

RESEARCH ARTICLE

Caries prevalence and association with oral hygiene in a group of school-age children from Yauhtepec, Morelos, Mexico, 2009

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ABSTRACT

Background. Caries is a multifactorial disease and is considered a public health problem because 95% of children worldwide suffer from it. It is intimately associated with oral hygiene quality. The objective of this work was to determine the relationship between the experience of dental caries and oral hygiene in school-age children living in Yauhtepec, Morelos, Mexico.

Methods. A cross-sectional study of 771 school-age children with mixed dentition in Yauhtepec, Morelos, Mexico was undertaken. An oral exam was used to collect data on oral hygiene and dental caries in primary and permanent teeth. This evaluation was developed by two dentists using standardized DMFT/dmft (lower case indicates primary dentition) index to determine dental caries according to the criteria established by the WHO (Cr = 0.03, Ca = 0.89, k = 0.942).

Results. The average experience of dental caries was a trend of approximately two primary teeth with some experience of caries and in secondary dentition the average was almost zero. In both cases these differences were found to be statistically significant ($p < 0.0001$). It was also noted that the disease had no relationship with gender ($p > 0.05$) but was related with the quality of oral hygiene ($p = 0.0001$).

Conclusions. The average experience of dental caries in both dentitions was low. The condition most frequently observed in terms of quality of oral hygiene was good. The average experience of dental caries was shown to be associated with age and quality of oral hygiene.

Key words: dental caries experience, school-age children, oral hygiene, DMFT/dmft.

INTRODUCTION

Dental caries is a destructive, multifactorial infectious disease that is reversible in its early stages. It is considered the leading cause of oral morbidity in the world affecting >90% of the population, which is why it has become a public health problem.¹⁻⁷ Its behavior is very variable according to the number of teeth it affects. For example, in highly developed countries such as Sweden, Norway and Denmark, the average values of DMFT (decayed, missing, filled teeth, for primary dentition lower

case dmft) are shown to be <1.⁸⁻¹³ This contrasts with observations in developing countries such as Mexico, Colombia, Venezuela and Nicaragua, whose average DMFT values are >4. Furthermore, according to the relative weight of its components, particularly the “decayed” state, it is still very high.¹⁴⁻²³ Its distribution by age group shows that the frequency of this disease increases in permanent teeth with age inversely to expectations in primary dentition because this decrease in dmft index values is influenced by the tooth exfoliation process. Its frequency according to gender is basically the same, with differ-

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ences that are not statistically significant. This allows us to understand why a theoretical model has failed to be established to date that makes it possible to estimate whether there is a higher risk in males or females to develop this disease.²⁴⁻³¹

The etiology of dental caries has been related to various factors, which interact dynamically such as a diet high in fermentable carbohydrates, amount of fluoride available in the body, pH and buffer capacity of the saliva, among others.²⁷⁻³¹ However, it has been shown that the most important factor is the quality of oral hygiene due to the biofilm.³² Oral hygiene is understood as a method comprising a series of activities designed to control the accumulation and bacterial biofilm development on the hard and soft tissues within the oral cavity. This is formed by a community of bacteria living in an organized structure on an interface between a solid and a liquid, which develop in encapsulated microcolonies in an organic matrix of extracellular polymeric substances, proteins and DNA, and its accumulation as a bacterial product reduces protection against desiccation, host defenses, other microorganisms and antimicrobial drugs.^{33,34}

Regarding its composition, due to the complexity of oral microflora it is constituted by several hundred million species and microorganisms, which develop on a single tooth organ, a reason why a particular type of microorganism cannot predict the development of caries in an individual.³⁵ However, the presence of microorganisms such as *Streptococcus mutans*, *S. sobrinus* and *Lactobacillus* spp modulate the cariogenic potential by causing a decrease in the local pH through acid production by the metabolism of the fermentable carbohydrates and the subsequent tooth demineralization.³² Therefore, dental caries is the result of an alteration in the physiological balance between mineral of the teeth and the fluid of the biofilms by endogenous bacteria.³²

Seow proposed that children are infected with the *S. mutans* by their mothers after the appearance of the primary dentition.³⁶ It has been found in recent studies that *S. mutans* and *Lactobacillus* could be detected in the oral cavity from 37 days of birth with a culture. The rate of infection increases from 11 to 47% at the end of the stage prior to the appearance of teeth in the oral cavity.³⁷ Colonization of *S. mutans* has been recently proposed as the model of vertical and horizontal transmission.³⁸ The relationship between the average experience of dental caries

with the quality of oral hygiene is very narrow, such that there is a very strong positive relationship between both variables, i.e., the greater deficiency in oral hygiene the greater the expectation of finding a high average of caries.³⁹⁻⁴³ For this reason the present work had as a goal to determine the average experience of dental caries and its relationship with the quality of oral hygiene in a group of primary school students in the township of Yautepec, State of Morelos, Mexico.

SUBJECTS AND METHODS

A descriptive, observational, cross-sectional prospective epidemiological study was carried out, which clinically evaluated a sample of 771 students between 6 and 12 years of age, of both genders, enrolled in four elementary schools in the municipality of Yautepec, State of Morelos, who were selected in a simple randomized manner without replacement. We included children whose parents signed an informed consent and who were in the established age range and were cooperative at the time of the oral exam. Permission was requested from the authorities of the school facilities to carry out the project. Also, the parents were informed about the conditions in which their children would be examined, covering the legal and ethical aspects of research.

Training of two dental interns was carried out for the epidemiological survey. Towards that goal a total of 20 students in three sessions were examined, which guaranteed the reliability of the measurements and avoid that biases would be generated ($Ca = 0.87$, $Cr = 0.07$), whether it was due to tiredness or by contamination of the observations. Similarly, we calculated the value of Cohen's kappa for the purpose of verifying that the concordances obtained were not due to random chance ($k = 0.898$, $p = 0.001$). Oral examination was done during daylight and with the use of chairs, a table, special flat dental mirrors (No. 5) without magnification and a dental probe with a rounded tip, with asepsis and antisepsis using white robes, face masks, disposable gloves and previously sterilized instruments. To measure the average experience of dental caries in the secondary dentition, a collection of the DMFT index was carried out, taking into consideration the guidelines established by Klein and Palmer. For the primary dentition the dmft index was applied by Gruebbel and for measuring the quality of oral hygiene the codes and criteria of the

simple oral hygiene index (OHI-S) of Green and Vermillion were used. Data were classified, codified and tabulated in an Excel format, based on the variables of interest, for the processing and statistical analysis. To evaluate the average experience of dental caries and the quality of oral hygiene by age and gender, the arithmetic mean was calculated as well as the standard deviation to determine the variability of events towards the central distribution. Confidence intervals were used for estimating the values in which the event would be shared at the population level. In order to evaluate the difference between the average experiences of caries related to gender, the value of the non-parametric Mann-Whitney U test was calculated (taking into consideration that the events of the study do not have a normal distribution). For differences between the average experience of primary and secondary caries with age and with the quality of the oral hygiene, Spearman correlation coefficient values were used. SPSS v.19.0 for MAC was used.

RESULTS

We studied a population total of 771 students enrolled in four elementary schools of the Yautepec Township, State of Morelos. Of these, 52.3% were female and 47.7% male. Furthermore, by age all categories had a similar proportional representation (Table 1).

The average experience in the permanent dentition showed values <1 . Its average distribution, in general, was 0.24, which showed an increase in the DMFT index as age increases, contrary to what was observed in the primary dentition because in this case the dmft decreased for older age categories. However, in both cases, these differences were statistically significant ($p < 0.0001$) (Table 2).

As far as oral hygiene quality is concerned, the trend in the study population was towards what is established as good. Also, there were no statistically significant differences found between age groups with this variable because the average experience of the SOHI was similar between the different categories ($p > 0.05$). Therefore, the quality of oral hygiene was not associated with age (Table 3).

With regard to gender, the average experience of caries in secondary dentition was very low both in males as in females, with statistically significant differences between these variables ($p < 0.05$). However, despite these statistics, from the clinical point of view it was not relevant

because in both categories the experience of caries in secondary dentition was <1 . The most relevant fact was that 88.5% of the children examined were found to be free of caries in this dentition. In the primary dentition the prevalence was relatively greater in both categories, independently of student's gender as both had a similar number of caries ($p > 0.05$). With regard to oral hygiene, the behavior was also similar between genders without significant differences being noted between ($p > 0.05$) (Table 4).

Finally, with regard to the behavior of the average experience of dental caries in primary and secondary dentition in children with higher DFMT/dmft values, the quality of oral hygiene was poor. This was contrary to what was observed in children with low DFMT/dmft in whom the quality of oral hygiene was good. The differences were significant in both dentitions ($p < 0.05$ for primary dentition and $p < 0.05$ for secondary dentition).

DISCUSSION

According to the observations in the study population, the average number of caries was low. This behavior was similar to what was reported by Angelillo et al. in Italy¹² and Mendes-Goncalves and Caricote-Lovera in Venezuela.²³ Also, according to the report on the behavior of this disease at the national level, the frequency observed in this population was lower in comparison with what has been reported for the State of Morelos in which there is an average number of caries of the primary dentition at a moderate level and much smaller when compared with other states such as the Federal District (DF), State of Mexico, Puebla and Tlaxcala.¹⁴ Villalobos-Rodelo et al.¹⁷ and Guido et al.⁴¹ also studied the average experience of caries related with the area of residence. This is relevant because despite not finding any association between variables, these authors mentioned the possibility of association with other factors such as economic, cultural and educational with this event. For this reason, this behavior could be due to the fact that the acquisitive ability of the area in reference is low, which probably does not allow access to highly cariogenic products. The majority of the schools in urban areas have a school cooperative that provides the students with these types of food, facilitating their consumption. However, despite the fact that in the rural zones these types of foods are available, the children do not have the resources to ac-

quire them or the consumption is low, a condition that may influence the fact that the average experience of caries is lower. This same condition has been observed by other authors such as Gorbatova et al.,²⁵ Cook et al.,²⁶ and Bedos and Brodeur,²⁷ who reported that the caries experience in general was greater in urban zones when compared with rural areas. This relationship is so evident that at the present time the Department of Public Education is in charge of regulating the consumption of “junk” foods as a fundamental strategy for the control

and prevention of childhood obesity. It would most probably have an impact on other health problems, among which are dental caries.

According to the results of the present study, the caries experience in primary dentition was greater when compared with the secondary dentition, a behavior that coincides with what was reported by Prashanth et al.⁴³ Also, this behavior resulted in being an expected behavior because for the establishment and development of this disease, the time of exposure of the teeth to different risks is very important, whether personal, behavioral or environment type reasons. Nevertheless, the experience of the disease was very low for both dentitions compared with the reports of Irigoyen et al.,¹⁴ Pérez-Domínguez et al.,¹⁵ Casanova-Rosado et al.,¹⁶ and Villalobos-Rodelo et al.¹⁷ This translates into the fact that these factors have had very little influence on the population for this disease to

Table 1. Distribution of the study population according to age and gender

Age (years)	Gender				Total	
	Female		Male			
	f	%	f	%	f	%
6	64	8.3	63	8.2	127	16.5
7	64	8.3	59	7.7	123	16.0
8	62	8.0	61	7.9	123	16.0
9	64	8.3	53	6.9	117	15.2
10	68	8.8	65	8.4	133	17.3
11	81	10.5	67	8.7	148	19.2
Total	403	52.3	368	47.7	771	100.0

f, frequency; %, percentage.

Table 2. Mean distribution, standard deviation and 95% confidence intervals in relation to the average experience of primary and secondary dentition according to age

Age	Mean	SD	95% CI
Prevalence of caries in primary dentition (dmft values)			
6	1.91	0.231	1.46-2.37
7	1.15	0.171	0.81-1.48
8	1.46	0.199	1.06-1.85
9	1.07	0.168	0.74-1.40
10	0.71	0.118	0.47-0.94
11	0.49	0.091	0.31-0.67
$p < 0.0001$			
Prevalence of caries in secondary dentition (DMFT values)			
6	0.00	0.000	0.00-0.00
7	0.01	0.008	0.00-0.02
8	0.11	0.046	0.02-0.21
9	0.23	0.059	0.11-0.35
10	0.32	0.069	0.18-0.45
11	0.57	0.090	0.39-0.74
$p < 0.0001$			

D, standard deviation; 95% CI, 95% confidence interval; dmft, decayed, filled, missing teeth; DMFT, decayed, missing, filled teeth.

Table 3. Distribution of the type of quality of oral hygiene of school-age children according to age (town of Yautepec, Morelos, 2009)

Age (years)	OHI-S	SD
6	0.53	0.676
7	0.71	0.698
8	0.68	0.644
9	0.65	0.620
10	0.61	0.638
11	0.53	0.611
$p > 0.05$		

SD, standard deviation; OHI-S, simplified oral hygiene index.

Table 4. Mean and standard deviation of distribution, variability and confidence intervals in relation to the mean experience of caries in primary and secondary dentition according to gender

Gender	Mean	SD	95% CI	p^*
Prevalence of caries in primary dentition (dfmt values)				
Female	1.13	0.100	0.93-1.32	$p > 0.05$
Male	1.09	0.097	0.90-1.28	
Prevalence of caries in secondary dentition (DFMT values)				
Female	0.15	0.028	0.10-0.21	$p < 0.05$
Male	0.29	0.042	0.20-0.37	
Quality of oral hygiene (OHI-S values)				
Female	0.57	0.231	0.55-0.67	$p > 0.05$
Male	0.57	0.069	0.55-0.68	

SD, standard deviation; 95% CI, 95% confidence interval; DFMT, decayed, filled, missing teeth; dmft, decayed, filled, missing teeth; OHI-S, simplified oral hygiene index.

develop and that surely there are others, which act in a preventative manner against the formation of dental caries such as the quality of oral hygiene and the low consumption of highly industrialized products.

The behavior of the average experience with dental caries in accordance with age was in agreement with expectations. In the primary dentition, the average values of experience of the disease decreased as the age advanced, probably being influenced by the dental exfoliation process. It must be remembered that the number of teeth susceptible for the recount of the average value of the dmft is less at an older age, a behavior that is inverse in the average values of dental caries in secondary dentition. Therefore, the DFMT value will always tend towards an increase or to maintain the same value in the best of cases.

The distribution and frequency of dental caries by gender in primary dentition showed no significant differences. However, the possibility that it has some influence on the establishment and development of the disease is not ruled out, fundamentally oriented not by the condition of being male or female, of tooth eruption (most of the time this is earlier in females; therefore, the mean exposure time of the teeth is greater for them). Moreover, Declerck et al. established that dental caries is related to several variables that have a close relationship with the onset of the disease, but the variable of gender has shown different behaviors and in an inconsistent manner.⁷ Some reports have mentioned that females presented a greater frequency; in other reports males showed this condition as reported by Gurrola-Martínez et al. in Mexican children⁴² and Smith and Lang²⁰ in Nicaraguan children. They noted that there was a small difference between genders, but it was not statistically significant, appearing more in males. This contrasts with what was established by Díaz-Cárdenas and González-Martínez²¹ and García et al.²² in Colombian children where a who observed a higher prevalence in females.

In regard to the relationship between the average experience of dental caries with the quality of oral hygiene, a high association was observed between both variables, a behavior similar to what has been reported in other studies.³⁹⁻⁴³ For this reason it is understood that oral hygiene is considered to be the factor of highest relevance for the establishment and development of caries. The following questions must be asked: does the condition of good quality oral hygiene that was observed in that

population meet the requirements for adequate management technique and oral hygiene aids? Or could it be that this condition is more narrowly related to the type of diet that they consume, which by itself may be noncariogenic? Even more, could the characteristics of the diet itself be causing autolysis? These are questions that come up and provide the possibility of continuing with this line of investigation in the study population. However, and independent of the possible response to these questions, it is an evident fact that the reference population had a very low prevalence of dental caries as well as good quality dental hygiene, trends which are desirable for any population. For this reason we can conclude that, in the study population, the average experience of caries in both dentitions was low as the dfmt values were in up to two primary teeth with some experience of caries at the most, whereas the average DMFT in the secondary dentition was almost zero. Also, the frequency of caries in both dentitions was not high as expected but was lower in accordance with what was reported by other authors in populations with similar characteristics. Likewise, it was observed that the average experience in secondary tooth decay increased with age. In regard to the quality of oral hygiene, the "good" condition was most frequently observed, both in age and gender. The average experience of dental caries was found to have a close relationship with the quality of oral hygiene, which was statistically significant.

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REFERENCES

1. Organización Mundial de la Salud. Salud bucodental. Nota informativa N° 318. Febrero de 2007. Available at: <http://www.who.int/mediacentre/factsheets/fs318/es/>
2. Anderson M. Risk assessment and epidemiology of dental caries: review of the literature. *Pediatr Dent* 2002;24:377-385.
3. Cuenca SE, Baca GP. *Odontología Preventiva y Comunitaria. Principios, Métodos y Aplicaciones*. Barcelona: Masson; 2005.
4. Harris NO, García-Godoy F. *Odontología Preventiva Primaria*. México, DF: Manual Moderno; 2001.
5. Rioboo-García R. *Odontología Preventiva y Odontología Comunitaria*. Madrid: Avances Médico-Dentales; 2002.

6. Petersson GH, Bratthall D. The caries decline: a review of reviews. *Eur J Oral Sci* 1996;104(4 Pt 2):436-443.
7. Declerck D, Leroy R, Martens L, Lesaffre E, García-Zattera MJ, Vanden Broucke S, et al. Factors associated with prevalence and severity of caries experience in preschool children. *Community Dent Oral Epidemiol* 2008;36:168-178.
8. Cinar AB, Christiansen LB, Hede B. Clustering of obesity and dental caries with lifestyle factors among Danish adolescents. *Oral Health Prev Dent* 2011;9:123-130.
9. Bratthall D. Estimation of global DMFT for 12-year-olds in 2004. *Int Dent J* 2005;55:370-372.
10. Ekbäck G, Persson C. Caries in five different socio-economic clusters in Örebro county. *Community Dent Health* 2012;29:229-232.
11. Haugejorden O, Magne B. Ecological time-trend analysis of caries experience at 12 years of age and caries incidence from age 12 to 18 years: Norway 1985-2004. *Acta Odontol Scand* 2006;64:368-375.
12. Angelillo IF, Anfosso R, Nobile CG, Pavia M. Prevalence of dental caries in schoolchildren in Italy. *Eur J Epidemiol* 1998;14:351-357.
13. Centers for Disease Control and Prevention (CDC). Dental caries in rural Alaska native children—Alaska, 2008. *Morb Mortal Wkly Rep* 2011;60:1275-1278.
14. Irigoyen ME, Mejía-González A, Zepeda-Zepeda MA, Betancourt-Linares A, Lezana-Fernández MA, Álvarez-Lucas CH. Dental caries in Mexican schoolchildren: a comparison of 1988-1989 and 1998-2001 surveys. *Med Oral Patol Oral Cir Bucal* 2012;17:e825-e832.
15. Pérez-Domínguez J, González-García A, Niebla-Fuentes M, Ascencio-Montiel I. Dental caries prevalence survey in children and teenagers. *Rev Med Inst Mex Seguro Soc* 2010;48:25-29.
16. Casanova-Rosado AJ, Medina-Solís CE, Casanova-Rosado JF, Vallejos-Sánchez AA, Maupomé G, Ávila-Burgos L. Dental caries and associated factors in Mexican schoolchildren aged 6-13 years. *Acta Odontol Scand* 2005;63:245-251.
17. Villalobos-Rodelo JJ, Medina-Solís CE, Vallejos-Sánchez AA, Espinoza-Beltrán JL. Caries dental en escolares de 6 a 12 años de Navolato, Sinaloa: resultados preliminares. *Rev Biomed* 2005;16:217-219.
18. Rodríguez-Vilchis LE, Contreras-Bulnes R, Arjona-Serrano J, Soto-Mendieta MR, Alanís-Tavira J. Prevalencia de caries y conocimientos sobre salud-enfermedad bucal de niños (3 a 12 años) en el Estado de México. *ADM* 2006;63:170-175.
19. Moreno-Altamirano A, Carreón-García J, Alvear-Galindo G, López-Moreno S, Vega-Franco L. Riesgo de caries en escolares de escuelas oficiales de la Ciudad de México. *Rev Mex Pediatr* 2001;68:228-233.
20. Smith AC, Lang WP. CPITN, DMFT, and treatment requirements in a Nicaraguan population. *Community Dent Oral Epidemiol* 1993;21:190-193.
21. Díaz-Cárdenas S, González-Martínez F. Prevalencia de caries dental y factores familiares en niños escolares de Cartagena de Indias, Colombia. *Rev Salud Pública* 2010;12:843-851. Available at: <http://www.redalyc.org/articulo.oa?id=42219911014>
22. García L, Giraldo S, Mossos R, Muñoz M, Perea C, Prado C. Prevalencia de caries y enfermedad periodontal en escolares del sector público de Cali, 2005. *Colomb Med* 2008;39(suppl 1):47-50.
23. Mendes-Goncalves D, Caricote-Lovera N. Prevalencia de caries dental en escolares de 6 a 12 años de edad del Municipio Antolín del Campo, Estado Nueva Esparta, Venezuela (2002-2003). *Revista Latinoamericana de Ortodoncia y Odontopediatría*. "Ortodoncia.ws" edición electrónica Diciembre 2003. Available at: <http://www.ortodoncia.ws/publicaciones/2003/art7.asp>
24. Milciuvienė S, Bendoraitienė E, Andruskeviciene V, Narbutaitė J, Sakalauskienė J, Vasiliauskienė I, et al. Dental caries prevalence among 12-15-year-olds in Lithuania between 1983 and 2005. *Medicina (Kaunas)* 2009;45:68-76.
25. Gorbatova MA, Grijbovski AM, Gorbatova LN, Honkala E. Dental caries experience among 12-year-old children in Northwest Russia. *Community Dent Health* 2012;29:20-24.
26. Cook SL, Martínez-Mier EA, Dean JA, Weddell JA, Sanders BJ, Eggertsson H, et al. Dental caries experience and association to risk indicators of remote rural populations. *Int J Paediatr Dent* 2008;18:275-283.
27. Bedos C, Brodeur JM. Determinants of dental caries in Haitian schoolchildren and implications for public health. *Sante* 2000;10:161-168.
28. Molina-Frenchero N, Irigoyen ME, Castañeda-Castaneyra E, Sánchez-Hinojoza G, Bologna RE. Caries dental en escolares de distinto nivel socioeconómico. *Rev Mex Pediatr* 2002;69:53-56.
29. Ozer S, Sen Tunc E, Bayrak S, Egilmez T. Evaluation of certain risk factors for early childhood caries in Samsun, Turkey. *Eur J Paediatr Dent* 2011;12:103-106.
30. Molina-Frenchero N, Castañeda-Castaneyra E, Marques-Dos-Santos MJ, Soria-Hernández A, Bologna-Molina R. Dental caries and risk factors in adolescents of Ecatepec in the State of Mexico. *Rev Invest Clin* 2009;61:300-305.
31. Hashizume LN, Shinada K, Kawaguchi Y. Factors associated with prevalence of dental caries in Brazilian schoolchildren residing in Japan. *J Oral Sci* 2011;53:307-312.
32. Selwitz R, Ismail AI, Pitts NB. Dental caries. *Lancet* 2007;369:51-59.
33. Scheie AA, Petersen FC. The biofilm concept: consequences for future prophylaxis of oral diseases? *Crit Rev Oral Biol Med* 2004;15:4-12.
34. Van Houte J. Role of micro-organisms in caries etiology. *J Dent Res* 1994;73:672-681.
35. Hausen H. Caries prediction—state of the art. *Community Dent Oral Epidemiol* 1997;25:87-96.
36. Seow WK. Biological mechanisms of early childhood caries. *Community Dent Oral Epidemiol* 1998;26(1 suppl):8-27.
37. Plonka KA, Pukallus ML, Barnett AG, Walsh LJ, Holcombe TH, Seow WK. Mutans streptococci and lactobacilli colonization in pre-dentate children from the neonatal period to seven months of age. *Caries Res* 2012;46:213-220.
38. Berkowitz RJ. Acquisition and transmission of mutans streptococci. *J Calif Dent Assoc* 2003;31:135-138.
39. Razmienė J, Vanagas G, Bendoraitienė E, Vyšniauskaitė A. The relation between oral hygiene skills and the prevalence of dental caries among 4-6-year-old children. *Stomatologija* 2011;13:62-67.
40. Gathecha G, Makokha A, Wanzala P, Omolo J, Smith P. Dental caries and oral health practices among 12 year old children in Nairobi West and Mathira West Districts, Kenya. *Pan Afr Med J* 2012;12:42.
41. Guido JA, Martínez-Mier EA, Soto A, Eggertsson H, Sanders BJ, Jones JE, et al. Caries prevalence and its asso-

- ciation with brushing habits, water availability, and the intake of sugared beverages. *Int J Paediatr Dent* 2011;21: 432-440.
42. Gurrola-Martínez B, Caudillo-Joya T, Adriano-Anaya MP, Rivera-Navarro MJ, Díaz-Sotelo DA. Diagnóstico en escolares de 6 a 12 años promedios CPOD, IHOS en la delegación Álvaro Obregón. *Revista Latinoamericana de Ortodoncia y Odontopediatría* "Ortodoncia.ws" edición electrónica Marzo 2009. Available at: <http://www.ortodoncia.ws/publicaciones/2009/art5.asp>
43. Prashanth ST, Bhatnagar S, Das UM, Gopu H. Oral health knowledge, practice, oral hygiene status, and dental caries prevalence among visually impaired children in Bangalore. *J Indian Soc Pedod Prev Dent* 2011;29:102-105.

www.medigraphic.org.mx