	4.87 (± 0.19) *	3.85 (± 0.81) *p < 0.02*	5.73 (± 0.16) *p < 0.001*	7.44 (± 0.38) *p < 0.001*	7.01 (± 0.75) *p < 0.001*
7 Years of Age	Caucasians	8.83 (± 0.18)	9.56 (± 0.49) *p < 0.01*	8.91 (± 0.16) *	8.69 (± 0.57) *	9.76 (± 0.12) *p < 0.001*	10.92 (± 0.33) *p < 0.001*	11.81 (± 0.68) *p < 0.001*
8 Years of Age	Caucasians	11.58 (± 0.16)	12.03 (± 0.53) *p < 0.05*	11.70 (± 0.15) *	11.89 (± 0.58) *	12.46 (± 0.13) *p < 0.001*	14.45 (± 0.46) *p < 0.001*	15.04 (±1.01) *p < 0.001*
9 Years of Age	Caucasians	13.09 (± 0.40)	13.27 (± 0.87) *	14.58 (± 0.51) *p < 0.001*	14.19 (± 1.29) *	15.10 (± 0.39) *p < 0.001*	17.80 (± 1.35) *p < 0.001*	17.56 (± 1.78) *p < 0.001*

Variance is statistically significant where p 0.05
Confidence Interval calculated at 95%
* *p>0.05*

Table 3 Mean Number of All Erupted Secondary Teeth, Contrast by Gender Among 6 Year Olds

	African American	Caucasian	Chinese	Hispanic	Filipino	Korean	Japanese	Native Hawaiian	Samoan	Southeast Asian	Tongan
Mandibular 1st Molars											
Boys	1.24(0.94)	1.20 (0.95)	1.30 (0.89)	1.17(0.92)	1.31 (0.91)	1.44 (0.89)	1.15 (0.94)	1.42 (0.88)	1.71 (0.69)	0.98 (0.96)	1.68 (0.70)
Girls	1.59(0.75)	1.44 (0.87)	1.23 (0.94)	1.42 (0.90)	1.53 (0.81)	1.67 (0.73)	1.34 (0.91)	1.63 (0.75)	1.89 (0.39)	1.00 (0.98)	1.75 (0.61)
	p <0.02	*p<0.001*	*	*	*p<0.001*	*	*p<0.05*	*p<0.001*	*p<0.01*	*	*
Maxillary 1st Molars											
Boys	1.00(0.99)	1.11 (0.95)	0.96 (0.95)	1.10 (0.97)	1.08 (0.95)	0.89 (0.97)	0.89 (0.94)	1.28 (0.92)	1.61 (0.75)	0.95 (0.95)	1.47 (0.83)
Girls	1.35(0.90)	1.27 (0.93)	0.85 (0.95)	1.13 (0.97)	1.25 (0.92)	1.62 (0.74)	0.98 (0.97)	1.44 (0.85)	1.67 (0.68)	0.79 (0.95)	1.45 (0.82)
	p<0.05	*p<0.02*	*	*	*p<0.002*	*p<0.005*	*	*p<0.001*	*	*	*
Mandibular Centrals											
Boys	1.59 (0.79)	1.37 (0.90)	1.26 (0.94)	1.38 (0.90)	1.25 (0.94)	1.41 (0.89)	1.26 (0.95)	1.41 (0.89)	1.65 (0.73)	1.19 (0.95)	1.79 (0.58)
Girls	1.78 (0.61)	1.43 (0.88)	1.25 (0.94)	1.40 (0.88)	1.44 (0.87)	1.81 (0.60)	1.38 (0.90)	1.59 (0.79)	1.84 (0.52)	1.15 (0.96)	1.70 (0.70)
	*	*	*	*	*p<0.001*	*	*	*p<0.001*	*p<0.02*	*	*
Maxillary Centrals											
Boys	0.61 (0.89)	0.40 (0.76)	0.32 (0.71)	0.42 (0.81)	0.36 (0.72)	0.44 (0.75)	0.40 (0.77)	0.60 (0.87)	0.88 (0.94)	0.46 (0.81)	0.97 (0.97)
Girls	0.61 (0.89)	0.53 (0.84)	0.51 (0.85)	0.56 (0.90)	0.52 (0.83)	0.47 (0.81)	0.57 (0.85)	0.79 (0.93)	1.11 (0.95)	0.26 (0.67)	0.84 (0.91)
	*	*p<0.02*	*	*	*p<0.001*	*	*	*p<0.001*	*	*	*
Mandibular Laterals											
Boys	0.51 (0.83)	0.33 (0.70)	0.33 (0.67)	0.27 (0.69)	0.38 (0.74)	0.48 (0.80)	0.42 (0.78)	0.48 (0.81)	0.82 (0.96)	0.29 (0.68)	0.74 (0.95)
Girls	0.75 (0.93)	0.44 (0.79)	0.54 (0.83)	0.52 (0.84)	0.56 (0.86)	0.71 (0.90)	0.57 (0.85)	0.67 (0.90)	1.14 (0.93)	0.26 (0.62)	1.04 (0.96)
	*	*p<0.05*	*	*	*p<0.001*	*	*	*p<0.001*	*p<0.01*	*	*

Variance is statistically significant where p ? 0.05
* *p > 0.05*

Table 4 Among 6 Year Olds, Variance by Contrast With Caucasian Benchmark in Mean (s.d.) Number of Erupted Teeth, by Tooth Type

	African American	Chinese	Hispanic	Filipino	Korean	Japanese	Native Hawaiian	Samoan	Southeast Asian	Tongan
Mandibular 1st Molars Caucasians 1.32 (0.92)	1.40 (0.88) *	1.27 (0.91) *	1.29 (0.91) *	1.40 (0.87) *p<0.05*	1.54 (0.82) *	1.24 (0.93) *	1.51 (0.83) *p<0.001*	1.81 (0.55) *p<0.001*	1.00 (0.97) *p<0.005*	1.72 (0.65) *p<0.001*
Maxillary 1st Molars Caucasians 1.19 (0.94)	1.16 (0.97) *	0.91 (0.95) *p<0.002*	1.11 (0.96) *	1.16 (0.94) *	1.21 (0.94) *	0.93 (0.95) *p<0.001*	1.35 (0.89) *p<0.001*	1.64 (0.71) *p<0.001*	0.87 (0.94) *p<0.005*	1.46 (0.82) *p<0.02*
Mandibular Centrals Caucasians 1.40 (0.89)	1.68 (0.72) *p<0.001*	1.26 (0.94) *	1.39 (0.89) *	1.34 (0.91) *	1.58 (0.79) *	1.31 (0.92) *	1.49 (0.85) *p<0.02*	1.75 (0.63) *p<0.001*	1.16 (0.95) *p<0.05*	1.74 (0.64) *p<0.001*
Maxillary Centrals Caucasians 0.46 (0.80)	0.61 (0.89) *p<0.05*	0.39 (0.77) *	0.49 (0.85) *	0.44 (0.77) *	0.46 (0.77) *	0.48 (0.81) *	0.68 (0.90) *p<0.001*	1.01 (0.95) *p<0.001*	0.39 (0.77) *	0.90 (0.94) *p<0.001*
Mandibular Laterals Caucasians 0.38 (0.75)	0.62 (0.88) *p<0.001*	0.41 (0.74) *	0.39 (0.78) *	0.46 (0.80) *p<0.05*	0.58 (0.85) *	0.49 (0.82) *p<0.02*	0.57 (0.86) *p<0.001*	1.00 (0.95) *p<0.001*	0.28 (0.64) *	0.90 (0.96) *p<0.001*

* *p>0.05*
s.d. standard deviation

Table 5 Among 8 Year Olds, Variance by Contrast With Caucasian Benchmark in Mean (s.d.) Number of Erupted Teeth, by Tooth Type

	African American	Chinese	Hispanic	Filipino	Korean	Japanese	Native Hawaiian	Samoan	Southeast Asian	Tongan
Mandibular 1st Molars Caucasians 1.99 (0.10)	2.00 (0.00) *	1.98 (0.12) *	2.00 (0.00) *	1.99 (0.14) *	1.98 (0.13) *	1.98 (0.22) *	1.99 (0.12) *	2.00 (0.00) *	2.00 (0.00) *	2.00 (0.00) *
Maxillary 1st Molars Caucasians 1.96 (0.16)	1.98 (0.12) *	1.94 (0.32) *p<0.01*	1.99 (0.09) *	1.97 (0.22) *	1.93 (0.26) *p<0.02*	1.97 (0.21) *	1.99 (0.14) *	2.00 (0.06) *	1.99 (0.11) *	1.97 (0.24) *
Mandibular Centrals Caucasians 1.99 (0.13)	2.00 (0. 00) *	1.98 (0.19) *	2.00 (0.00) *	1.99 (0.14) *	1.98 (0.13) *	1.98 (0.19) *	1.99 (0.11) *	1.98 (0.12) *	2.00 (0.00) *	2.00 (0.00) *
Maxillary Centrals Caucasians 1.91 (0.38)	1.90 (0.39) *	1.848 (0.49) *p<0.05*	1.84 (0.51) *	1.88 (0.43) *	1.89 (0.41) *	1.89 (0.43) *	1.94 (0.32) *	1.99 (0.13) *p<0.002*	1.89 (0.39) *	1.97 (0.17) *
Maxillary Laterals	1.41 (0.88)	1.31 (0.92)	1.14 (0.88)	1.16 (0.92)	1.51 (0.78)	1.40 (0.87)	1.50 (0.82)	1.72 (0.63)	1.10 (0.95)	1.75 (0.66)

Table 6 Percentage of Children With At Least One Erupted Secondary Tooth, By Tooth Type

	Caucasian	African American	Chinese	Hispanic	Filipino	Korean	Japanese	Native Hawaiian	Samoan	Southeast Asian	Tongan
5 Years of Age											
Mandibular 1st Molars	19.5 %	24.6 %	17.4 %	20.2 %	25.1 %	18.4 %	19.5 %	33.2 %	49.5 %	23.7 %	56.2 %
Maxillary 1st Molars	15.6	18.5	12.3	19.3	16.4	15.8	11.9	36.8	41.3	21.1	32.8
Mandibular Centrals	21.8	33.1	18.7	30.2	17.3	26.3	19.8	27.8	39.4	28.9	39.1
6 Years of Age											
Maxillary Centrals	26.6	33.6	21.7	25.1	25.9	29.2	27.7	38.5	55.4	22.4	51.2
Mandibular Laterals	22.3	35.6	26.3	21.3	26.5	35.4	28.5	32.2	54.6	17.1	35.5
7 Years of Age											
Maxillary Laterals	29.6	36.5	22.0	26.0	23.2	39.4	26.5	39.9	57.3	18.9	61.5
8 Years of Age											
Maxillary 1st Bicuspids	11.2	11.8	11.8	13.3	20.9	21.0	12.9	23.6	44.5	18.7	47.1
Mandibular 1st Bicuspids	8.0	8.7	10.3	9.7	13.5	17.5	8.8	19.1	39.8	17.3	45.6
9 Years of Age											
Maxillary 2nd Bicuspids	20.9	6.7	12.9	11.1	21.4	0.0	8.8	23.0	41.7	19.0	33.3
Mandibular 2nd Bicuspids	8.4	3.3	9.7	3.8	22.6	7.1	11.8	21.7	46.7	14.3	55.6
Maxillary Cuspids	8.8	6.7	6.4	11.1	16.3	14.3	19.1	20.7	40.0	9.5	50.0
Mandibular Cuspids	15.8	20.0	29.0	16.5	34.5	35.7	35.3	39.4	58.3	28.6	66.7

Centrals *central incisors – U.S. tooth numbering 8, 9, 24 & 25 and F.D.I./W.H.O. numbering 11, 21, 31 & 41*
Laterals *laterals incisors – U.S. tooth numbering 7, 10, 23 & 26 and F.D.I./W.H.O. numbering 12, 22, 32 & 42*

Table 7 Predominant Sequence of Eruption Among Secondary Teeth

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
All Girls	3L	8L	3U	8U	7L	7U	5U	5L	6L	6U	4U	4L	2L	2U
All Boys	3L	8L	3U	8U	7L	7U	5U	5L	6L	4U	4L	6U	2L	2U
Caucasian	3L	3U	8L	8U	7L	7U	5U	5L	6L	6U	4L	4U	2L	2U
African American	8L	3L	3U	7L	8U	7U	6L	5U	5L	6U	4U	4L	2L	2U
Chinese	8L	3L	3U	7L	8U	7U	6L	5U	5L	4U	4L	6U	2L	2U
Hispanic	8L	3L	3U	8U	7L	7U	5U	6L	5L	6U	4U	4L	2L	2U
Filipino	3L	8L	3U	7L	8U	7U	5U	5L	6L	4U	6U	4L	2L	2U
Korean	8L	3L	3U	7L	8U	7U	6L	5L	5U	6U	4L	4U	2L	2U
Japanese	8L	3L	3U	8U	7L	7U	5U	6L	5L	6U	4U	4L	2L	2U
Native Hawaiian	3L	8L	3U	8U	7L	7U	5U	5L	6L	4U	4L	6U	2L	2U
Samoan	3L	8L	3U	7L	8U	7U	5U	5L	6L	4L	4U	6U	2L	2U
Southeast Asian	8L	3L	3U	8U	7L	7U	5U	5L	6L	4U	4L	6U	2L	2U
Tongan	3L	8L	3U	8U	7L	7U	5U	5L	6L	4L	4U	6U	2L	2U

Utilizing a quadrant tooth numbering system, U = maxillary, L = mandibular, 8 = central incisors, 7 = lateral incisors, 6 = cuspids, 5 = 1st bicuspids, 4 = 2nd bicuspids, 3 = 1st molars and 2 = 2nd molars

cuspids. A clear tendency towards the eruption of mandibular teeth prior to their maxillary counterparts was evident in both gender and all ethnic groups, with the exception of bicuspids, which often exhibited maxillary precedence.

Discussion

Findings identify a higher overall rate of secondary (permanent) tooth eruption in girls, at all ages examined, than boys. However, by tooth-type, for many ethnic groups, the variance between girls and boys was statistically insignificant. From a community health planning and policy perspective, higher rates among girls (gender variance) was not demonstrated to be significant enough to warrant special consideration with regards to the implementation and management of disease prevention or dental treatment strategies.

On the other hand, the findings of this project support, in a quantified manner, previous reports of advanced secondary dentition emergence among Pacific Islanders in French Polynesia and speculation that the norms of tooth eruption among other Pacific Islanders groups may also differ from those of European or Asian ancestral cohorts. In general, Native Hawaiian (regardless of blood quantum), Samoan and Tongan children were shown to exhibit secondary tooth eruption timing which was earlier and eruption rates which were significantly greater than those seen in Hawai'i public school children of European, African or Asian lineage. Early tooth eruption and early tooth development, by contrast with the (Western) Caucasian benchmark, should be a factor considered when planning and implementing dental disease prevention programs targeting children of Native Hawaiian, Samoan and Tongan heritage.

Since this analysis did not adjust other factors, which might influence secondary tooth eruption, it can not be concluded that ethnic heritage alone is the deciding factor which influences eruption. More research needs to be done in consideration of the influence of anthropomorphic, cultural and environmental influences on the emergence of secondary teeth as well as possible correlations with the sequence and timing of eruption and exfoliation of the primary dentition. However, based upon the consistency of findings among the various indicators analyzed for this project, we feel that ethnic

findings support a need for earlier preventive services intervention, including the placement of dental (pit & fissure) sealants on the vulnerable surfaces of permanent posterior teeth, among Native

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