**Abstract**

**Objectives**

The purpose of this study was assessing an elder population from Northern Portugal, as to what concerns its dental tooth decay profile.

**Materials and Methods**

A descriptive, cross-sectional study was made, using a questionnaire intended to assess the institutionalized elders oral health condition by means of quantifying certain oral pathologies, amongst which, the dental tooth decay, using the Index DMF for the crown’s condition assessment and the RCI for the root’s condition assessment. Univariate analysis and multivariable logistical regressions were performed (p<0.05). The data analyses procedures were performed using the IBM© SPSS© Statistics vs.19.0.

**Results**

Three hundred and seventy-two participants were assessed with an age average of 78.8 years, 260 women (69.9%). In the sample, 30.4% had no literacy degree and 81.7% were considered independent concerning their daily oral hygiene aspects. 30.9% of the elders were edentulous and 84.9% had less than 20 teeth. The average number of teeth was 8.9 and the DMF was 25.6. For the RCIi, concerning the gender, men present 44.3% (±30.4%) of tooth root decay, and women 39.4% (±31.2%). Using multivariate logistical regression model the outcome RCIi≥20% was shown to be significantly and positively associated with prosthesis bearing individuals as well as with daily tooth brushing.

**Conclusion**

The prevalence of tooth decay in this elder institutionalized population of Northern Portugal is high. The lack of resources is the prevailing factor in the Portuguese elder population which is associated with the absence of oral health care in the existing national health system.

**Key words:** elderly, oral health, prosthesis, root caries

**Introduction**

Aging is a natural process which is defined as a progressive deterioration of the organism’s biological functions, after achieving its height of reproductive capacity. Several genetic studies have been helping us to better understand the variance between individuals, for a more profound acknowledgment of the aging mechanisms as well as of the age related illness’ etiology, in order to improve the type of therapeutic responses. The biological mechanisms and the aging process are becoming more and more related, the former being inevitable and characterized by the general decline of physiological functions and by the accumulation of deficiencies and diseases which limit the normal bodily functions1,2.

The tooth tissues, similarly to those pertaining to other parts of the body, present modifications throughout life suffering pathological, anatomical and physiological changes. Nevertheless, inside the oral tooth decay, what constitutes a dentition’s “normal aging” is wrongly defined since the teeth are subjected to pathological and physiological changes for years, making it many times difficult or impossible to distinguish between these two procedures3. The prevalence of oral diseases increases with age. In elder populations, dental loss, constant dental tooth decay’s situations and a high incidence of periodontal disease are frequently seen as characteristic traces of the oral health state4.

The dental tooth decay is one of the most prevailing chronic pathologies in the whole world, since people are more susceptible to it throughout life. It can develop in the crowns or in the teeth roots, being related with physical, biological, environmental and behavioural factors, as well as certain associated life styles. Other disease related factors are a high number of acidogenic bacteria, an inadequate salivary flux, bad oral hygiene, insufficient exposure to fluoride, amongst others5. At a worldwide level, dental tooth decay is considered an important public health problem in elder people which is intrinsically connected, in this case, to social action and behavioural factors.

The aging population, combined with the increase of natural teeth maintenance, shall present a new challenge to clinicians: the presence of tooth decay in older patients. Associated with the appearance of tooth decay on elder people comes the need of an assessment of the clinical, as well as of the behavioural factors, which influence their appearance and development. Several studies have been relating the risk of dental tooth decay with: the socio-economical level, the microbiological status, the salivary function, as well as the purely clinical factors such as the presence of dental prosthesis and dental plaque6,7.

The maintenance of increasingly more natural teeth on the oral tooth decay of elder people for longer is another factor which contributes to an increase in exposed roots, apt for the development of superficial caries on the root8,9. The tooth root decay is more prevalent in this age group than in any other9. When the surfaces of the roots become exposed, whether it is due to a physiological process or periodontal atrophy, the tooth decay rate is high both in the cement, as well as in the exposed dentin areas. There are other factors associated with elder people, such as a decrease in the quantity, as well as quality, of the saliva due to pathologies or polypharmacy and also the lack of oral hygiene, deriving from the decrease of physical dexterity caused by the age increase10,11.

As to what concerns elder people, food, that is, the eating habits seem to be of importance in tooth decay development7. The type of food, how long it remains on the surfaces and the intake frequency of some of them are the factors which are going to provide the specific conditions for the bacterial action.

However, this illness is a controllable pathology, whether it is a crown, or a tooth root decay, yet the strategies for the management and the prevention are different for the considered age ranges; from a practical point of view, it is important to understand the importance of intervention in the disease control, since the preventive strategies, in this case, present an increased ease in implementing themselves 7.In relation with the prevalence of one of the most characteristic oral pathologies such as tooth decay, its high prevalence is registered by several authors in many European countries ranging from Northern Europe (Norway) that presents DMF values of 25.4, to Southern Europe countries (Spain), in which the registered DMF values are of 27.02 and 29.211-13.

Tooth root decay on elder people also registers a high prevalence worldwide. In Japan, 287 elder people over 60 years old were assessed, and 39.0% of these individuals were registered as having one or more carious roots and 53.3% had, at least, one cavity9. In Sri Lanka, the tooth root decay prevalence on elder people was of 89.7% and the root caries index average (RCI) per individual was of 3.814.In England, on 462 elder people with 65 years old or older, an RCI of 26% and 46%, respectively, was registered both in non-institutionalized as well as in institutionalized elder people6.

The purpose of this study was to assess an elder population from Northern Portugal, as to what concerns its dental tooth decay profile.

**Material and Methods**

The study was approved by the Ethics Committee of the University Fernando Pessoa (UFP) and complied with the ethical standards and recommendations laid down in the 1964 Declaration of Helsinki and its later amendments.

*Study population*

A descriptive, observational, cross-sectional study was made, through the application of a face-to-face questionnaire and clinical observation (carried out at the UFP-mobile unit, with dental equipment and good lighting conditions) that intended to assess the institutionalized elder concerning their oral health condition by means of quantifying certain oral pathologies, amongst which, the dental tooth decay.

The target population main characteristics were having over sixty years, of residing in homes and of being independent, that is, capable of performing their own oral hygiene, as well as of answering questions placed to them by the observer, or of being partially dependent, only as to what oral hygiene is concerned, that is, to require assistance in some occasions for performing those tasks. The sample was selected using a probabilistic or random sampling method, in relation with the 158 elder people’s nursing homes inside the Oporto district (total of 5855 individuals). Twenty two nursing homes were visited, corresponding to 1046 elder residents. A minimum sample size of 361 was estimated and 372 participants were observed. The participants were enrolled after obtaining written informed consent. From the target population studied, the following were excluded: individuals whom, due to health problems, were not in condition to provide, in a conscious way, permission for being examined; the citizens who hadn’t yet reached sixty years old, despite presenting themselves with the suitable physiological conditions for the study, as well as being institutionalized; the citizens who refused to participate, some due to indispositions, others occasionally justifying themselves with the fact that “they did not have teeth, hence they did not need a Dentist”, even after being enlightened by the observer.

The oral tooth decay’s observations, as well as the questions to be posed to the elder, were performed by the first author whom was previously subjected to a calibration done between the former and an external examiner, with the purpose of minimizing the diagnostic variability, that is, the bias from the established criteria. In the assessments, an intra-examiner agreement of 95.0% was achieved, corresponding to a Kappa of Cohen (κ) value of 0.90.

The adopted diagnosis criteria, for data registering, bear into consideration the WHO recommendations for epidemiological studies15. Thus, for the crown state assessment the presuppositions of the DMFT (average of Decayed, Missed and Filled Teeth) Index were used, which considered, in this case, a maximum total of 32 teeth. The root state assessmentas well as the identification of tooth root decay lesions, the conventions adopted were those Root Caries Index (RCI).This index was used in order to quantify the prevalence of surfaces with root caries, which was obtained by multiplying by 100 the quotient between the sum of the number of decayed root surfaces, with the number of filled root surfaces, over the sum of the decayed root surfaces with that of the filled root surfaces, as well as of the exposed and sound root surfaces, the Root Caries per Individual Index (RCIi)having been performed afterwards, its calculations being obtained by adapting the formula for the RCI calculations, the number of surfaces being accounted per individual.

*Data analyses*

Counts and proportions were reported for categorical variables, and 95% confidence intervals (95% CI) were calculated, Wald or Exact method, for prevalence of oral health conditions. Proportions were compared using the chi‑squared test. The kappa of Kohen coefficient was used to analyse statistical agreement between observations collected the first author and a calibrated external examiner. Quantitative data were described as mean values and their respective standard deviation, or as median values and corresponding 25th and 75th centiles for non-normally distributed variables. The comparisons between two or more than two groups were performed using the non-parametric tests U of Mann-Whitney and of Kruskal-Wallis, respectively, as the presupposition concerning normalcy (Kolmogorov-Smirnov test) was not verified. Multivariable logistic regression was performed using the Wald backward stepwise estimate method (p=0.05 for variable inclusion and p=0.20 for variable exclusion) in order to estimate variables associated with RCIi≥20% outcome. The statistical analysis procedures were performed resorting to the IBM© SPSS© Statistics vs. 19.0 (SPSS Inc., Chicago, IL, USA).Values of p<0.05 were considered statistically significant.

**Results**

*Socio-demographic sample characterization*

A total of 372 individuals from both genders, were assessed, representing 35.6% of the resident population in 22 visited nursing homes. This sample was composed of 260 women (69.9%) and 112 men (30.1%). The youngest individual was 60 years old and the oldest was 101, the age average being of 78.8 years. The biggest elder people representation, 41.9%, is observed on ages ranging between 76 and 84 years old (Table 1).

Table 1 – Age distribution of the participants from the sample (all and according to gender) and indication of the most relevant statistics (counts, percentage, average, standard deviation (stdev), median, percentiles (25 and 75), minimum and maximum).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Age** | | **n** | **%** | **Average (±stdev)** | **Median (P25-P75)** | **Min-Max** | **p** |
| **60-65 years** | | 43 | 11.6 |  |  |  |  |
| **66-75 years** | | 75 | 20.2 |  |  |  |  |
| **76-84 years** | | 156 | 41.9 |  |  |  |  |
| **≥ 85 years** | | 98 | 26.3 |  |  |  |  |
| **All** | | 372 | 100 | 78.8 (± 9.1) | 80 (73-85) | 60-101 |  |
| **Gender** | **F** | 260 | 69.9 | 79.3 (± 8.8) | 81 (74-85) | 60-101 | 0.125 |
| **M** | 112 | 30.1 | 77.7 (± 9.7) | 79 (71-84) | 60- 98 |

In this sample 30.4% had not attended school and had no degree of literacy and the majority of elder people, 55.8%, had attended school for only a few years, in a maximum of 6 years. Only 4.9% of the elder people observed had higher education. In the sample, 81.7% (304) of the individuals was considered independent in relation with the aspects concerning their daily oral hygiene and 18.3% (68) claimed needing assistance. The latter presented an average age of 80.5 years, slightly superior to the age average of independent individuals, 78.5 years, which was proved insufficient in order to find significant differences as to what concerns the age of the two groups (Mann-Whitney-U test, p =0.161).

*Oral health conditions*

The individual’s characteristics in relation with the type of edentulism presented and the type of prosthesis he used to bear in order to compensate the tooth loss, both in the upper jaw, as well as in the mandible, showed that 115 (30.9%) of the assessed elder were total edentulous and only 2 (0.5%) had all their teeth (Table 2).

Table 2 – Distribution of the sample participants according to their type of edentulism

|  |  |  |  |
| --- | --- | --- | --- |
| **Edentulism situation** | **n** | **%** | **95%CI** |
| **Has all the teeth** | 2 | 0.5 | 0% - 1.2% |
| **Total edentulous** | 115 | 30.9 | 26.2% - 35.6% |
| **Partially edentulous** | 255 | 68.6 | 63.9% - 73.3% |
| **All** | 372 | 100 |  |

The biggest percentage of elder people were of partially edentulous whom used no type of prosthesis whatsoever in order to compensate that edentulism, both in the upper jaw, 35.5% [95%CI: 30.6%-40.4%], as in the lower jaw, with 40.6% [95%CI: 35.6%-45.5%]. The total edentulous rehabilitated in the upper jaw, but not on the lower jaw, were 23 (6.2%) [95%CI: 3.7%-8.5%], whereas 70 (18.8%), [95%CI: 14.8%-22.8%], presented total rehabilitations on both arches.

From the 257 who presented, at least, one tooth in their mouths, 100 (38.9%) claimed they did not brush their teeth on a daily basis and only 85 (33.1%) said they had the habit of brushing 2 or more times a day. Elder people of the female gender were the ones who brushed their teeth daily and for a bigger number of times, the number of daily tooth brushing being considered influenced by the degree of Independence / Dependence expressed by the individuals, that is, an association between these two variables was registered (chi-squared test, p=0.013), showing that independent individuals brushed their teeth daily more often.

*Tooth decay profile*

As to what concerns the number of teeth present in the mouth, 315 (84.9%) of the elder from the sample had less than 20 teeth, and the number of teeth present in the mouth, per elder and in average, was of 8.9 (±8.7). The average value of the DMF Index was of 25.6, which leads to the conclusion that 50% of the elder observed showed a DMF index of up to 28 and only 2 (0.5%) of the individuals presented a DMF of zero. The average percentage of decayed teeth in this index is of 7.1% [95%CI: 4.5%-9.7%], the one concerning tooth loss is of 87.0% [95%CI: 83.6%-90.4%] and the related with filled teeth is of 4.7% [95%CI: 2.6%-6.9%]. In average, each elder (Table 3) presented 1.7 (±2.3) decayed teeth and the average number of filled teeth was of 0.9 (±2.1), existing, nevertheless, elders who had up to 14 filled teeth. 49.6% was the percentage of elders who presented decayed teeth in their mouth, the percentage of those who had, at least, one lost tooth was of 99.5% while that of those who presented, at least, one restoration was of 28.0%. Each elder presented, in average, 1.8 (±2.3) decayed teeth, 22.9 (±8.9) lost teeth and 0.9 (±2.1) filled teeth. One should also consider that 50.0% did not present any decayed tooth whatsoever, yet 50.0% of the elder presented a loss of 25 teeth, minimum.

Table 3 – Components of the DMF index with indication to the most relevant statistics (average, standard deviation (stdev), median (percentiles 25 and 75), and minimum and maximum) (n=371) as well as the calculation of the confidence interval for the average population of the 3 components.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **DMF** | **Average (± stdev)** | **95%CI for the mean** | **Median (P25-P75)** | **Min-Max** |
| **Decayed** | 1.8 (± 2.3) | 1.6 – 2.0 | 0 (0-2.5) | 0-14 |
| **Lost** | 22.9 (± 8.9) | 22 – 23.8 | 25 (16-32) | 0-32 |
| **Filled** | 0.9 (± 2.1) | 0.7 – 1.1 | 0 (0-1) | 0-14 |

The DMF index assessment by gender allows to conclude that there are no significant differences (Mann-Whitney-U test, p>0.05). Notwithstanding, as to what age is concerned, it can be concluded that there are significant differences in the DMF index related with the age range (Kruskal-Wallis test, p<0.001) thus meaning that age influences the index values, increasing it significantly. Similar to the degree of independence (in relation with the maintenance of oral hygiene) which also influences the DMF index values, the former also allowing to present a lower DMF index, as well as elder with higher degrees of education presenting significantly lower DMF values.

The RCI values were of 40.6% and by gender, a 39.5% RCI was registered for the female gender and a 42.2% RCI was registered for the male gender. The RCIi (Root Caries Index per individual) allows to verify that in this assessment, 33 individuals were found with a RCIi of 100%, whereas 38 of the 240 elder who complied with the presuppositions for the tooth root decay assessment (Table 4), did not present any tooth root decay, this way revealing the existence of only 15.8% of elder without tooth root decay in the sample with teeth and of 10.2% in the total sample of elders. Individuals with tooth root decay, that is, those who presented exposed and decayed roots, represented 54.3% of assessed people in the study. However, while evaluating the individuals that have some teeth for root assessment, it was accounted that 78.6% have tooth root decay, which represents the prevalence of root caries in the individuals with teeth [95%CI: 74.4%-82.8%]. The average number of root caries per individual assessed was of 3.4 cavities (±3.6), varying between zero and 24 root caries.

In relation with gender, the RCIi values reveal that, in average, men present 44.3% (±30.4%) of tooth root decay and women 39.4% (±31.2%), both genders being able to achieve values of 100%, yet no significant RCIi differences were detected by gender (Mann‑Whitney-U test, p>0.05). Individuals on the age range of 60-65 years old presented a RCIi average of 30.3% (±22.6%) and individuals with 85 years old or older presented a RCIi average of 48.1% (±32.7%). The apparently growing tendency of the RCIi for the 4 age ranges was confirmed, significant differences being able to be detected on the RCIi by age range (Kruskal-Wallis test, p<0.05).

Table 4 – Indication of the number of participants with tooth root decay (with RD), without tooth root decay (without RD), without exposed roots for assessment (without ER), with exposed roots for assessment (with ER) and participants without teeth (sample of 372).

|  |  |  |  |
| --- | --- | --- | --- |
| **Tooth root decay** | **n** | **%** | **95%CI** |
| **Individuals with RD** | 202 | 54.3 | 49.2% - 59.3% |
| **Individuals without RD** | 38 | 10.2 | 7.5% - 13.7% |
| **Individuals with ER** | 240 | 64.5 | 59.5% - 69.2% |
| **Individuals without ER** | 17 | 4.6 | 2.8% - 7.2% |
| **Individuals without teeth** | 115 | 30.9 | 26.4% - 35.8% |

The variables age (years), gender, situation as prosthesis bearer and the number of daily tooth brushings were included in a logistic regression model, allowing for the verification that the age and gender variables are not significantly associated with the RCI forecast equal or superior to 20.0% in institutionalized dentate elder (the initial categorization of the RCIi having been up to 20.0% and equal or superior to 20.0%). It was found that the RCIi≥20.0% in institutionalized dentate elder is significant and independently associated with being a prosthesis bearer, as well as with the daily tooth brushing (p<0.05) and that an institutionalized elder partially toothless and bearer of skeletal prosthesis has a 5.3 fold probability increase of presenting a RCIi≥20.0%, in comparison with elders in other situations (does not include bearer of acrylic prosthesis) (OR=5.348; p=0.030; 95%CI: 1.176–24.329) (Table 5).

Table 5 – Predictors of RCIi equal or superior to 20% for dentate institutionalized elders, identified through multivariable\* logistic regression (n=237). The model correctly foresees 72.6% of the cases.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Category** | **p** | **OR** | **OR 95%CI** |
| **Situation** | Other | 0.065 | 1 |  |
| Partially edentulous acrylic prosthesis | 0.286 | 1.539 | 0.698 – 3.395 |
| Partially edentulous skeletal prosthesis | **0.030** | 5.348 | 1.176 – 24.329 |
| **Daily tooth brushing** | Brushes (≥ 1 times) | **0.002** | 1 |  |
| Does not brush (0 times) | 2.802 | 1.445 – 5.433 |
|  | Constant | 0.018 | 1.589 |  |

\* Variables which entered in the regression model: age (years), gender, situation as prosthesis bearer, daily tooth brushing. Adjusted model: -2 *Log likelihood*=263.7; R2Cox & Snell=0.060; R2Nagelkerke=0.087. CI (confidence interval); OR (*odds ratio*)

**Discussion**

The importance of studying the tooth decay profile in a population is based upon either the assessment of the treatment’s general effects to which elder people were subjected throughout their lives, or of the repercussions caused by the absence of dental medical treatment, a situation which is characteristic in these populations. Nevertheless, in these age ranges, during the tooth decay profile assessment, one must not forget that combined with this condition, are the physiological changes of the oral cavity that came with age and the repercussions deriving from them, which develop adequate conditions for the appearance of the above mentioned pathology, directly influencing their assessment.

Based upon the dimensions of elder people residing in homes in the Oporto District, Northern Portugal, the minimum sample dimension needed for the study was estimated and 372 elders were assessed, representing 35.6% of the residing population in the 22 homes visited. The home’s selection was performed randomly (probabilistic). This way, 260 women (69.9%) were assessed, as well as 112 men (30.1%). The youngest individual was 60 years old and the oldest was 101, the age average being of 78.8 years. An identical characterization, as to what concerns gender and average age of the assessed, was found by other authors in studies performed on elder populations from several countries in the world11,12,14,16,17,19-25.

Within the assessed sample, 30.4% had not attended school and had no degree of literacy whatsoever and as for the majority of elders, 55.8%, had attended school for a maximum period of 6 years. Only 4.9% of the observed elders claimed having higher education studies, the lower levels of literacy being associated with the female gender. The issue of education was registered by other authors in identical assessment studies, in which the results were similar17,21,22,26. The assessment of this parameter is directly related with the fact that one often associates education or the elder people’s literacy level to their oral health condition, namely as to the importance he might bestow upon maintaining a healthy mouth. In Brazil, a study performed in an elder population concludes that studying less than 4 years is an indicator in relation to non-perception of the oral health’s interference in social relationships27, a fact which comes together with the claimed statements. However, in the present study, the degree of education did not relate itself with the number of times elder people brushed their teeth (chi-squared test, p=0.065), yet one can claim that the education levels, “Illiterate” and “Basic education” presented a higher percentage of elders whom did not brush their teeth, as opposed to the “Medium/Average” and “Superior/Higher” levels. The knowledge concerning the need to sanify the mouth and teeth does not depend upon an increased academic education. These individuals might have a bigger probability of accessing information as to the need of tooth brushing, as well as to the implications of a poor hygiene, but, in reality, the habit is related with principles provided with upbringing and personal hygiene cares. Other authors did not register a significant statistic relation between the educational degree and the oral hygiene of home’s resident elder people, also mentioning that the elders who were assessed all claimed to perform the oral hygiene tasks on their own, without any help28. Amongst the elders who participated in the study, 81.7% (304) was considered independent in regard of the issue concerning their daily oral hygiene and 18.3% (68) claimed needing assistance.

Of the 38.9% who did not brush their teeth, 71.1% did not feel the need to do it and only 2.4% claimed not possessing the manual dexterity to do it and 6.0% claimed lack of assistance. The complementary means of oral hygiene were unknown for the majority of the elders observed, an aspect which is registered in studies performed in populations with the same characteristics28,29. Only 85 (33.1%) declared to have the habit of brushing their teeth 2 or more times a day. Identical tooth brushing frequencies having been registered in other studies in populations with similar characteristics, with small variations, namely as to what concerns the way of assessing the tooth brushing frequency issue; all of them, nonetheless, allowing for the conclusion that their daily tooth brushing habit is identical21,28.

*Tooth decay profile*

Little is known about the natural history of the presence of dental tooth decay amongst older adults but, recently, some reports deriving from a series of big cohort studies allowed for a better understanding of the nature, as well as of the determiners of dental tooth decay on elders. An article review about dental tooth decay incidence was published, concluding that the elders are a risk group for active tooth decay, the crown tooth decay bearing the highest contribution for the disease. Enhancing the necessity for strategies with multiple prevention activies47, many authors identify the factors which might contribute for the development of tooth decay on elder population: poor oral hygiene, the changes on both quality and quantity of saliva, the psychic and functional incapacities, as well as the socio-economical factors12,25,30.

The elders tooth condition assessment, as to what concerns the past or present tooth decay history aspects, in the present study, registered average DMF values of 25.6 (±7.3) and we have encountered 37.4% of individuals with an index of 32 and only 0.5% of individuals with DMF index of zero. Identical values can be found in similar studies of populations with the same characteristics12,21,24,25,27,31.

The prevalence of decayed teeth was of 7.1%, of filled of 4.7% and of lost, it was of 86.8%, bearing into consideration that the DMF values in this population are directly influenced by the M component, which diverges the values in an exponential way in populations with these characteristics, for the percentage of elders whom presented, at least, one lost tooth was of 99.5% and those who presented, at least, one restoration was of 28.0%. On each elder, it was registered, in average, 1.8 (±2.3) decayed teeth, 22.9 (±8.9) lost teeth and 0.9 (±2.1) filled teeth, different values from those published in other studies12,21,31 and as to what concerns the individual assessment of the DMF components. This fact can be justified by the absence of dental medical care of the Portuguese population for many years; the individuals assessed in this study still belonging to the generations during which the Portuguese’s oral health was totally disregarded. For this reason, the values concerning filled teeth, present on the sample, were inferior to those on the referred studies. The DMF index was registered as being associated with the elders’ dependency for the oral hygiene’s tasks issue, the dependent elder people presenting higher index values, 2.8, similar to the issue of literacy which is equally registered as being associated with the DMF values, since higher education degrees present lower DMF values.

The number of teeth present on the mouth of the elders from the sample was assessed so it could be related to any condition associated with their health condition for they registered 84.9% with less than 20 teeth, that is, only 56 (15.1%) of the individuals under this investigation had 20 or more teeth. In average, one found 8.9 teeth present on the mouth of the individuals, a different value from that registered by other authors, in studies performed on elder populations11,19,21,24.The presence of a specific number of teeth in the oral tooth decay has been an aspect studied by many authors and has been associated with several predisposing factors, including age, gender, education and oral hygiene, socio-demographic as well as economic conditions and dental services access perception32,35. Other studies relate the number of teeth present inside the elder people’s mouths with for example, difficulties in eating which might be harmful in terms of nutritional condition, as well as health in general, besides obesity33 or also that the number of teeth is independently associated with mortality, thus meaning that an improvement on oral health might have a positive impact over health in general, being able to delay mortality or decrease the quality of life34.

Since the 90’s that several publications have been associating tooth root decay with age, gender, the fluoridation of drinkable water, race, specific microorganisms, the presence of crown caries, the number of remaining teeth. The tooth root decay diagnosis is problematic, since it is not clinically easy to distinguish the area of the carious lesion. Besides, in the case of elders, lesions extend to the proximal and, sometimes, to the sub-gingival surfaces. The clinical approach of such lesions may, also, be complex, presenting some specificities’ such as the suited tooth decay removal, as well as control during the restoration’s procedures, which may lead to many relapses. This type of tooth decay has been a growing clinical problem due to the increase of elder dentate population during the last two decades.

Assessing root surfaces for determining the presence of tooth root decay was performed in the present study, in a direct way, without the proper hygienization so that the assessment would be considered as not having modifying factors. What it means is that no accumulated *Materia Alba* and/or plaque on the surfaces were removed which, in some situations, might have influenced the correct diagnosis. Nevertheless, one must not consider this aspect as having been exclusive to the present study. In the studies published and performed with institutionalized elders, and in similar assessment conditions, this factor as well as the difficulty in confirming the presence of proximal root caries, only detected through radio-diagnosis, certainly influenced the values obtained and are never mentioned. The RCI is one of the most widely used indexes in order to determine tooth root decay in the populations yet, the considered criteria differ from study to study. A series of studies have been reporting throughout the years the high prevalence of root caries on elder people35,36. The average RCIi value, for the 240 individuals with teeth in who was considered possible to evaluate the presence of tooth root decay was of 43.8%. It was verified that the tooth root decay presents a prevalence of 78.6% between elder people with teeth. The average number of root carries was of 3.4 (±3.6) per elder, varying between 0 and 24 cavities. Lower prevalence values of tooth root decay were registered in studies performed in other countries, in populations with the same characteristics35,37. Identical values of tooth root decay prevalence can, however, be found in other works of identical characteristics6,36.

The average RCIi value presented itself as higher for the male gender (44.3%), whereas in the female gender it was of 39.4%, significant statistical differences being impossible to be detected (Mann-Whitney-U test, p>0.05). For the age range of 85 years old or older, the RCIi registered the highest, 48.1% and the 60-65 years range registered the lowest value, 30.3%, yet significant differences were only detected between the oldest and the youngest and between the oldest and the age range of 76-84 years old (Mann-Whitney-U test, p=0.010 and 0.047 respectively). Through these results, one can conclude that age, the number of existing teeth and the number of root surfaces with recessions, are conditions which allow the find of a higher RCI index, the former having been, on the Kularatne *&* Ekanayake study, considered as being predicting factors of the presence of tooth root decay19. Other factor presents higher RCI values on their assessments done in studies with institutionalized elder people6, cases in which the samples presented characteristics similar to those of the population in this study.

The oral hygiene assessment, through the daily tooth brushing frequency, demonstrated that the group of elders who did not brush showed significant differences in the RCIi in relation with the group of elders who brushed once and with the group who brushed more than once (Mann-Whitney-U test, p<0.001 and p=0.040, respectively). However, tooth brushing once or more than once a day does not present differences on the RCIi. We can conclude that the number of decayed roots is susceptible of being smaller on individuals who referred brushing their teeth more frequently, considering oral hygiene a potential risk factor for root caries. This conclusion is also supported by other authors38,39.

A logistic multivariable regression model was built, in order to foresee the presence of a RCIi equal or superior to 20%, on the sample individuals with teeth showing this way that age and gender are not significantly associated. Nevertheless, the value of RCI considered is significant and independently associated with the prosthesis bearing individual as well as with daily tooth brushing, the fact remaining that an institutionalized elder, partially edentulous and bearer of skeletal prosthesis presented a 5.3 fold increased probability of having a RCIi≥20% when compared to non-prosthesis’ users, this condition also being assessed in the Nevalainen study, that refers the presence of any kind of removable prosthesis as being associated with the increase of tooth root decay40, a fact which is not always registered with this tendency, since other referred authors conclude that the use of removable partial prosthesis does not contribute for the increase of root caries9. The number of daily tooth brushings in the model shows that elders who do not brush have a 2.8 fold increased probability of having a RCIi≥20%, in relation with elders who brush their teeth (p<0.002). The application of the logistic regression model in our study, in relation with the RCIi, is justified by the significant associations in the lineal relationship established between the dependent variable considered and each one of the predicting factors which we have associated.

**Conclusion**

The prevalence of cavities in this institutionalized elder population in the Northern Portugal is very high. Such values are compatible with the unawareness elder people, themselves, have concerning the importance of maintaining a tooth decay free mouth. In other situations, due to lack of resources, namely economical, a factor which prevails amongst the Portuguese elder population and which is associated with the absence of oral health care in the existing national health system. However, it is registered throughout the country a complete unawareness of the true dental health state of these populations.

Thus, knowledge and effort should unite, in the sense of converging towards an oral health promotion, throughout an individual’s entire life. The former covers several dimensions: individual, professional, institutional and political as well as organizational, with the purpose of living and aging in a healthy manner, according to the concept of active aging from the World Health Organization.

**Acknowledgements**

The research team would like to thank the “PASOP” mobile unit (ambulatory project of public and oral health) of the University Fernando Pessoa for the space where clinical observations with dental equipment and good lighting conditions were possible.

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