

Prevalence of Hypodontia in 10- to 14-Year-Olds Seeking Orthodontic Treatment at a Group of Clinics in Puerto Rico

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Objective: To estimate the prevalence of hypodontia in a group of 10- to 14-year-olds from a group of orthodontic clinics in Puerto Rico.

Methods: A cross-sectional study was conducted to estimate the prevalence of hypodontia in 10- to 14-year-olds from orthodontic clinics located in each of 9 regions (as determined by the government-run health insurance program, Reforma) in Puerto Rico. A total of 1,911 patients, ranging in age from 10 to 14 years, were evaluated using patient charts covering from May 2004 through June of that same year. A logistic regression model was done to evaluate the relation between the prevalence of hypodontia in the study group and clinic location, gender, and age; a 5% significance level was used.

Results: The overall weighted prevalence of hypodontia was 6.02%. Females showed a higher weighted prevalence of hypodontia than did males (7.02% vs. 4.72%, respectively; $p=0.06$). The prevalence also varied by geographic region, ranging from 3.21% at the San Juan clinic to 10.68% at the Aibonito clinic ($p=0.01$). The most prevalent missing teeth were the maxillary lateral incisors, followed by the lower second premolars (1.9%).

Conclusion: The prevalence of hypodontia in Puerto Rico was 6.02%. Females presented a higher prevalence of hypodontia than did males. Each of the clinics in Fajardo, Bayamón, San Juan, and Guayama had a lower prevalence of hypodontia than the Aibonito clinic did. The tooth most frequently missing in the study group was the maxillary right lateral incisor. [*P R Health Sci J* 2014;33:9-13]

Key words: Hypodontia, Agenesis, Prevalence, Tooth hypodontia, Cross-sectional study, Puerto Rico

Non-syndromic hypodontia of the permanent teeth, defined as the congenital absence of 1 or more teeth, is the most common developmental dental anomaly in humans (1-2). It ranges in prevalence from 2.7% to 6.9% (3). The variability observed in these studies may be attributed to differences in genetic background and the prevalence of other risk factors in these populations (3-4).

Hypodontia leads to dental malposition, a lack of development of the alveolar bone (height and width), and periodontal damage as well as functional and aesthetic problems (5). Thus, dental management of hypodontia presents a challenge for dental health practitioners (6-7). Therefore, the early detection of hypodontia is an essential factor in the diagnosis and treatment planning for said practitioners. Additionally, orthodontists should consider patient age, the developmental stages of adjacent teeth, and the condition of the primary teeth (7).

Previous studies have demonstrated there to be a higher prevalence of hypodontia in females than in males (5, 8-10). Others have argued that various mutated genes are risk factors for hypodontia (11), pointing out problems of the MSX1 gene located on the 4p chromosome, critical to abnormal

development of teeth (2,11-12). Furthermore, environmental exposures in the form of rubella, drugs, irradiation, trauma, and osteomyelitis, among others, as well as hormonal and metabolic influences, are suggested to be risk factors for hypodontia (7, 12, 13). In addition, evolutionary factors have been postulated as a potential explanation for this trait (13).

Several investigators have reported the upper second premolar as being the most frequently missing tooth (8), whereas various studies have observed the lower second premolar to be the most commonly missing tooth (1, 2, 5, 10-14). In a study of Mexican subjects with hypodontia, the third molar was determined to be the most commonly missing tooth, followed by the upper lateral

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The authors have no conflicts of interest to disclose.

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incisor and, after that, the lower second premolar (15). However, studies of Swedish and Singaporean Chinese subjects have reported that the lower central incisors are the most likely to be missing in those populations (16, 17). Rose (14) noted that the tooth that most consistently failed to develop in his hypodontic population was the lower second premolar. More recently, in a meta-analysis by Polder, the lower second premolar was found to be the most frequently missing tooth in 6 out of 9 surveys, which was followed by the upper lateral incisor in the other 3 surveys. He also reported that hypodontia of the canines, upper central incisors, and upper and a lower first molar is rare (5).

Bäckman (16) reported that hypodontia is 3 times more common in the mandible than in the maxilla. Arte (11) stated that 81% of unilateral cases of hypodontia affected the left side of the mandible. Nevertheless, Mok (17) has noted there to be a greater number of third molars missing in the maxilla (61.5%) than in the mandible (38.5%).

To the best of our knowledge, there has not been a study that adequately describes the prevalence of hypodontia in Puerto Rico; given that, the aims of this study were to estimate the prevalence of hypodontia in a group of 10- to 14-year-olds in Puerto Rico and describe its distribution by different socio-demographic groups.

Methods

To estimate the prevalence of hypodontia in Puerto Rico, an epidemiological cross-sectional study was performed from May through June 2004. One orthodontic clinic from each of the 9 health regions (as determined by Reforma, the government-run health insurance program) in Puerto Rico was selected by convenience in order to have spatial variation.

A simple random sample of patient charts within each clinic was selected to assess the prevalence of hypodontia. A list was prepared in each clinic using the subjects' record numbers; from this, a random sample was selected using patient ID numbers. The program Excel was used to randomly select patient IDs.

The sample size was calculated using the expected 7.0% prevalence of hypodontia, a 99.74% confidence level, and a maximum tolerable error of 2.0% (18). Examiner A analyzed patient X-rays from 7 clinics (67.2% of all patient records), whereas Examiner B evaluated the remaining 32.8% of patient X-rays from the Bayamón and Caguas clinics. The research protocol was approved by the IRB Committee of the Medical Sciences Campus, University of Puerto Rico.

Inclusion and exclusion criteria

The study included patients ranging in age from 10 to 14 years with initial orthodontic records including a panoramic radiograph, a dental and medical history, and treatment progress history. Patients with a history of any syndrome or palatal fissure were excluded from the study.

Assessment of hypodontia and reliability

The presence or absence of teeth was assessed by 2 dental examiners using panoramic X-rays and previous dental histories from the records. A convenience sample (n=30) of charted patients of the Orthodontic Clinic of the Medical Sciences Campus, University of Puerto Rico, was selected to conduct a standardization and calibration exercise prior to the study.

An examiners' reliability assessment was conducted prior to the evaluations, using inter- and intra-examiner Kappa coefficients. Both intra- (kappa= 1.0, and 1.0) and inter-examiner (kappa = 0.84) reliability were excellent (19).

Statistical analysis

A descriptive analysis was performed using relative and absolute frequencies.

The overall prevalence of hypodontia (by socio-demographics) was estimated using logistic regression, as described in the following equation:

$$p_i = \frac{1}{1 + e^{(\beta_0 + \beta_i x_i \pm 1.96SE)}} \quad (20)$$

in which equation is the estimator of the prevalence of hypodontia, β_0 is the model intercept, x_i is a categorical socio-demographical variable, and β_i is the mean change for each category.

For each patient, the presence or absence of hypodontia was coded either as 1 for presence or 0 for absence. Gender was coded as a nominal variable, either as 1 or 0 for female or male, respectively. Age in years was described as a discrete variable. The 9 orthodontic clinics were evaluated as a nominal variable; the clinic in Aibonito was used as the reference clinic.

In the inferential analysis, odds ratios (OR) were calculated to evaluate the statistical association between the prevalence of hypodontia and socio-demographics (sex, age, and location of the orthodontic clinic) throughout the logistic regression model. Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS, versions 11.5 and 16.0) and Statistical Analysis System software (SAS versions 9.1.).

Results

To estimate the prevalence of hypodontia, a total of 1,911 patient records from the 9 clinics were examined (culled from a total of 2,944) (Table 1).

As described in Table 2, the overall weighted prevalence of hypodontia for the 9 orthodontic clinics was 6.02%. The Aibonito (10.68%), Aguadilla (10.48%), and Arecibo (8.06%) clinics exhibited the highest prevalence of hypodontia, whereas the Guayama (4.26%), Fajardo (3.85%), and San Juan (3.21%) clinics showed the lowest weighted prevalence of hypodontia. Females presented a higher weighted prevalence of hypodontia than males did (7.02% vs. 4.72%, respectively); this conclusion was true for 7 out of 9 clinics. At the Caguas, Ponce, and Fajardo

clinics, females showed the highest prevalences, while males showed higher prevalences of hypodontia at the Aguadilla and Aibonito clinics than they did at other clinics.

As depicted in Figure 1, the distribution of the prevalences of hypodontia with regard to the maxillary right and left quadrants was bimodal. The most commonly absent maxillary teeth in the right and left quadrants were the lateral incisors (1.90% and 1.80%, respectively) and second premolars (0.70% and 0.80%, respectively).

Table 1. Sample profile by municipality.

Orthodontic Clinic Municipality	Number of existing records N	Sample n
Aibonito	125	103
Aguadilla	286	229
Arecibo	353	211
Ponce	216	146
Caguas†	323	143
Bayamón*†	483	483
Guayama	341	258
Fajardo	451	182
San Juan	366	156
Total	2,944	1,911

*Complete coverage of eligible records; †The Caguas and Bayamón records were evaluated by 1 examiner.

As presented in Figure 2, the distribution of the prevalence of hypodontia with regard to in the right and left mandibular quadrants was unimodal, with the second premolar being the most commonly missing tooth in the right and left quadrants (1.3%).

As can be seen in Table 3, logistic regression analysis was performed to determine differences in the prevalence of hypodontia, explained by the following variables: (1) gender, (2), age, and (3) clinics. In the exploratory data analysis, females showed a higher risk of hypodontia (OR = 1.46; CI 95%: 0.99, 2.10) than did males, after adjusting for region and age. Statistically significant differences were observed between

Table 2. Weighted prevalence of hypodontia per each clinic, overall and by gender.

	Male	Prevalence	Female	Prevalence	Total	Prevalence	95% Confidence Interval	
	n	%	N	%	n	%	Lower limit	Upper limit
Aibonito	44	11.36	59	10.17	103	10.68	4.71	16.64
Aguadilla	96	11.46	133	9.77	229	10.48	6.51	14.45
Arecibo	95	7.37	116	8.62	211	8.06	4.38	11.73
Ponce	60	3.33	86	10.47	146	7.53	3.25	11.82
Caguas*	69	2.90	74	10.81	143	6.99	2.81	11.17
Bayamón*†	207	5.31	276	5.80	483	5.59	3.54	7.64
Guayama	112	2.68	146	5.48	258	4.26	1.80	6.73
Fajardo	73	1.37	109	5.50	182	3.85	1.05	6.64
San Juan	73	1.37	83	4.82	156	3.21	0.44	5.97
Total	829	5.07	1,082	7.49	1,911	6.44	5.34	7.54
Weighted Prevalence		4.72		7.02		6.02		

*Only 1 examiner; †Complete coverage: standard error=0

regions, with the clinics in Fajardo, Bayamón, San Juan, and Guayama having lower prevalences of hypodontia than the Aibonito clinic had. In this study, we were surprised to observe that age increased the risk of hypodontia (OR = 1.12; CI 95%: 1.012, 1.37), after adjusting by clinic and gender.

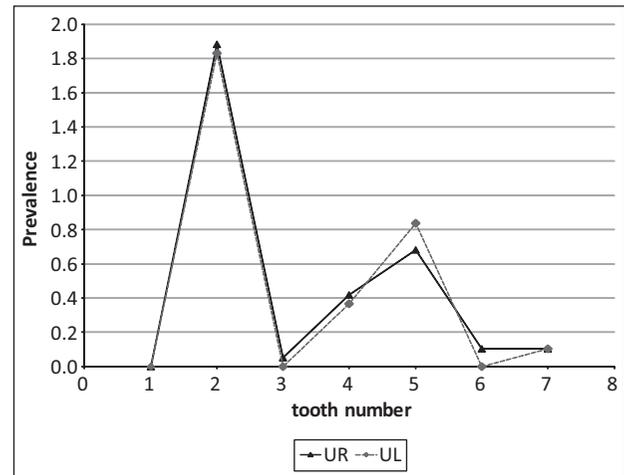


Figure 1. Prevalence of hypodontia in the maxilla, by tooth number and quadrant

Discussion

The aims of this study were to estimate the prevalence of hypodontia using patient records from a group of 10- to 14-year-olds, each of whom had visited 1 of 9 orthodontic clinics in Puerto Rico from May through June 2004, and to describe its distribution in this sample by socio-demographic group.

This weighted prevalence of hypodontia was 6.02%; other studies report a prevalence of hypodontia ranging from 2.7% to 6.9%. The prevalence of hypodontia was 2.5% in Saudi Arabia, 3.4% in Switzerland, 4.4% in United States, 4.6% in Israel, 6.1% in Sweden, 6.9% in Mongolia, 8% in Finland, and 9.6% in Austria (1, 2, 5, 10, 14). Since none of these studies employed

probabilistic sampling methods, it is difficult to compare the prevalence of hypodontia in Puerto Rico with that of other ethnic groups.

In several studies, females present a higher prevalence of hypodontia than do males. Polder (5) reported an odds ratio for females compared to males that is similar to that of the present study (1.37 vs. 1.46, respectively). The gender differences observed in this study persisted after we stratified by orthodontic clinic; however, a large variability in the prevalence of hypodontia was observed among clinics throughout Puerto Rico. Nunn (12)

proposed that sex hormones explain the higher prevalence of hypodontia in females compared to males. Another explanation may be a higher demand for treatment by females.

The logistic regression analysis demonstrated an association between the prevalence of hypodontia and age. This increase in the prevalence of hypodontia related to age may be explained by a selection bias caused by older children's seeking orthodontic treatment or by the misclassification of extracted versus absent teeth.

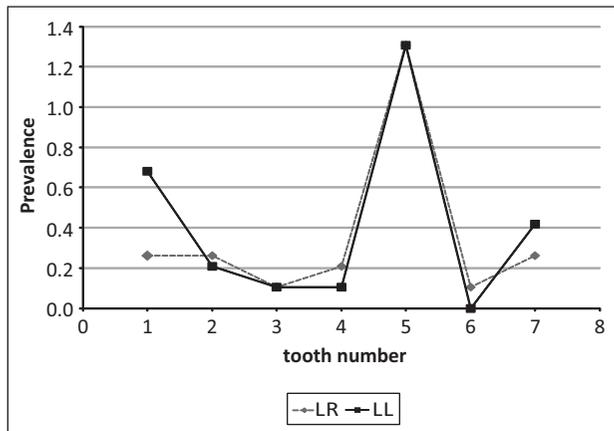


Figure 2. Prevalence of hypodontia in the mandible, by tooth and quadrant

The prevalences of hypodontia were statistically significantly lower in Fajardo, Bayamón, San Juan, and Guayama than was the hypodontia prevalence at the Aibonito clinic. These results should be interpreted cautiously because the lowest effective sample rates were observed at the Fajardo and San Juan clinics; therefore, this finding might simply be a residual effect.

Table 3. Odds ratios (OR) and 95% confidence intervals for the prevalence of hypodontia, by region and socio-demographic variable*.

	OR	95% Confidence Interval		p-value
		Lower Limit	Upper Limit	
Age (years)	1.18	1.01	1.37	0.03
Gender†	1.46	0.99	2.14	0.06
Ponce‡	0.61	0.25	1.46	0.26
Guayama‡	0.31	0.13	0.75	0.01
San Juan‡	0.25	0.08	0.74	0.01
Arecibo‡	0.65	0.30	1.46	0.30
Aguadilla‡	0.80	0.37	1.75	0.56
Fajardo‡	0.31	0.12	0.83	0.02
Caguas‡	0.64	0.26	1.56	0.32
Bayamón‡	0.42	0.20	0.90	0.03

*Logistic regression models included age, clinic location (municipality), and gender; †The referent clinic was that of Aibonito. ‡The reference category was male.

In his early work in 1966, Rose (14) reported a controversy regarding the tooth with the highest frequency of being absent. In our own study, we observed that the most common missing

maxillary teeth were the lateral incisors and second premolars; these findings were similar to those described by Silva (2003) (15), who studied a group of 9- to 20-year-old Mexicans. Other studies have confirmed that the most frequently missing teeth in hypodontia cases are the lower central incisors (12). The study described herein, however, identified the second premolar as being the most common missing mandibular tooth in the right and left quadrants.

The strength of this study comes from the standardization and training exercises conducted as well as from the randomized sampling of the patient records selected from the 9 orthodontic clinics, which sampling thereby enhanced the internal validity of the data collected. This approach may have reduced the selection bias in the population of patients in these clinics.

However, a limitation of this study is the fact that the 9 clinics chosen to provide patient charts were selected by convenience and may not be representative of all the orthodontic clinics in Puerto Rico. Moreover, other socio-demographical variables, such as household income and health insurance, were not gathered, which lack may explain the direction of the selection bias.

Conclusions

The prevalence of hypodontia in females was 6.02%, which is a higher prevalence than was seen in males. In addition, the orthodontic clinics in Fajardo, Bayamón, San Juan, and Guayama had lower prevalences of hypodontia than did the Aibonito clinic. The most frequently missing tooth identified in this study was the maxillary right lateral incisor.

Future studies are needed to generalize these findings to the population of 10- to 14-year-old children living in Puerto Rico. Such studies should also attempt to assess socio-demographic, genetic, and environmental risk factors for hypodontia in Puerto Rico.

Resumen

Objetivo: Estimar la prevalencia de hipodoncia en un grupo de niños entre las edades de 10 y 14 años, en Puerto Rico. Métodos: Se realizó un estudio corte-transversal epidemiológico en las clínicas de ortodoncia dentro de cada una de las nueve Regiones de la Reforma de Salud (según lo determinado la Administración de Servicios de Salud administrada del gobierno, La Reforma) en Puerto Rico. Se evaluaron 1,911 expedientes, que incluían radiografías e historiales médicos dentales. Se utilizó un modelo de regresión logística para evaluar la asociación en la prevalencia de hipodoncia en el grupo de estudio y la localización de las clínicas, el género y edad, con una significancia de 5%, para estimar la prevalencia de hipodoncia. Resultados: La prevalencia de hipodoncia fue de 6.02%. Las niñas mostraron una mayor prevalencia de hipodoncia que los niños (7.02% vs. 4.82%, respectivamente) (p=0.055). Hubo diferencias en las

distribuciones de las prevalencias en las clínicas sondeadas, que van desde 3.12% en la clínica de San Juan hasta 10.68% en la clínica de Aibonito ($p=0.013$). Los dientes que estaban ausentes con mayor frecuencia fueron los laterales maxilares, seguidos por las segundas premolares mandibulares (1.9%). Conclusión: La prevalencia de hipodontia en Puerto Rico fue de 6.02%. Las niñas presentaron una prevalencia mayor que los niños. Las clínicas en la Fajardo, Bayamón, San Juan y Guayama tuvieron menor prevalencia de hipodontia al comparar con la clínica de Aibonito. El diente que estaba ausente con mayor frecuencia fue el incisivo lateral derecho de la maxila.

Acknowledgments

The authors would like to express their gratitude to Dr. Jazmín Oliva, the director of the orthodontics program, Dr. Carlos Martínez, for his assistance in data collection, and Dr. Carlos Toro and Dr. Omar García, for their help with the statistical analysis.

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