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Dental Functionality: construction and validation of an oral health indicator for institutionalized elderly persons in the city of Natal, Rio Grande do Norte

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Abstract

Objective: to suggest a composite indicator that identifies the oral health condition of institutionalized elderly persons. **Method:** an observational and cross-sectional study was performed. A total of 315 elderly persons were investigated in long-stay care facilities for the elderly in the city of Natal, Rio Grande do Norte, Brazil. Such individuals underwent an epidemiological evaluation of their oral health conditions, based on the DMFT index, CPI and the PAL (periodontal attachment loss) index. Factor analysis was used to identify a relatively small number of common factors by principal component analysis. **Results:** five oral health variables were included in factor analysis, and using the Kaiser criterion, which considers the percentage of variance explained by the factors, a single factor which together explained 79.7% of the total variance of the variables included in the analysis model was selected. This factor was analyzed and interpreted according to the dimension to which it related, and was entitled the factor of Dental Functionality. **Conclusion:** this factor generated an objective indicator to characterize the oral health of the elderly in long-term care facilities for the elderly of Natal, Rio Grande do Norte, and represents a parameter for studies of the oral health outcomes of this elderly population. It also revealed a change in the dental profile of this population with more teeth present in the mouth and a reduction in edentulism.

Keywords: Health Status Indicators. Oral Health. Elderly.

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INTRODUCTION

Population aging is a worldwide phenomenon the evolution of which varies according to the degree of development of a country. In Brazil, the changes in the age structure of the population have occurred in an intense and accelerated manner. The speed at which the process of demographic and epidemiological transition has taken place in the country has resulted in a number of important issues for health managers and researchers, mainly due to the social and economic inequalities that have accompanied this process in recent decades¹⁻³.

Health services must adapt to the increasing demands of chronic diseases and disabilities, which are common to the elderly, especially in Brazil. At the same time, several studies have shown that the oral health of these individuals is neglected by the elderly, or even by public policies themselves. These studies reveal that the main dental health problems affecting the elderly population are tooth loss, periodontal disease, xerostomia and soft tissue injuries. These problems produce disabilities that are often not even perceived in the context in which these elderly people live, especially institutionalized elderly people⁴⁻⁶.

When evaluating the distribution of oral health diseases, there are several indicators that try to measure oral conditions, facilitating the interpretation of the data obtained. However, this interpretation can often be impaired, as these indicators do not always present adequate accuracy, especially in relation to the elderly population⁷.

Data from the most recent oral health survey conducted in Brazil, SB Brazil 2010, showed that 53.7% of individuals aged 65-74 years were edentulous, that is, more than half of the individuals investigated were found to be in the same situation when they were investigated using traditional indexes that measure oral health⁸.

The DMFT index (number of decayed, missing and filled teeth), for example, is an effective tool for gauging the oral health conditions of the younger population. However, when it comes to the elderly population, this index loses accuracy, failing to discriminate the elderly from their oral health condition. It is understood, therefore, that the use

of alternative indexes, such as functional edentulism, occluding tooth pairs, the presence of a shortened dental arch and number of molar teeth present is one option for assessing the oral health of these individuals, considering their particularities^{9,10}.

It has been found, however, that although the alternative indexes of oral health consider the particularities of the elderly population, they do so in an isolated manner, making it difficult to identify elderly persons who truly present an unfavorable oral health condition from such information. Therefore, the study in question proposes the construction and validation of an indicator composed of alternative indexes of oral health, which were applied among the institutionalized elderly in the city of Natal, Rio Grande do Norte, Brazil.

METHOD

Before beginning the study, the project was submitted to the Ethics Research Committee of the Universidade Federal do Rio Grande do Norte, under approval nº 263/11-P. The subjects, as well as their caregivers and tutors, were given information about the survey and signed a Free and Informed Consent Form, as established by the National Health Council under Resolution nº 466/2012.

Thus, the study employed a cross-sectional design, with the elderly persons individually examined as an observation and analysis unit. The sample consisted of individuals aged 60 years and older residing in Long Term Care Facilities for the Elderly (LTCFs), properly registered with the sanitary surveillance department of the city of Natal (Rio Grande do Norte). Of the 14 LTCFs in the municipality, two refused to participate and a third was closed. Therefore, data collection was performed at 11 LTCFs.

To obtain the sample all the elderly who were present in the LTCFs at the time of data collection were included. However, those with severe physical and/or mental limitations and restrictions, as well as those who were undergoing palliative care or had a serious infectious or other disease that prevented the collection of data, were excluded from the tests and, consequently, the study. Therefore, 315 individuals from the 400 residing in LTCFs in the

municipal region of Natal (Rio Grande do Norte) were interviewed and examined by November 2013, after which time the data collection was closed.

The procedures performed during data collection consisted of the application of a sociodemographic questionnaire and evaluation of the oral health conditions of the elderly persons through an intraoral examination. These procedures were carried out by previously trained examiners calibrated using the Kappa statistic, in order to ensure the uniformity of the understanding, interpretation and application of the evaluated criteria.

The clinical record for obtaining the data referring to the oral health conditions of the elderly was based on the dental record form of SB Brazil 2010⁸, but with a field added relating to occluding tooth pairs. The socioeconomic and demographic questionnaire was the same as that used by the Health, Welfare and Aging Project (SABE)¹¹.

From the clinical record, alternative oral health indexes (presence of shortened dental arch, presence of anterior sextants, number of teeth with root caries, number of molar teeth and number of occluding tooth pairs) were obtained and dependent variables of the study. Therefore, these variables, since they represent dimensions of the oral health of the elderly, were included in factor analysis in order to produce the composite oral health indicator for these individuals.

A shortened dental arch was characterized by the presence of 10 pairs of anterior teeth in occlusion, that is, 20 teeth distributed from the 2nd premolar to the 2nd premolar in both arches¹². To determine the presence of root caries the World Health Organization (WHO) probe was used to detect the presence of cavities in the region. Root caries were only considered when there was a need for separate restorative treatment.

The data collected through the socioeconomic-demographic questionnaire and the intraoral examination were organized in a database and analyzed using SPSS software version 20.0 (SPSS Inc.). Initially, a descriptive analysis of these variables and the selected socioeconomic-demographic variables

was performed, which allowed the characterization of the sample according to the conditions investigated.

The alternative indexes of oral health were submitted to factor analysis, where they were reduced to factors by the analysis of main components, in order to produce the composite indicator. It was therefore initially observed whether the alternative indexes of oral health were sufficiently correlated with each other, guaranteeing the satisfactory extraction of the statistical variables. The correlation matrix, the sample correlation measure, the Bartlett sphericity test and the anti-image matrix were used as evaluation methods. With the confirmation of the applicability of the statistical model, we extracted the factors using the Kaiser technique, which informs us how much each factor explains the total variance of the model. The Varimax rotation method was selected to facilitate the interpretation of the factors produced.

RESULTS

The sociodemographic profile of the 315 individuals examined showed a significant predominance of female individuals, with elderly women representing 74.5% of the interviewees. The mean age was 81.8 (\pm 9.0) years and the mean institutionalization time was 5.4 (\pm 5.2) years. It was also observed that 71.1% of the sample resided in non-profit LTCFs.

Regarding oral health, of the 315 elderly evaluated, an average DMFT of 29.56 (\pm 4.4) was observed, in which the lost component represented 90.1% of the index. It was therefore verified that 289 individuals, that is, 91.7% of the sample did not have a shortened upper or lower arch. The mean number of molar teeth present was 0.87 (\pm 1.8), the number of occluding tooth pairs was 1.08 (\pm 2.6) and the mean number of decayed teeth was 0.59 (\pm 1.9).

In relation to the production of the composite indicator, the five variables representative of the alternative indexes that measured the oral health of the elderly were initially included in the factor analysis. Of these five variables (presence of shortened dental arch, presence of anterior sextants, number of teeth with root caries, number of molar

teeth and number of occluding tooth pairs), two (presence of a shortened dental arch and number of teeth with root caries) were excluded because they presented significant and perfect correlations with the other.

In order to confirm the applicability of the factor analysis, the correlation matrix of the three remaining variables (Table 1) was analyzed. This matrix had values higher than 0.30 and lower than 0.90, guaranteeing the applicability of the model.

Table 1. Matrix of correlations of oral health variables of elderly subjects submitted to factor analysis. Natal, Rio Grande do Norte, 2013.

Variables	Number of occluding tooth pairs	Number of molar teeth present	Presence of 2nd and 5th sextants
Number of occluding tooth pairs	1.000	0.844	0.637
Number of molar teeth present		1.000	0.599
Presence of 2nd and 5th sextants			1.000

Another way to evaluate the adequacy of the variables for the proposed factor analysis technique is based on the KMO (Kaiser-Meyer-Olkin) statistic, which is also considered a measure of the adequacy of the sample, with values close to 1 indicating the adequacy of the technique, and the Bartlett sphericity test, which should have a *p*-value in the range of statistical significance, indicating that there are significant correlations between the variables¹³. In the analysis of the present study, values of 0.686 for the KMO and the *p*-value of <0.001 for the Bartlett test were obtained, therefore corroborating the use of factor analysis.

The analysis of the anti-image matrix presented in Table 2 showed that none of the variables had a value lower than 0.5 in its principal diagonal, which again guarantees the application of the model in relation to the three variables selected. In addition, the analysis of the values outside the principal diagonal showed a weak partial correlation between the variables of the model, with values below 0.7, except for the partial correlation between the number of occluding pairs and number of molar teeth present variables, which had a correlation value of 0.748, although these exhibited a high

commonality value (Table 3), justifying their permanence in the model. It can therefore be concluded that the selected variables correlate with each other, and are little influenced by other variables which were not studied or that did not participate in the factor analysis.

Based on the Kaiser criterion (Table 4), which extracts factors with eigenvalues greater than 1.0, the retention of a factor explaining 79.7% of the total variance of the variables included in the model was observed. Therefore, this factor represented the composite indicator capable of assessing the particularities related to the oral health of the elderly persons investigated, from the variables added to the model.

The rotated matrix in Table 5 shows the factorial loads of each of the variables that make up the factor (indicator) generated, showing that, in fact, *number of occluding tooth pairs*, *number of molars present* and *presence of the anterior sextants* are the variables which together best characterize the oral health of the elderly persons investigated. From the interpretation of Table 5, the constructed factor was denominated Dental Functionality.

Table 2. Anti-image matrix of oral health variables of elderly subjects submitted to factor analysis. Natal, Rio Grande do Norte, 2013.

Variables	Number of occluding tooth pairs	Number of molar teeth present	Present of 2nd and 5th sextants
Number of occluding tooth pairs	0.631	- 0.748	- 0.305
Number of molar teeth present	- 0.748	0.648	- 0.150
Presence of 2nd and 5th sextants	- 0.305	- 0.150	0.869

Table 3. Values of commonality of oral health variables of elderly subjects undergoing factor analysis. Natal, Rio Grande do Norte, 2013.

Variables	Commonalities
Number of occluding tooth pairs	0.871
Number of molar teeth present	0.845
Presence of 2nd and 5th sextants	0.676

Table 4. Anti-image matrix of oral health variables of elderly subjects submitted to factor analysis. Natal, Rio Grande do Norte, 2013.

Factor	Auto-value	Percentage of variance explained	Percentage of accumulated variance
1	2.392	79.74	79.74
2	0.453	15.11	94.84
3	0.155	5.16	100.00

Table 5. Rotated matrix of factorial loads of the representative factor of the oral health variables of the elderly. Natal, Rio Grande do Norte, 2013.

Variables	Factor 1
Number of occluding tooth pairs	0.933
Number of molar teeth present	0.919
Presence of 2nd and 5th sextants	0.822

The categorization of the Dental Functionality factor was performed based on the median of the factor scores generated for each of the individuals in the sample. Therefore, individuals with a factor score above the median had their oral health dichotomized as favorable, while those with a factor score below the median had their oral health classified as unfavorable.

Therefore, from the indicator produced, it was observed that the dental functionality of 177

individuals (56.2%) was classified as unfavorable, whereas dental functionality was favorable for the remaining 138 patients (43.8%). Among individuals with unfavorable dental functionality, 78.5% were from non-profit LTCFs, 76.3% were female, the mean age was 83.6 (\pm 8.95) and 53.7% self-declared themselves to be white. In contrast, of individuals with favorable dental functionality, 60.9% were from non-profit LTCFs, 71.7% were female, the mean age was 79.4 (\pm 8.49) and 52.9% self-declared themselves to be white.

DISCUSSION

Health indicators are created to facilitate the quantification and evaluation of information on the state of health of the population¹⁴, helping to control diseases and improving the concept of health and its social determinants. The formulation of indicators capable of reflecting health risk conditions from adverse environmental and social components is important for the diagnosis of health situations in a given population. In this sense, the Dental Functionality factor constructed allowed the identification of elderly individuals of LTCFs in Natal (Rio Grande do Norte) with unfavorable conditions in terms of the functionality of the dental elements present in a more specific and simple manner.

In the planning of programs and development of public policies aimed at oral health the use of epidemiological data measured through indices such as the DMFT, CPI and PAL is common⁸. However, these indices do not effectively discriminate between the oral health of the elderly, as these individuals present a high level of tooth loss and are internally homogeneous yet quite heterogeneous in relation to the other age groups.

This confirms the need for new indices capable of adequately categorizing the oral health condition of these elderly people, since the curative-invasive model, which is still deeply ingrained, has made these individuals equal in terms of oral health conditions. In this sense, we highlight institutionalized elderly persons, who become doubly excluded.

The variables *presence of upper and lower anterior sextant, occluding tooth pairs* and *presence of molar teeth*, referred to as alternative oral health indexes, are most capable of discriminating the oral health conditions of the institutionalized elderly persons of Natal, Rio Grande do Norte, as observed during the construction of the Dental Functionality indicator. These components express the same characteristic though different forms of measurement: the presence of dental elements, which is the most relevant characteristic of the population in question. This characteristic is important due to its negative consequences for general health, such as dietary restrictions, phonation, aesthetics, loss of pleasure in eating, and as a result, weight loss and malnutrition,

as well as temporomandibular joint and muscle problems due to loss of the vertical dimension and joint problems resulting from the aging process¹⁵.

As a limitation of the study, we did not include measurements of periodontal, stomatological and prosthesis conditions. The periodontal condition is of great relevance for the elderly population, and it was observed that only 1.8% of the elderly who participated in SB Brazil 2010 were free of periodontal problems, according to the Community Periodontal Index (CPI)⁸.

Thus, the presence of teeth may be more harmful than their absence in some of these individuals due to the existence of periodontal disease infection foci. This situation is even more serious in the institutionalized geriatric population, due to their greater functional incapacity, with a consequent restriction in oral hygiene. In the study by Jerez-Roig et al.¹⁶, 53.5% of institutionalized elderly persons in Natal had functional disability for one or more basic activities of daily living. Meanwhile literature also reveals that caregivers, whose role is to ensure the adequate oral hygiene of disabled elderly persons, are not in the habit of performing such care due to the lack of protocols, knowledge and adequate training^{17,18}.

The results reliably reflect the oral health conditions of the institutionalized elderly of Natal (Rio Grande do Norte), as data collection was performed in all the LTCFs and with all the elderly persons who met the inclusion criteria. However, in spite of employing a considerable sample size (more than 300 elderly persons), the findings of the present study have limitations in terms of the extrapolation of the results to other municipal regions in Brazil, as the outcome is influenced by local characteristics. Factors such as access to dental services in the past and present, as well as care for oral hygiene throughout life, vary among the regions of Brazil, as shown in the SB Brazil 2010 study⁸.

Thus the Dental Functionality factor categorized represents an objective indicator that characterizes the oral health of the elderly of the LTCFs of the city of Natal, Rio Grande do Norte, serving as a parameter for studies with the outcome of the oral health of the institutionalized elderly population. The indicator also reveals a change in the profile of

this population, with more teeth in the mouth and reduced edentulism.

With the aim of returning to the research carried out and in view of the oral health conditions found, the team has begun the extension project *Oral health care of elderly people living in the municipal region of Natal, Rio Grande do Norte*, financed by the Universidade Federal do Rio Grande do Norte, performing weekly activities of health assistance and care for the elderly living in these LTCFs, as well as for elderly people living in households.

CONCLUSION

The Dental Functionality index created is capable of discriminating between the elderly population residing in Long-Term Care Facilities for the Elderly

(LTCFs) of Natal, Rio Grande do Norte, based on the alternative indexes of oral health: presence of upper and lower anterior sextant, occluding tooth pairs and presence of molar teeth. The composition of the constructed indicator demonstrates the significant absence of dental elements, requiring oral rehabilitation actions so that elderly persons have adequate phonation, chewing comfort and aesthetic conditions.

This factor was therefore able to generate an objective indicator that characterizes the oral health of the elderly of the LTCFs in Natal, Rio Grande do Norte, serving as a parameter for studies that have as their outcome the oral health of this elderly population. In addition, it revealed a change in the profile of this population with increased numbers of teeth in the mouth and the reduction of edentulism, representing the emergence of a "new elderly".

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