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Prevalence of Dental Caries in the School Population of a Municipality in the Northern Interior of Portugal

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ABSTRACT

Dental caries affects all age groups and is the most common chronic disease in children aged 5 to 17 years. The present work seeks to know the dimension of the problem, to compare the reality found in the school population, aged between 7 and 19 years old, in a municipality in the northern interior of Portugal with others already studied, to calculate the distance that separates them from the goals of the World Health Organization for the year 2020 and to evaluate and analyze the association of the presence of dental caries with behavioral variables.408 children, from the 1st and 2nd school cycles, from the 2006/2007 school year, attending public schools were examined. Dental caries was measured by the DMF index and SIC. A cross-sectional observational analytical methodology was used. The average age of those examined was 11.8 years, with a proportional sample between females and males in any age group. The percentage of caries-free children was 11.0%. The DMF index of the sample was 4.65 and the SiC was 9.41. The value of decayed teeth is the most representative. There was a trend towards a decrease in caries episodes with the increase in brushing frequency. This northern interior municipality has one of the highest DMF and SIC values in Portugal, and well above the goals proposed by the WHO for 2020, finding a parallel with less developed countries.

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Introduction

Oral health is an integral and fundamental part of a child's general health. Dental caries is the most common chronic disease in childhood and one of the most prevalent oral diseases, both in childhood and adulthood, of the world population [1,2]. It is an infectious disease, which arises after tooth eruption, which can be transmitted, and which causes the destruction of mineralized dental tissues. Its appearance results from an interaction between several host and environmental factors [2].

The pain caused by the disease has several implications for people's lives, including school abstinence, loss of appetite and changes in language and growth, which may have repercussions on the child's normal development [2].

Despite the fact that this disease has declined in Portugal [1,3,4], it remains an epi-demic disease, with an increase in the disease being predicted in some African countries, either by dietary changes with greater availability of cariogenic foods, or due to inadequate monitoring of oral health [3].

The decline observed in the values of dental caries indices, all over the world, but with special relevance in more developed countries, is not unrelated to the policies adopted over the years [5-10]. The measures included the incorporation of fluoride supplements in drinking water [5-8,10], the use of fluoride in toothpastes [5,6,8,10], an in-crease in the number of dentists, facilitating access to dental care [5,6], an increase in the demand for dental care [6] and growth in the number and scope of Oral Health actions [5-8,10].

In short, prevention is the best way to control this pathology and must be based on three fundamental steps: (i) oral hygiene from the moment the first tooth eruptions; (ii) intake of sugary foods limited to a single weekly time, followed by strict hygiene and (iii) administration of fluoride in its various forms [11,12]. However, it should be noted that there are studies that establish a relationship between the prevalence of dental caries and the level of education of parents or caregivers [13-15].

Considering the above, the decline in dental caries can lead to the phenomenon of polarization of the disease, that is, to register a concentration of the pathology in certain fringes of society. Reason that justifies the verification if this phenomenon affects the population under study. In addition, epidemiological surveys are an instrument to be valued in the sense of establishing space-time comparisons[16,17].

Bearing in mind, it is extremely important to know the dimension of this health problem in the communities that are intended to intervene, enabling the adoption of adjusted measures to control the disease [18-20]. Only in this way can the demand for oral health care be adapted to individual needs, avoiding impulsive or negligent demand [21,22].

Thus, an epidemiological investigation was carried out, using a cross-sectional ob-servational analytical methodology, with the objectives of (i) knowing the dimension of the problem; (ii) to compare the reality found in the school population, aged between 7 and 19 years old, in a municipality in the northern interior of Portugal with others already studied; (iii) calculate the distance that separates it from the goals of the World Health Organization for the year 2020; and (iv) to evaluate and analyze the association between the presence of dental caries and behavioral variables.

Materials and Methods

Measure the percentage of young people free from caries, calculate the DMF index (sum of the number of decayed, missing and filled teeth/number of examined) and the SIC (Significant Caries Index – average DMF for the subgroup that represents the third of the group that presents the highest values of disease) [23] of the school population attending the 1st and 2nd cycle of basic education, in a municipality in the northern interior of Portugal, during the academic year 2006/2007. Compare the reality found in this municipality with others already studied and calculate the distance that separates them from the goals of the World Health Organization (WHO) for 2020 [20].

The municipality under study is in the north of Portugal, in the province of Trás-os-Montes, being an integral part of the district of Vila Real. Its approximate area is 322 km 2 and the total population is around 8 thousand inhabitants. The county's economy is based on the primary, secondary and tertiary sectors, with the primary and tertiary sectors having the greatest expression. At the time of the study, the municipality was served by a Health Center and educational care was provided by 2 1st cycle schools and one 2nd cycle school.

The choice of this municipality was due to the fact that there are no data regarding the oral health of its school population until the date of this study, the resulting data will be, it is believed, an asset in the evaluation of oral health in Portugal.

Epidemiological investigation, carried out through an observational and cross-sectional analytical study of a quantitative nature.

The sample coincided with the target population, formed by 408 students who attended the 1st and 2nd cycles (students from the 1st to the 9th year of schooling) of basic education in public schools in a municipality in the northern interior of Portugal.

Data collection took place in April, after the participants had been previously informed and requested written consent, in the form of a declaration, from their guardians.

The exams were held in a classroom with plenty of natural light. The examiner was seated in a chair and the participant was seated in a slightly higher plane to optimize observation. The data collected were recorded by the annotators on the sheets created

for this purpose. The material used was the mouth mirror and the "CPI" probe.

The activity was carried out by the Portuguese Association of Oral Health in partnership with the Faculty of Dental Medicine of the University of Porto, in collaboration with teachers from the different schools involved and the local City Council.

The examiners, annotators and motivators were final year dental students. The examiners were previously calibrated by a "Gold Standard" calibrator, to guarantee the uniformity of the exams [24].

For processing and statistical analysis of the collected data, Microsoft Excel® and SPSS® software were used.

The DMF and SIC indices and the percentage of those examined free of dental caries were calculated.

The statistical tests used to examine the hypotheses were Chi-square, Mann-Whitney test and Kuskall-Wallis test. The confidence interval used was 95%, with $p < 0.05$.

Categorical variables were described using absolute and relative frequencies. Continuous variables were described using mean and standard deviation.

The statistical analysis of the data will be presented in the form of graphs and tables to facilitate its visualization and understanding.

Results and Discussion

The age of the 408 students evaluated varied between a minimum of 7 and a maximum of 19 years, with an average age of 11.8 years (**Fig 1**). Based on the median, 50% of respondents were between 7 and 12 years old. The most frequent ages were 10, 13 and 15 years old, with 12.0%, 11.8% and 11.5% respectively.

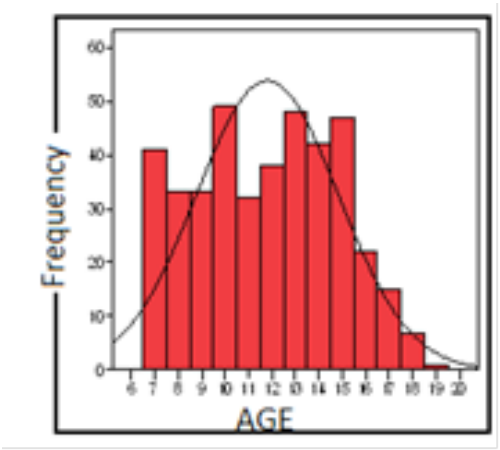

Figure 1: Histogram with normal curve for the age of the sample.

As for the distribution of the sample, according to sex, 49.3% were female children and 50.7% male children (**Table 1**).

Table 1: Distribution of the sample by sex.

Fri	Frequency (n)	Percentage (%)
Female	201	49,3
Male	207	50,7

Considering the age of the children and using the chi-square test of independence ($p = 0.698$) we found that there are no statistically significant differences in the distribution of the sample by sex and age (Table 2). Considering the gender variable, no statistically significant differences were found in the mean age of the sample, which was 11.7 years for females and 11.9 years for males ($p = 0.369$) **(Table 2)**.

Table 2: Distribution of the sample according to sex and age.

Fri / Age	Female		Male		Total	
	n	%	n	%	n	%
7	21	51,2	20	48,8	41	10,0
8	17	51,5	16	48,5	33	8,1
9	15	45,5	18	54,5	33	8,1
10	26	53,1	23	46,9	49	12,0
11	20	62,5	12	37,5	32	7,8

12	20	52,6	18	47,4	38	9,3
13	19	39,6	29	60,4	48	11,8
14	18	42,9	24	57,1	42	10,3
15	26	55,3	21	44,7	47	11,5
16	11	50,0	11	50,0	22	5,4
17	5	33,3	10	66,7	15	3,7
18	3	42,9	4	57,1	7	1,7
19	0	0,0	1	100,0	1	0,2
Total	201	49,3	207	50,7	408	100
$\bar{X} \pm S$	11,7 ± 2,9		11,9 ± 3,1		11,8 ± 3,0	
P50	12		12		12	
Mann-Whitney test: U=19739,5; Z=-0,898; *p*=0,369 ns						
Qui-Quadrado test: χ^2= 8,169; g.l.= 11; *p*=0,698						

As for the number of habitual brushings (**Fig 2**), 50.2% of children and adolescents habitually brushed their teeth twice a day, 4.9% three times and 20.3% once a day; 24.5% of the sample did not regularly brush their teeth.

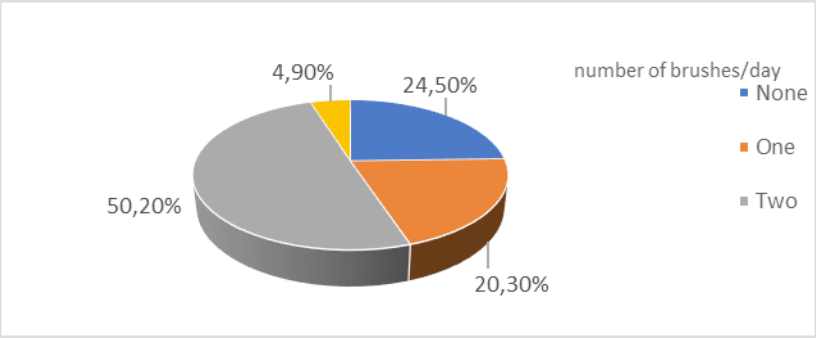

Figure 2: Distribution of the sample, according to the number of daily brushings.

Comparing the number of brushings according to sex and age, applying the Kruskal-Wallis test, it was found that there were statistically significant differences between the groups (p = 0.004). Thus, analyzing the average of the orders, it was found that the ages of 7, 11, 12 and 14 years old were the ages that most frequently brushed their teeth. On the contrary, the group aged between 15 and 19 years old was the one who indicated brushing their teeth less frequently.

At the ages of 9 years (36.4%) and 10 years (36.7%), more than 1/3 of the students never brushed their teeth, increasing this value to 44.7% at the age of 15 years. Comparing the groups according to sex, based on the Mann-Whitney test, no statistically significant differences were found regarding the frequency of brushing (p = 0.526).

Descriptive analysis of decayed, missing and filled teeth

As for the number of decayed teeth, 18.1% of the participants did not have any decay. The remaining (81.9%) had between 1 and 21 cavities, and, on average, each individual had 3.39 cavities and 61.5% of children and adolescents had between 1 and 5 cavities.

Regarding filled teeth, 57.8% of the individuals did not have any filling and 42.2% had between 1 and 12 filled teeth. Of the students with fillings, the majority (88.4%) had between 1 and 3 fillings.

Finally, regarding the number of missing teeth, it was found that the majority (82.8%) had no missing teeth, while 17.2% had already lost between 1 and 10 teeth and of these, 91.4% had lost between 1 to 3 teeth.

The DMF index ranged from a minimum of 0 to a maximum of 23, with 11.0% of students with DMF equal to zero, meaning the absence of present or past signs of dental caries. The mean of the distribution was 4.65 values with a standard deviation of 3.66 values.

The mean DMF index at 12 years was 3.71 with a standard deviation of 2.42. With regard to the global SIC index, there was an average of 9.41 values with a standard deviation of 2.86 values, and this indicator decreased to 7.80 with a standard deviation of 0.84 values for the specific age of 12 years (**Fig 3**).

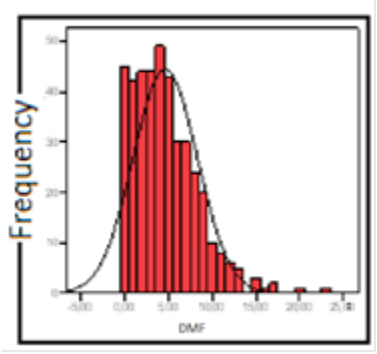

Figure 3: Histogram with normal curve of the DMF index.

Of the study participants, 11% had a DMF index value=0. Most individuals (57.1%) had a mean DMF index value greater than 3 and 31.9% had between 1 and 3 of decayed, missing and filled teeth (**Fig 4**).

Figure 4: DMF index histograma.

Comparative analysis of the number of decayed, missing and filled teeth, according to age

In **Fig 5**, whatever the age, the average number of missing teeth is always the lowest value, followed by the number of filled and decayed teeth. Children aged between 11 and 14 years had the lowest number of decayed teeth and DMF index in the sample.

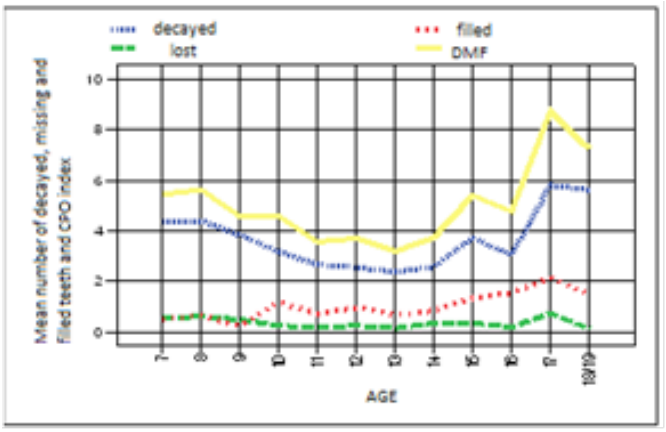

Figure 5: Distribution of the number of decayed, missing and filled teeth, according to age.

It was also found that the missing teeth did not increase significantly with age, on the contrary, the number of filled teeth clearly increases.

By applying the Kruskal-Wallis test (**Table 3**) it was found that, taking into account the age of the participants, the differences are statistically significant for the mean number of decayed and filled teeth and DMF index, but not for the number of teeth lost.

Table 3: Comparison of decayed, missing and filled teeth according to age.

Idade	$\overline{X} \pm S$	$\overline{X} \pm S$	$\overline{X} \pm S$	$\overline{X} \pm S$
7 Years	*4,37 ± 3,96*	*0,56 ± 1,84*	*0,51 ± 1,27*	*5,44 ± 4,71*
8 Years	*4,39 ± 3,71*	*0,61 ± 1,03*	*0,64 ± 0,96*	*5,64 ± 4,08*
9 Years	*3,85 ± 3,37*	*0,48 ± 1,48*	*0,24 ± 0,61*	*4,58 ± 3,81*
10 Years	*3,18 ± 2,64*	*0,24 ± 0,83*	*1,16 ± 1,86*	*4,59 ± 3,54*
11 Years	*2,66 ± 2,06*	*0,19 ± 0,64*	*0,72 ± 1,02*	*3,56 ± 2,34*
12 Years	*2,55 ± 2,10*	*0,24 ± 0,59*	*0,95 ± 1,16*	*3,71 ± 2,42*
13 Years	*2,38 ± 2,02*	*0,15 ± 0,55*	*0,69 ± 1,06*	*3,19 ± 2,35*
14 Years	*2,57 ± 2,24*	*0,33 ± 0,75*	*0,83 ± 1,10*	*3,74 ± 2,65*
15 Years	*3,72 ± 3,82*	*0,34 ± 0,66*	*1,34 ± 2,20*	*5,40 ± 4,37*
16 Years	*3,05 ± 2,36*	*0,18 ± 0,50*	*1,55 ± 1,84*	*4,77 ± 2,94*
17 Years	*5,80 ± 2,93*	*0,73 ± 1,10*	*2,13 ± 2,20*	*8,73 ± 3,10*
18/19 Years	*5,63 ± 5,95*	*0,13 ± 0,35*	*1,50 ± 1,31*	*7,25 ± 5,99*
Kruskal Wallis test	c^2 = *23,638* *g.l.=11* *P=0,014*	c^2 = *19,481* *g.l.=11* *P=0,053*	c^2 = *30,991* *g.l.=11* *P=0,001*	c^2 = *36,874* *g.l.=11* *P<0,001*

Comparative analysis of the number of decayed, missing and filled teeth, according to sex

Applying the Mann-Whitney test (p >0.05), it was found that the mean number of decayed, missing and filled teeth and the DMF index do not show statistically significant differences between sexes.

Comparative analysis of the number of decayed, missing and filled teeth, according to the number of brushings

Fig 6 shows the comparative analysis of the number of decayed, missing, filled teeth and the DMF index, according to the number of daily brushings. There was a tendency to decrease the DMF values as the frequency of brushing increases.

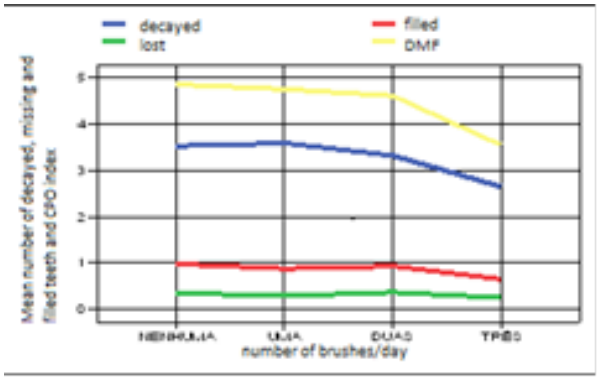

Figure 6: Distribution of the number of decayed, missing and filled teeth according to the number of daily brushings.

Using the Kruskal-Wallis test (p >0.05), the mean number of decayed, missing and filled teeth and the DMF index is significantly the same as the number of usual brushings, al-though there is a decrease of the DMF from the two daily brushes.

In **Fig 7**, students with a CIS of zero were associated with the fact that they generally brushed 3 times a day, tended to be female, aged 12, 14 and 11 and with a DMF level of less than 6.

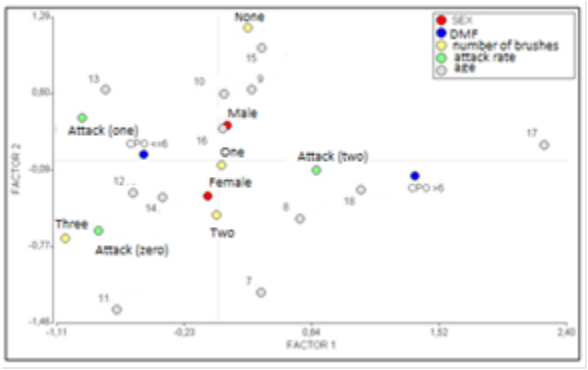

Figure 7: Multiple Correspondence Analysis between the DMF index, attack index (SIC), sex, age and number of brushings.

Conclusions

The average age of the examinees was 11.8 years old with a standard deviation of ±3 years, with a proportional sample between females and males in any age group.

About half of the study participants said they brushed their teeth twice a day, 20.3% brushed their teeth only once a day, and only 4.9% brushed their teeth 3 times a day. It should be noted that 24.5% of the individuals surveyed never brushed their teeth.

The DMFT index found in this population was 4.65 with a standard deviation of ±3.66, and at 12 years of age it was 3.71 with a standard deviation of ±2.42.

The SIC found for the sample studied was 9.41, while for the 12-year-olds the SIC had a value of 7.80. The values found in the study proved to be higher than those published in the DGS report (DGS, 2008) for the North Region, where the municipality in question is located, in 2008, and it was a DMF index of 2.75 and with SIC of 6.4.

Comparing the values for 12 years, it appears that the values found were for the DMF index 3.71 with SIC of 7.80, values higher than those found by the DGS [25] which was 1.62 for the DMF and 4 .0 for SIC, in the same region and with only 5 years of temporal distance. On the other hand, the results are closer to those found in Bragança, a city in the North region of Portugal and with similar socioeconomic characteristics, where the DMF index value found, at 12 years old, was 3.2 and the SIC 6.28 [26].

Analyzing the DMF index by its components, component C (decayed) represents 72.9% of the final DMF, component O (filled) 19.7% of DMF and P (lost) 7.4%. Thus, it appears that the population studied had a high activity of caries, which may alert to lack of demand or access to oral health care.

When compared with studies carried out in countries such as Brazil [27,28] and Japan [29] and with the data contained in the DGS report [25], we found that the relative weight of C (caries) in the DMF index value is much higher in the population studied, while the component (filled) is less representative in the DMF index value.

Values close to those found in the population studied were described for the population studied in Nigeria [30] with C=77.2%, P=7%, O=15.8%, with the exception of treating is a country with lower development indicators than the Portuguese.

When evaluating the entire study sample, or specifically the age group of 12 years, the high prevalence of dental caries could be explained by the absence of oral health programs in the municipality during the year under observation. In addition, students would have access to a high-sugar diet, associated with an increase in the purchasing power of parents with low educational attainment, which can translate into insufficient monitoring and referral of their children, resulting in poor oral health.

In fact, a study carried out in 2003 demonstrated the importance of parental education and the influence of consumption of sugary foods on the prevalence of caries in their children [31]. Furthermore, the rural nature of the environment intervention studied translates into less access to information and oral health care, exacerbated, in the case under study, by the lack of oral health programs and in the community with education for prevention. On the other hand, oral health care in this municipality, at the time of data collection, was provided by only three dental clinics, which operated on a part-time basis. The existence of worse health indicators in rural areas was also described by other authors [32] who attributed this oral fact to fewer oral health prevention/education campaigns, inadequate planning of resources and still lack of data to plan these same interventions. Another author adds that populations residing in rural areas are particularly vulnerable to dental caries because of geographic, economic and socio-cultural barriers [33].

The specific case found in this municipality with a DMF of 3.71 at 12 years old is in line with figures found in other studies carried out in countries that emerged from the former USSR, such as: Lithuania (1998) with a DMF of 4.0, Hungary (1996), Poland (2000) with a DMF of 3.8 and Croatia (1999) with a DMF of 3.5 [34]. In fact, in the municipality under study it was possible to find DMF numbers close to those found in Portugal in 1984 [20]. As such, it is necessary to study this case in greater depth, which seems to be an "outlier" municipality in the reality of the country and also in the international context.

The high rate of 9.41 for the population observed shows that the caries activity in the most affected individuals is very high, that is, there is a tendency for the polarization of the disease. The same phenomenon can be seen in populations studied in Brazil [27,35,36] and in the emigrant population studied in Japan [29].

The number of caries-free children is relevant information because it also allows the assessment and comparison of the oral health status of the population studied. In the population of this county, the number of children free from caries was 11.0%.

Drawing a parallel with countries such as Japan [29], there are studies carried out that show much higher percentages of caries-free children [27]. Another interesting comparison will be with a study carried out in 2004 in Brazil [35], where it was found that, at 12 years of age, the percentage of caries-free children from rural areas was lower than those from urban areas. Urban environments, pointing to better living conditions for these populations. In other words, the rural tendency of that county is confirmed here, with all the inequalities that such conditions represent and have repercussions on the oral health of its children.

According to the WHO [37] the goals for 2000 for the DMFT index at 12 years of age were DMFT=3. The value of the DMF index, more than a decade later, of the population of the present study was 3.71 at 12 years of age, a value higher than those proposed by the WHO. On the other hand, 11.0% of the population had a low risk of caries, 31.90% had a moderate risk of caries and 57.10% had a high risk of caries.

Correlating the number of brushings with the age of the children, it was concluded that the frequency varied according to age, with children aged 7, 11 and 12 being those who brushed their teeth most frequently. Conversely, individuals aged 14 and 19 years were the ones who less often indicated brushing their teeth. On the other hand, relating the number of brushings with sex, it was found that there were no statistically significant differences between the variables, corroborating another study [26] carried out in Bragança, in 2005, where no relationship was found between number of brushings and the sex of those examined.

Based on these conclusions, the relationship between the number of daily brushings and the DMF index in the study population was sought.

It was found that the relationship between daily brushing and the decrease in DMF was not statistically significant. However, from the two daily brushings, there was a clear tendency to decrease the DMF. Investigating the relationship between age and DMFT, it was found that the age group from 11 to 14 years old had the lowest values. The highest values were found in the 7 to 10-year-old groups. No statistically significant differences were detected in the variation of the DMF index and the sex of the individuals. The same conclusion was drawn from a study carried out in Bragança in 2005 [26].

The results found in this study may suggest a particular socioeconomic disadvantage in the municipality, a lack of preventive or curative oral health care or a combination of several factors. The numbers found by the DGS [25] show that the northern region of Portugal has a DMF index value close to countries with less favored market economies for the years 1992/1993 [34]. When compared with studies carried out in Brazil [38], Japan [23], Spain [39], Argentina [40], USA [34], Canada [34], Australia [34], Finland [34] then it is verified, once again, that the studied county has a higher DMF index.

Concluding, in most of the indicators related to dental caries, it was concluded that the municipality of the sample under study is among the least favored.

The sample had one of the highest DMF and SIC values in Portugal, finding a parallel in less developed countries. The overall DMF index in this population was 4.65 and the SIC was 9.41. At 12 years of age, a DMF of 3.71 and a SIC of 7.80 were found. The subgroup aged between 11 and 14 years had the lowest DMF levels in the sample studied. The percentage of caries-free children was 11.0%. Analyzing the DMF index by its components, it was found that the value of decayed teeth is the most representative. The frequency of brushing showed a tendency to reduce caries episodes, reinforcing the importance of education for the adoption of healthy lifestyles. The prevalence of dental caries and the frequency of brushing showed in the association with the sex of the individuals.

Supplementary Materials

The following supporting information can be downloaded at: https://urfpublishers.com/journalname, Figure S1: title; Table S1: title; Video S1: title.

Author Contributions

Conceptualization, Manuel Brás, Ricardo Brás and Dora Machado.; methodology, Manuel Brás, Ricardo Brás and Dora Machado.; software, Manuel Brás, Ricardo Brás and Dora Machado.; validation, Manuel Brás, Ricardo Brás and Dora Machado.; formal analysis, Manuel Brás, Ricardo Brás and Dora Machado.; investigation, Manuel Brás, Ricardo Brás and Dora Machado.; resources, Manuel Brás, Ricardo Brás and Dora Machado.; data curation, X.X.; writing-original draft preparation, X.X.; writing-review and editing, X.X.; visualization, X.X.; supervision, Manuel Brás, Ricardo Brás and Dora Machado; project administration, Manuel Brás, Ricardo Brás and Dora Machado.; funding acquisition, Manuel Brás, Ricardo Brás and Dora Machado. All authors have read and agreed to the published version of the manuscript." Authorship must be limited to those who have contributed substantially to the work reported.

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Conflicts of Interest

The authors declare no conflict of interest.

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