Factors related to dental health in 12-year-old children: a cross-sectional study in pupils

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Abstract

Objective: The aim of this study was to identify factors related to the prevalence of caries in 12-year-old schoolchildren.

Methods: A cross-sectional study was carried out using a representative sample (n = 1217) of the population of 12-year-old schoolchildren in Galiza (northwest Spain). Independent variables were measured through a questionnaire, and dependent variables were determined through oral examination. Multiple and logistic regression were applied.

Results: The decayed, missing and filled permanent teeth/decayed, filled primary teeth (DMFT-dft) value in the sample was 1.83 (95% confidence interval [CI], 1.67-1.98), the DMFT value was 1.53 (95% CI, 1.37-1.67), and the prevalence of caries was 61% (95% CI, 57.7-64.5). The prevalence of caries was directly related to a low frequency of brushing, greater use of toothpaste, and a higher consumption of sweets. The prevalence of caries was higher in rural than in urban areas. In contrast, the higher the mother's level of education and the greater the subject's knowledge of dental health, the lower the prevalence of caries.

Conclusions: The main goals of dental health programmes should be to achieve quality brushing every day in children, to reduce the consumption of sweets, and to increase knowledge of dental health.

Key words: Children. Dental knowledge. Health practice. Oral health surwey. Spain.

Resumen

Objetivo: Identificar los factores asociados a la prevalencia de caries en escolares de 12 años.

Métodos: Estudio transversal sobre una muestra (n = 1.217) de escolares de 12 años de Galicia. Las variables independientes se midieron mediante un cuestionario y las dependientes, a través de exploración bucal. En el análisis estadístico se aplicaron regresión logística y regresión lineal múltiple.

Resultados: El índice CAO-co en la muestra fue 1,83 (intervalo de confianza [IC] del 95%, 1,67-1,98), el índice CAO 1,53 (IC del 95%, 1,37-1,67), mientras que la prevalencia de caries se situó en el 61% (IC del 95%, 57,7-64,5). La prevalencia de caries estuvo directamente asociada a la baja frecuencia del cepillado, al mayor uso de pasta y al elevado consumo de golosinas. La prevalencia de caries determinada en el medio rural fue más alta que en el medio urbano. Por último, el mayor nivel de estudios de la madre y los mayores conocimientos sobre salud oral de los individuos se asocian a una menor prevalencia de caries.

Conclusiones: A pesar de la moderada afectación por caries, los principales objetivos de los programas de salud oral para este grupo de edad deben ser: lograr el cepillado dental diario, reducir el consumo de golosinas e incrementar los conocimientos sobre salud oral. Por último, los programas de salud oral deben estar dirigidos principalmente a la población del medio rural y de menor nivel sociocultural.

Palabras clave: Niños. Conocimientos dentales. Práctica odontológica. Encuesta sobre salud bucal. España.

Introduction

Epidemiological studies about dental caries in schoolchildren are numerous[1-3]. However, many of these studies only analyse caries prevalence, as the prevalence rate of caries, or through the different caries ratios defined in the bibliography (DMFT, decayed, missing, filling in definitive tooth; dmft, decayed, missing, filling in temporary tooth; dft,

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decayed, filling in temporary tooth)[1,2]. Dental caries is a disease in which cultural and hygienic habits are decisive, so prevalence found in different habitats and different moments could be strong related with these factors.

On the other hand, determining the factors associated with the appearance of caries is of greater interest, given that these factors present high geographical and temporal stability[4]. However, the number of articles that analyse these factors is lower, and despite there being studies on the factors associated with caries in 12 year olds[5-7], studies that use multivariate methodology including cultural variables are scarce[8], a method that allows us to isolate the contribution of each of the risk factors.

The objectives of this study were: to determine caries prevalence in 12-year-old pupils and to identify the factors related to caries prevalence.

Methods

Design and sample

This study has a cross-sectional design, and the study participants were 28 297 children aged 12 years old. The pool of schools was stratified by province (A Coruña, Lugo, Ourense, Pontevedra) and habitat (urban; and rural). Eight clusters were generated. A total of 95 schools were selected proportional to cluster size. Finally, each school had a number of sampled pupils proportional to its size. This sample is comprised of 1217 subjects.

Data collection

For data collection, six teams were created and each one of them were made up of two persons: 1 dentist and 1 assistant who administered out the questionnaire. Diagnosis criteria between the six teams were calibrated by a training of two weeks. The training was made in 4 schools.

The teams visited the schools during the second term of the year 2000. Before the team visited the schools, they were contacted to set dates and determine requirements to carry out the questionnaire and the exploration. Authorisation from the pupils' parents was requested.

Taking previous studies as a starting point, we collected socio-demographic and medical variables, which could be associated with dental caries, through the questionnaire. The questionnaire was designed to be short and easy to fill. Pupils were asked whether they considered they had a healthy mouth, and what pathology they had. Pupils were also queried about their beliefs on health: whether they believed it was important to look after their teeth, if they thought that with age their teeth would be less healthy, and if they believed that sugar produces caries. Pupils were also queried about sweets' consumption.

In as far as their hygienic habits were concerned, the pupils were asked whether they cleaned their teeth habitually, if they used dental floss and if they used an electric toothbrush. Pupils were also asked at what age they had started cleaning their teeth, when was the last time they had cleaned their teeth, how many times they clean their teeth a day, when was the last time they changed their toothbrush, how much toothpaste they put on the toothbrush, and who showed them how to clean their teeth.

The pupils were also asked about their use of fluorinated toothpaste, fluorine tablets, fluorine drops, and fluorinated mouthwashes. Pupils were also queried about whether they had been to the dentist, and if the dentist had advised them to wash their teeth. The schoolchildren's knowledge was also measured on the usefulness of fluorine and on prevention of caries and gingivitis.

Dependent variables were obtained through mouth exploration of the schoolchildren carried out by the dentist. This information was registered using a modified exploration form[9].

Independent variables

Pupils were also queried about their knowledge on dental health through 6 questions, giving 0 (incorrect) or 1 (correct) point to each answer. A variable with values between 0 and 10 was generated, given that some questions had a multiple answer. The questions considered were: *a)* sugar provokes caries, 0 = none, 0 = little, 1 = quite a lot or a lot; *b)* fluorine is good so that, 1 = teeth are more resistant, 0 = teeth are whiter, 0 = teeth are sparkler; *c)* caries is a disease, 1 = that destroys teeth, 0 = that makes your gums bleed, 0 = that gives a bad smell, 0 = in which your teeth get whiter; *d)* gingivitis is a disease, 0 = that destroys your teeth, 1 = that makes your gums bleed, 0 = that gives a bad smell, 0 = in which your teeth get whiter; *e)* I can avoid having caries, 1 = with hygiene, 1 = eating few sweets, 1 = using fluorine, 1 = going for check ups, and *f)* I can avoid gingivitis, 1 = with hygiene, 0 = eating few sweets, 0 = using fluorine, 1 = going for check ups.

In as far as their hygienic habits, the pupils were asked when they had cleaned their teeth last (today, yesterday, day before yesterday, or more than two days ago); and how much toothpaste they had put on the toothbrush (a third, two thirds, or complete).

Pupils were queried about their consumption of sweets and where they eat them habitually (doesn't eat them, at school, at home, with friends, in other situations). This

variable is part of the models as the number of situations in which they eat sweets (doesn't eat them, in 1 situation, in 2, in 3, or in 4). Pupils were also queried about visiting a dentist: when was the last time they had visited the dentist (never visited, more than 1 year ago, between 3 months and one year, less than 3 months ago). Finally, pupils were also queried about orthodontic treatment (yes/no).

One socio-economic variable was considered: mother's education (no education, primary, secondary, university). In addition, an ecological variable which measures the socio-economic habitat was considered: municipality (rural, urban).

Dependent variables

We defined 3 variables to measure caries affectation: *1.* Presence of decayed tooth, missing pieces or with fillings due to caries, dichotomous variable (0 = no; 1 = yes); *2.* DMFT-value; *3.* DMFT-dft-value, average decayed teeth surface in temporary and definite pieces.

Data analysis

The weighted Cohen's Kappa was used to evaluate the concordance between gold standard (evaluation of specialist-professor) and the teams in four schools. A univariate (prevalence) analysis was performed. To analyse the factors related to DMFT-value and DMFT-dft-value (continuum variable) linear multiple regression was used. To study the factors related to caries presence we carried out a logistic regression analyses. Taking into account that our study is a cross-sectional study, odds ratios calculated are really prevalence odds ratio (POR).

According to the hypothesis, maximum models were generated. We excluded from the logistic models variables that had no effect and were not cofounders of the other independent variables (change in coefficients > 10%). We used the Hosmer-Lemeshow test to determine the goodness of fit of the models to the data[10].

Results

Of the 1217 pupils in our sample, 1105 pupils participated in the study (90.8%). The caries prevalence in the studied population was 61.1% (95% confidence interval [CI], 57.7-64.5). The DMFT-dft value in the sample was 1.82 (95% CI, 1.67-1.98), and the DMFT value 1.52 (95% CI, 1.37-1.67). The kappa statistics for concordance ranged from 0.75 to 0.95.

Table 1. Description of subjects studied for the main dependent variables

		95% CI
Decayed tooth by subject (temporary and definite, D-d)	1.03	(0.90-1.18)
DMFT-value (decayed, missing, filling in definitive tooth)	1.52	(1.37-1.67)
dft-value (decayed, filling in temporary tooth)	0.31	(0.26-0.35)
DMFT-dft	1.82	(1.67-1.98)
DMFM (first permanent molar)	1.23	(1.12-1.34)
Proportion of subjects with decayed pieces (D-d) (%)	42.6	(38.9-46.4)
Proportion subjects with missing pieces (M) (%)	3.09	(1.91-4.27)
Proportion of subjects with pieces with fillings (F-f) (%)	33.5	(29.9-37.1)
Proportion of subjects with caries (prevalence caries, DMFT-dft) (%)	61.1	(57.7-64.5)

Table 1 shows the characteristics of the participants; in as far as the main dependent variables are concerned. Table 2 shows the distribution of subjects according to the different categories of the variables of knowledge.

Table 3 shows multiple regression models including the variables chosen for DMFT value and DMFT-dft value as outcomes. The DMFT-dft value and the DMFT value reduce with knowledge on dental health, and with educational level. On the other hand, low frequency in brushing teeth, the use of a lot of toothpaste, and the consumption of sweets are related to higher ratios. The ecological habitat variable (rural/urban) is significant, given that a rural habitat is associated with higher ratios.

Logistic regression model is shown in table 4. The model includes all the variables comprised in the table. This table also includes the description of the sample through independent variables and caries prevalence in different groups.

Discussion

The results of this study show that caries is directly related to a low frequency in brushing, the use of more toothpaste, and a higher consumption of sweets. The study has also shown that there is higher caries prevalence in rural habitats compared to urban habitats. On the other hand, the higher the mother's level of education is and the more knowledge on dental health the subjects have, the lower the caries prevalence.

According to the results of the study, subjects with low knowledge of dental health show more caries (POR = 1.32; 95% CI, 1.20-1.61) than those subjects with higher knowledge. Different studies have found that health education could reduce caries affectation, concluding that higher knowledge generates more positive attitudes that in turn generate healthier habits. On the other hand, the results of our study show that knowledge has

Table 2. Distribution of subjects according to the different categories of the variables of knowledge. The numbers shows the percentage of subjects that agree with the statement

	A lot	Quite a lot	Little	No	DK/DA[b]
Sugar provokes caries	47.0[a]	43.2	8.4	1.0	0.5
	Destroys tooth	Makes your gums bleed	Gives a bad smell	Whitens your tooth	DK/DA
Caries is a disease that[c]	87.7[a]	13.5	14.6	1.0	9.3
Gingivitis is a disease that[c]	2.7	30.6[a]	3.1	0.7	63.0
	With hygiene	Eating less candies	Using fluor	Going to reviews	DK/DA
I can avoid having caries[c]	79.8[a]	66.1[a]	39.8[a]	35.4[a]	2.7
I can avoid gingivitis[c]	20.5[a]	12.1	17.9	18.2[a]	61.0
	Resistant	White	Shiny		DK/DA
Fluor is for teeth to be[c]	75.3[a]	35.6	11.5		12.7

[a]Answers that are considered as correct in the evaluation of knowledge.
[b]Doesn't know, doesn't answer.
[c]Questions with multiple answers. The percentages do not add up to 100%.

Table 3. Related factors with DMFT-dft value and DMFT-value in 12 year old. Linear multiple regression coefficients (Coef), confidence intervals (95% CI) and statistical significance (p-value)

	DMFT-dft-value			DMFT-value		
	Coef*	95% CI*	p-value	Coef*	95% CI*	p-value
Dental health knowledge[a]	–0.068	(–0.136 to –0.000)	0.049	–0.047	(–0.109 to 0.015)	0.135
Last time brushed teeth[b]	0.245	(0.093-0.397)	0.002	0,261	(0.123-0.399)	< 0.001
How much toothpaste used[c]	0.251	(0.053-0.449)	0.013	0.201	(0.021-0.381)	0.029
Sweet consumption[d]	0.142	(0.017-0.267)	0.026	0.164	(0.050-0.277)	0.005
Visits to the dentist[e]	–0.309	(–0.440 to –0.177)	< 0.001	–0.271	(–0.391 to –0.152)	< 0.001
Orthodontics[f]	–0.537	(–0.950 to –0.123)	0.011	–0.377	(–0.752to –0.002)	0.049
Mother's education[g]	–0.259	(–0.417 to –0.100)	< 0.001	–0.207	(–0.351 to –0.063)	0.005
Habitat[h]	0.664	(0.406-0.922)	< 0.001	0.559	(0.325-0.793)	< 0.001

*Adjusted for the other independent variables included in this table.
[a]Measurements on four question (0 = all questions wrongly answered or doesn't answer… 10 = all questions correctly answered).
[b]1 = today, 2 = yesterday, 3 = day before yesterday, 4 = more than two days ago.
[c]1 = a third of the toothbrush, 2 = two thirds, 3 = the toothpaste covers the toothbrush completely.
[d]Five possibilities don't have any, at school, with friends, in my house, others (0 = doesn't consume… 4 = consumes in all situations).
[e]1 = less than 3 months, 2 = less than three months and less than a year, 3 = more than a year, 4 = I've never been to the dentist.
[f]0 = no, 1 = yes.
[g]1 = without education, 2 = primary education, 3 = secondary education, 4 = university education.
[h]0 = urban, 1 = rural.

an effect on its own, independently of being able to modify attitudes and habits.

The fact that the models have been adjusted for follow brushing guidelines, visits to the dentist and consumption of sweets indicates that with the same habits, the subjects with more knowledge on oral health show less caries. There are 2 possible explanations for this result: first, better knowledge is related to better brushing techniques, although when adjusting by the quantity of toothpaste used, part of this effect should be controlled, and second, a certain amount of residual confounding cannot be ignored due to the misclassification introduced in the variables that measure the habits[11].

In as far as the effect of brushing on caries is concerned, the results of our study are consistent with those found by different authors[7]. Therefore, considering the subjects who cleaned their teeth today as a reference category, among those who cleaned their teeth yesterday, we found more caries (POR = 1.48; 95% CI, 1.22-1.78), (POR = 1.57; 95% CI, 0.91-2.33) among those who brus-

Table 4. Factors related with caries presence

	n*	%*	Prevalence odds ratio (POR)[a,b] (95% CI)
Knowledge on dental health			
More knowledge (5-10 points)	340 (30.8%)	59.0	1[c]
Less knowledge (0-4 points)	761 (69.2%)	65.6	1.32 (1.20-1.61)
Last time you brushed your teeth			
Today	687 (62.6%)	55.2	1[c]
Yesterday	294 (26.8%)	68.0	1.48 (1.22-1.78)
Day before yesterday	47 (4.3%)	68.2	1.57 (0.91-2.36)
More than two days ago	70 (6.4%)	81.4	1.60 (1.20- 2.28)
How much toothpaste do you use			
A third	80 (7.3%)	53.8	1[c]
Two thirds	323 (29.4%)	59.1	1.45 (0.87-2.09)
The whole toothbrush	694 (63.3%)	62.7	1.52 (1.10-2.16)
Sweet consumption			
Never	62 (5.7%)	37.1	1[c]
In 1 situation	419 (38.2%)	60.2	1.39 (0.88-2.22)
In 2 situations	377 (34.4%)	61.3	1.44 (0.95-2.30)
In 3 situations	171 (15.6%)	66.7	1.46 (1.02-2.41)
In 4 situations	76 (6.9%)	72.4	1.68 (1.06-2.86)
Visits to the dentist			
Never	129 (11.7%)	49.6	1[c]
> 1 year	229 (20.7%)	59.0	1.74 (1.27-5.83)
Between 3 months and 1 year	335 (30.3%)	63.1	1.50 (1.12-2.13)
< 3 months	411 (37.2%)	64.2	1.48 (1.05-2.06)
Do you have orthodontic treatment			
Yes	126 (11.4%)	53.2	1[c]
No	979 (89.6%)	62.1	1.73 (1.24-2.10)
Mother's education			
University	161 (16.4%)	49.7	1[c]
Secondary	253 (25.8%)	58.9	1.60 (1.32-2.92)
Primary	514 (52.4%)	63.2	1.40 (1.01-1.93)
Without education	52 (5.3%)	78.8	1.40 (1.06-1.86)
Habitat			
Urban	617 (55.8%)	55.4	1[c]
Rural	488 (44.2%)	68.2	1.78 (1.42-2.05)

*Number of subjects and percentage (n), percentage of subjets with caries (DMFT-dft) (%).
[a]Adjusted for the effects of the other independent variables included in the table.
[b]Hosmer-Lemeshow test. p-value > 0.05.
[c]Reference category.

hed their teeth before yesterday and among those who brushed their teeth more than two days ago (POR = 1.60; 95% CI, 1.20-2.28). These results are of statistical significance.

The final models also considered the variable of quantity of toothpaste on the toothbrush. Taking as a reference category those who use a third of the toothbrush with toothpaste, the subjects who use two thirds show more caries (POR = 1.32; 95% CI, 1.10-2.16), and also those who use the whole brush (POR = 1.52; 95% CI, 1.20-1.61). These results show a clear significant tendency. This association between quantity of toothpaste and caries could be due to 3 reasons: *a)* the variable quantity of toothpaste could be a proxy of the quality of brushing. Therefore, the subjects who use less toothpaste are probably those who have more knowledge on the more adequate way to brush their teeth; *b)* the quantity of toothpaste used is related to the frequency of brushing (p = 0.02). Therefore, it is reasonable to think that the subjects who brush their teeth more frequently use less toothpaste, and *c)* the use of great quantities of toothpaste could generate a false sensation of cleanliness (production of great amounts of foam and a pleasant sensation), which reduces brushing time.

Consistently with previous studies, a high consumption of sweets is related to higher caries prevalence, these results are consistent with the bibliography[12-15], even though the consumption between meals could be a more suitable measure. Therefore, taking the subjects who never consume as a reference category, we found

increasing values of caries prevalence as the situations in which they are consumed increase: in one situation (POR = 1.39); in two situations (POR = 1.44); in three situations (POR = 1.46), and in four situations (POR = 1.68). The fact that the models have been adjusted according to brushing, quantity of toothpaste, or visits to the dentist, allows us to confirm the negative effect that the number of times we eat sweets has on caries, independently of the subject maintaining adequate hygienic habits.

In as far as the variable of education of the mother is concerned, a univariate analysis shows how caries prevalence increases as the level of education decreases, we go from a prevalence of 49.7% in children with mothers with higher education, to a prevalence of 78.8% in children with mothers who have no education. These results are consistent with those in the bibliography[6,16], which generally show worse dental health in the lower economic strata[17-19].

However, when analysing prevalence odds ratio we observe different data: taking higher education as a reference category, caries prevalence odds ratio in secondary education is POR = 1.62, while in the categories of primary and no education this increase is lower POR = 1.40. These results show an important confusing effect of the remaining variables, an effect that has not been described in the bibliography.

The lower caries prevalence in subjects belonging to the lower cultural strata compared with the middle cultural strata is not easy to explain. Perhaps the subjects belonging to a lower socio-economic strata consume less refined sugar products[20], although we cannot ignore that this difference in prevalence may be a sample effect, in fact, the confidence intervals are not significant.

We also considered one aggregate variable of the municipality where the pupils live, rural municipalities and urban municipalities, finding that there is a lower level of dental health in rural habitats. Traditionally, there has always been a lower economical and cultural level in rural habitats, and less possibility of access to a dentist. And despite including the parents' level of education and check ups in the models, we cannot ignore a certain degree of residual confounding. Moreover, the level of studies is a proxy of socio-cultural level, but both are not equal. In any case, these interpretations must be made with caution, due to the possibility of «ecological fallacy» in the measurement of these variables[11].

Moreover, the models include variables of orthodontics and visits to the dentist. These variables have been included solely to adjust the models, and their coefficients have no direct interpretation on the models.

Since the current analysis is based on cross-sectional data, the validity of the conclusions could be limited by the difficulty in differentiating between cause and effect. In this case however, the factors associated with caries (i.e. habitat, socio-economical level, oral hygiene, sweet consumption) are variables that are unlikely to change during the period of time in which the dependent variable is measured[11].

This study may give health educators, planners and other health professionals' information that will help to reduce dental caries. The main goals of dental health programmes should be to achieve quality brushing every day in children, to reduce the consumption of sweets, and to increase knowledge on dental health.

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