

Correlation between the caries status of the first permanent molars and the overall DMFT Index

A cross-sectional study

América Patricia Pontigo-Loyola, DDS, PD, MSC, DSc^a, María de Lourdes Márquez-Corona, DDS, MPer^a, Mirna Minaya-Sánchez, DDS, SPer, MSc^b, Salvador Eduardo Lucas-Rincón, DDS, PD^{a,c}, Juan Fernando Casanova-Rosado, DDS, SOrth, MSc^b, José Luis Robles-Minaya, DDS, SProsth^b, Juan Alejandro Casanova-Sarmiento, DDS, SOrth^b, Alejandro José Casanova-Rosado, DDS, SEnd, MSc^b, Martha Mendoza-Rodríguez, DDS, MOrth^{a,*}, Carlo Eduardo Medina-Solís, DDS, OSurg, MSc^{a,d,*}

Abstract

To analyze whether a correlation exists between the caries status (Decayed, Missing and Filled Teeth, DMFT Index) of the first permanent molars (FPMs) and that of the full permanent dentition of Mexican adolescents, and to propose its use in large epidemiological studies of dental caries.

We conducted a cross-sectional study of 1538 adolescents from 12 to 15 years old. Based on a clinical oral examination, we determined the DMFT Indices of their FPMs (FPM-DMFT) and of their full permanent dentition (comprehensive DMFT Index). We explored each FPM to determine whether it was with or without caries, filled, missing or sealed. For our statistical analysis, we used Fisher exact test and Spearman correlation in Stata software.

After examining a total of 6157 FPMs, we found that 56.8% of our sample of adolescents had no caries in their 4 FPMs whereas 4.9% experienced caries in all 4. No significant differences emerged by sex ($P > .05$); however, by age, the older adolescents experienced greater FPM-DMFT ($P < .05$). Analysis yielded a correlation of $r = 0.8693$ between the FPM-DMFT and comprehensive DMFT scores ($P < .0001$) of participants. The underestimation of caries prevalence (DMFT > 0) was 5.4% (48.6% vs 43.2%), while the DMFT Index was underestimated at 0.34 (1.15 vs 0.81).

The strong correlation between the FPM-DMFT and comprehensive DMFT Indices suggests that overall caries status can be inferred on the basis of FPM caries status. This evidence is useful when conducting large epidemiological studies such as national surveys.

Abbreviations: DMFT = Decayed, Missing and Filled Teeth, FPMs = first permanent molars, ICDAS = International Caries Detection and Assessment System, PPME = Partial-Mouth Periodontal Examination.

Keywords: adolescents, dental caries, DMFT Index, first permanent molars, oral health

1. Introduction

Given their high prevalence and incidence across populations, dental caries, severe periodontitis, and their end result, tooth loss, constitute an oral health problem in Mexico^[1–9] and the world at large.^[10–15] They also impose a heavy burden of health-care costs

on health systems and households;^[16–19] one need only look at the cost of curative care in developed countries, estimated at 5% to 10% of public health expenditure.^[20] Most oral conditions and diseases require professional dental care; however, the limited availability and the inaccessibility of these services lead to

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^a Academic Area of Dentistry of Health Sciences Institute at Autonomous University of Hidalgo State, Pachuca, ^b School of Dentistry, Autonomous University of Campeche, Campeche, ^c Clinic of Dental Specialties of the General Hospital of Pachuca, Campus Arista of the Ministry of Health of Hidalgo, Pachuca, ^d Advanced Studies and Research Center in Dentistry "Dr. Keisaburo Miyata", School of Dentistry, Autonomous University State of Mexico, Toluca, Mexico.

* Correspondence: Martha Mendoza-Rodríguez, Carlo Eduardo Medina-Solís, Academic Area of Dentistry of Health Sciences Institute at Autonomous University of Hidalgo State, Avenida del Álamo # 204, Fraccionamiento Paseo de los Solares, Colonia Santiago Tlapacoya, CP, Pachuca 42113, Mexico (e-mail: romen65@hotmail.com, cemedinas@yahoo.com).

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minimal utilization rates among vulnerable population groups.^[20]

The first permanent molars (FPMs) are the earliest tooth organs of secondary dentition. They erupt while temporary teeth still exist in the mouths of children, thereby turning the primary into a mixed dentition.^[21] FPMs are the most important dental organs of permanent dentition given their pivotal role in the development and physiology of the stomatognathic system: characterized by numerous moats and grooves, they account for approximately 50% of masticatory efficiency, determine lifelong mastication and serve as a guide for the eruption of the remaining molar teeth; they are responsible for the second physiological phase of occlusion, and are considered the key in Angle occlusion.^[21–24] Because of the age at which they emerge and the circumstances in which they appear in the mouth—that is, without exfoliating primary teeth—parents are often unaware that FPMs are permanent. They are thus exposed to risk factors and progressive dental caries that often result in the destruction and premature loss of teeth.^[23,25]

Today, it has become increasingly necessary to identify methods that allow large population studies to collect data on dental caries more efficiently. This would represent a savings in economic resources and health staff work time. Epidemiological studies are considered of the utmost importance for dental public health because they constitute the only source of exact information on the frequency and distribution of oral diseases, providing the basis for the assessment of treatment needs. Data from epidemiological studies are also crucial in the planning, implementation, and evaluation of measures for controlling and preventing such diseases, in addition to organizing health-care services. In regards to epidemiological indices specifically, their use ensures that epidemiological studies on oral health are conducted under comparable conditions and yield viable, reproducible, valid, and reliable results in any situation or place.^[26] For instance, the DMFT Index (Index of Decayed, Missing or Filled Teeth), a method for measuring present (decayed teeth) and past (missing and filled teeth) caries experiences in permanent dentition, gathers information on the entire set of teeth of individuals; therefore, when used to assess the health status of FPMs, they can also provide updated information on the health status of full dentition in children and adolescents. The objective of our study was to analyze whether a correlation exists between the caries status of the FPMs and that of the full set of teeth of 12-to-15-year old Mexican adolescents and propose its use in large epidemiological studies of dental caries.

2. Material and methods

2.1. Study design, population, and sample

We reanalyzed a cross-sectional study of 12-to-15-year-old adolescents from the elementary and middle schools of Tula Centro, San Marcos and El Llano, in Mexico. Tula de Allende, one of the 84 municipalities in the State of Hidalgo; comprises 6 principal localities: Tula (the municipal head), El Llano, San Marcos, Santa Ana Ahuehupan, San Miguel Vindhó, and Bomintzha. The methodology of this study has been published elsewhere.^[27–31] Seven schools did not grant us permission to perform clinical oral examinations of their students, representing an exclusion of 139 adolescents (7.9%). We examined a total of 1629 students enrolled in 25 participating schools. Of these, 91

were excluded for the following reasons: 43 had fixed orthodontic appliances; 2 had full anterior dental crowns; 40 withdrew from school; and 6 refused to be examined. The nonresponse rate for the clinical oral examination came to 5.6%, leaving a final sample of 1538 adolescents for analysis.

2.2. Variables and data collection

Variables analyzed were the DMFT Index of the first permanent molars (FPM-DMFT Index) and that of the full permanent dentition (comprehensive DMFT Index) of our sample of adolescents. The latter measured their present (decayed teeth component) and past (missing and filled component) caries experiences. A dental probe and number-5 mouth mirror were used for the examinations in daylight. Students were assessed on the premises of the respective educational institutions, interfering as little as possible with their educational activities. These examinations served to determine the caries experience of the participants;^[32] they were conducted by examiners trained and standardized in the epidemiological criteria used in the study ($\kappa > 0.80$).

2.3. Statistical analysis

We used Stata 11.0 software for all statistical analyses, which consisted in determining the frequencies and percentages of the qualitative variables together with the averages and standard deviation of the quantitative variables. A bivariate analysis was conducted using Fisher exact test and Spearman correlation test.

2.4. Ethical considerations

This study was implemented in compliance with the requirements for the protection of study participants, and adhered to the current ethical regulations of the Autonomous University of the State of Hidalgo (35-09-APPL-14).

3. Results

The total sample included 1538 adolescents, of whom 55.3% were 15 years old and 49.9% were female (Table 1). A total of 6157 FPMs were evaluated. Of the total sample, we found that the 4 FPMs of 56.8% of our sample were without caries, while 4.9% of participants had caries in all 4. Table 2 shows the status of the FPMs by sex: it can be seen that no significant differences between male and female participants were found in any of the 4 FPMs (16, 26, 36, and 46). Table 3 presents the status of the FPMs by age: with the exception of tooth 26, we found significant differences ($P < .05$), with older individuals having fewer healthy FPMs and a higher DMFT percentage.

Table 1
Description of the characteristics of participating adolescents from Hidalgo.

Variables	Frequency	Percentage
Age		
12 years	688	44.7
15 years	850	55.3
Sex		
Male	770	50.1
Female	768	49.9

Table 2
Status of each first permanent molar in our sample of adolescents, by sex.

	Male	Female	P value*
Tooth 16 (n=1538)			
Healthy	675 (87.7)	663 (86.3)	P=.146
Decayed	70 (9.1)	66 (8.6)	
Filled	22 (2.8)	31 (4.0)	
Missing	3 (0.4)	3 (0.4)	
Sealed	0 (0.0)	5 (0.7)	
Tooth 26 (n=1535)			
Healthy	666 (86.8)	663 (86.3)	P=.937
Decayed	68 (8.9)	68 (8.8)	
Filled	28 (3.7)	29 (3.8)	
Missing	4 (0.5)	5 (0.7)	
Sealed	1 (0.1)	3 (0.4)	
Tooth 36 (n=1536)			
Healthy	546 (71.0)	524 (68.3)	P=.241
Decayed	171 (22.2)	167 (21.8)	
Filled	42 (5.5)	59 (7.7)	
Missing	6 (0.8)	12 (1.6)	
Sealed	4 (0.5)	5 (0.7)	
Tooth 46 (n=1538)			
Healthy	570 (74.0)	556 (72.4)	P=.111
Decayed	144 (18.7)	133 (17.3)	
Filled	47 (6.1)	64 (8.3)	
Missing	6 (0.8)	14 (1.8)	
Sealed	3 (0.4)	1 (0.1)	

* Fisher exact test.

Table 3
Status of each first permanent molar in our sample of adolescents, by age.

	12 years	15 years	P value*
Tooth 16 (n=1538)			
Healthy	617 (89.7)	721 (84.8)	P=.040
Decayed	46 (6.7)	90 (10.6)	
Filled	20 (2.9)	33 (3.9)	
Missing	2 (0.3)	4 (0.5)	
Sealed	3 (0.4)	2 (0.2)	
Tooth 26 (n=1535)			
Healthy	610 (88.9)	719 (84.7)	P=.080
Decayed	46 (6.7)	90 (10.6)	
Filled	25 (3.6)	32 (3.8)	
Missing	3 (0.4)	6 (0.7)	
Sealed	2 (0.3)	2 (0.2)	
Tooth 36 (n=1536)			
Healthy	489 (71.3)	581 (68.3)	P=.007
Decayed	156 (22.7)	182 (21.4)	
Filled	35 (5.1)	66 (7.8)	
Missing	2 (0.3)	16 (1.9)	
Sealed	4 (0.6)	5 (0.6)	
Tooth 46 (n=1538)			
Healthy	525 (76.3)	601 (70.7)	P=.037
Decayed	117 (17.0)	160 (18.8)	
Filled	39 (5.7)	72 (8.5)	
Missing	5 (0.7)	15 (1.8)	
Sealed	2 (0.3)	2 (0.2)	

* Fisher exact test.

Table 4 shows the correlation between the FPM-DMFT and comprehensive DMFT Indices of participants, which yielded an $r=0.8693$. It also provides descriptive data for both indices. The underestimation of caries prevalence (DMFT > 0) was 5.4% (48.6% vs 43.2%), while the DMFT Index was underestimated at 0.34 (1.15 vs 0.81).

4. Discussion

This study aimed to correlate the caries status (Decayed, Missing and Filled Teeth, DMFT Index) of the first permanent molars (FPM-DMFT) with that of the full permanent dentition (comprehensive DMFT Index) of Mexican adolescents from 12 to 15 years old. The results demonstrated that it is possible to use FPM caries experience as an approximation of the overall dental health status of adolescents, given that we obtained a correlation of almost $r=0.90$. Oral health has not improved in the last 3 decades, and oral diseases continue to represent an important public health challenge around the world. As a result of demographic changes, such as the growth and aging of the population, the accumulated burden of poor oral health increased dramatically between 1990 and 2015: the number of people with untreated oral problems grew from 2.5 billion in

1990 to 3.5 billion in 2015.^[33] Using methods that generate savings in resources (material, financial and human) facilitates determining the health status of the population and, hence, planning adequate health services.^[34]

In epidemiological studies of caries, a complete clinical oral examination is the current gold standard: all teeth are examined, with the International Caries Detection and Assessment System (ICDAS) and the DMFT Index being the 2 most used evaluation tools. Oral examinations are time-consuming for examiners. In addition, checking all tooth surfaces can be tiring for both the examiner and the patient (primarily children and adolescents), likely leading to an increase in measurement errors.^[35] Another reason for using an abbreviated index in developing countries such as Mexico relates to its cost. Such an index offers the possibility of conducting frequent national surveys of dental caries, as recommended by dental-care organizations. Frequent surveys contribute updated, accurate and timely information that decision makers can translate into targeted and effective oral health programs and services.^[36] Because of its simplicity, the DMFT Index is one of the most used tools in epidemiological studies of caries. Our study quantified the level of disagreement between 2 approaches, complete vs partial dentition, finding significant agreement between the 2 indices. As the FPMs are the

Table 4
Correlation of the comprehensive DMFT Index with the FPM-DMFT Index (DMFT Index of the first permanent molars).

	Prevalence	Mean ± sd (Median)	Comprehensive DMFT	FPM-DMFT
Comprehensive DMFT	48.6	1.15 ± 1.71 (0)	1.00	
FPM-DMFT	43.2	0.81 ± 1.14 (0)	$r=0.8693$ $P=.0000$	1.00

first teeth to erupt, the experience of these teeth reflects that of the entire mouth. The fact that the FPM-DMFT and comprehensive DMFT Indices are highly correlated suggests little loss of information, crucial when using abbreviated versions of epidemiological indices. These results are consistent with findings from other abbreviated protocols. In these studies—albeit only of periodontal disease—it was also observed that minimal information had been lost.^[35,37,38] These research efforts employed the Partial-Mouth Periodontal Examination (PPME) Protocol, widely used in epidemiological studies. Once the underestimated values are known, precautions can be taken to make the necessary corrections.

The main limitation of using partial indices in epidemiological studies resides in underestimating the outcome variable. However, if researchers take it into account, this limitation can be overcome. One viable solution to this problem is to perform full oral health examinations of all participants in a study subsample and calculate the percentage underestimated. Results can then be corrected accordingly.

5. Conclusions

We observed a strong correlation between the comprehensive DMFT and FPM-DMFT Indices, suggesting that the general status of caries can be inferred on the basis of the FPMs; this could be useful in large epidemiological studies such as national surveys. The decision to use an abbreviated DMFT Index protocol can serve to evaluate the benefits of reduced effort for data collection in the face of the possible loss of data.

Author contributions

Conceptualization: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Mirna Minaya-Sánchez, Salvador Eduardo Lucas-Rincón, Juan Fernando Casanova-Rosado, José Luis Robles-Minaya, Juan Alejandro Casanova-Sarmiento, Alejandro José Casanova-Rosado, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Data curation: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Formal analysis: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Mirna Minaya-Sánchez, Salvador Eduardo Lucas-Rincón, Juan Fernando Casanova-Rosado, José Luis Robles-Minaya, Juan Alejandro Casanova-Sarmiento, Alejandro José Casanova-Rosado, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Funding acquisition: Carlo Eduardo Medina-Solís.

Investigation: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Salvador Eduardo Lucas-Rincón, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Methodology: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Mirna Minaya-Sánchez, Salvador Eduardo Lucas-Rincón, Juan Fernando Casanova-Rosado, José Luis Robles-Minaya, Juan Alejandro Casanova-Sarmiento, Alejandro José Casanova-Rosado, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Project administration: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Resources: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Supervision: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Validation: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Writing – original draft: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Mirna Minaya-Sánchez, Salvador Eduardo Lucas-Rincón, Juan Fernando Casanova-Rosado, José Luis Robles-Minaya, Juan Alejandro Casanova-Sarmiento, Alejandro José Casanova-Rosado, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Writing – review & editing: América Patricia Pontigo-Loyola, María de Lourdes Márquez-Corona, Mirna Minaya-Sánchez, Salvador Eduardo Lucas-Rincón, Juan Fernando Casanova-Rosado, José Luis Robles-Minaya, Juan Alejandro Casanova-Sarmiento, Alejandro José Casanova-Rosado, Martha Mendoza-Rodriguez, Carlo Eduardo Medina-Solís.

Carlo Eduardo Medina-Solís orcid: 0000-0002-1410-9491.

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