

## Does non-institutionalized elders have a better oral health status compared to institutionalized ones? A systematic review and meta-analysis

Idosos não-institucionalizados apresentam melhor saúde bucal comparado aos idosos institucionalizados? Uma revisão sistemática e meta-análise

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**Abstract** *This systematic review compared the oral health status between institutionalized and non-institutionalized elders. The following electronic databases were searched: PubMed (Medline), Scopus, Web of Science, Lilacs and Cochrane Library, in a comprehensive and unrestricted manner. Electronic searches retrieved 1687 articles, which were analyzed with regards to respective eligibility criteria. After reading titles and abstracts, five studies were included and analyzed with respect their methodological quality. Oral status of institutionalized and non-institutionalized elderly was compared through meta-analysis. Included articles involved a cross-sectional design, which investigated 1936 individuals aged 60 years and over, being 999 Institutionalized and 937 non-institutionalized elders. Studies have investigated the prevalence of edentulous individuals, the dental caries experience and the periodontal status. Meta-analysis revealed that institutionalized elderly have greater prevalence of edentulous (OR = 2.28, 95%CI = 1.68-3.07) and higher number of decayed teeth (MD = 0.88, 95%CI = 0.71-1.05) and missed teeth (MD = 4.58, 95%CI = 1.89-7.27). Poor periodontal status did not differ significantly between groups. Compared to non-institutionalized, institutionalized elders have worse dental caries experience.*

**Key words** *Institutionalization, Homes for the aged, Dental caries, Tooth loss*

**Resumo** *Esta revisão sistemática comparou o estado de saúde bucal entre idosos institucionalizados e não institucionalizados. As seguintes bases de dados eletrônicas foram pesquisadas: PubMed (Medline), Scopus, Web of Science, Lilacs e Cochrane Library, de forma abrangente e irrestrita. Pesquisas eletrônicas recuperaram 1.687 artigos, que foram analisados com relação aos respectivos critérios de elegibilidade. Após a leitura de títulos e resumos, cinco estudos foram incluídos e analisados quanto à qualidade metodológica. A condição bucal de idosos institucionalizados e não institucionalizados foi comparada por meio de meta-análise. Os artigos incluídos envolveram um delineamento transversal, que investigou 1.936 indivíduos acima de 60 anos, sendo 999 institucionalizados e 937 não institucionalizados. Investigou-se a prevalência de edentulismo, a experiência de cárie e a condição periodontal. A meta-análise revelou que idosos institucionalizados possuem maior prevalência de edentulismo (OR = 2,28, IC95% = 1,68-3,07), maior número de dentes cariados (DM = 0,88, IC95% = 0,71-1,05) e de dentes perdidos (DM = 4,58, IC95% = 1,89-7,27). A condição periodontal ruim não diferiu significativamente entre os grupos. Comparados aos não institucionalizados, os idosos institucionalizados tem pior experiência de cárie.*

**Palavras-chave** *Institucionalização, Casas para os idosos, Cárie dentária, Perda dentária*

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## Introduction

It has been observed an evident process of population aging worldwide. In spite of being a global phenomenon, each country shows different characteristics. Variety in the way people are getting older is the main mark of this demographic scenario and it can be observed among different nations, cities, or even between neighborhoods of the same city<sup>1</sup>.

According to the World Health Organization (WHO), the global population is increasing at the annual rate of 1.7%, whilst the population of those over 60 years is increasing at a rate of 3%. In addition, United Nations estimates that further increase in the population of older persons is almost inevitable, since this is the fastest growing population segment in most countries<sup>2</sup>. This may impact the way society deal with older population, since both the developed and the less-developed countries are expected to experience significant shifts in the age distribution of the population by 2050<sup>2</sup>.

The demographic and epidemiological transitions in which many countries have been going through indicate an urgent need to investigate the predictors and prevalence of health issues in older population<sup>3</sup>. Although advances in medicine and dentistry have resulted in people living longer and presenting better oral and general health<sup>4,5</sup>, it has been observed an increased population that is dependent of their daily activities and, therefore, living in long-term care facilities. Nevertheless, the health condition of elders that live in long-term care institutions may be also investigated and compared to those who live independently in the community.

An increasing number of older adults are permanently homebound and unable to access routine medical or dental care because of chronic illness and functional impairment<sup>6</sup>. In addition, they need support to maintain their oral health<sup>7,8</sup>. Homebound older adults typically do not see a dentist for years, their oral health deteriorates, resulting not only in pain and infection, but also into compromised ability to eat and socialize. In consequence, it is observed a worsening of their already compromised overall physiological functioning and quality of life<sup>9</sup>.

It has been shown that the oral health status of older people is poor, and living in nursing homes may increase the likelihood of oral and dental diseases, as well as the need for oral care<sup>7,10</sup>. However, it is not clear whether oral health of people living in long-term care facili-

ties differ from those living independently in the community.

Therefore, the aim of this systematic review is to compare the oral health status between institutionalized and non-institutionalized older people. This study addresses the following question, according to the PECO (Population/Exposition/Control/Outcomes) strategy: Does non-institutionalized (Control group) elders (Population) have a better oral health status (Outcomes) compared to institutionalized ones (Exposition)? The hypothesis was that the institutionalized elderly people present a higher prevalence of oral disorders and poorer oral status.

## Material and methods

This systematic review followed the recommendations of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)<sup>11</sup> (<http://www.prisma-statement.org>). It was also registered in PROSPERO database.

### Literature search strategy

The search strategy covered electronic databases and the reference lists of such articles published up to February 2018. The following electronic databases were searched: PubMed (Medline), Scopus, Web of Science, Lilacs and Cochrane Library, in a comprehensive and unrestricted manner with regards to year or language of publication. The MeSH terms used for research were "aged", "aged, 80 and over" (population); "institutionalization", "homes for the aged" (exposition); "dental caries", "tooth loss", "periodontitis", "gingivitis", "dental plaque", "dental plaque index" and "stomatitis, denture" (outcomes). The search strategy was adapted for each database. In addition, free terms related each topic were included, using the Boolean operators "AND" and "OR" to match the search terms (Table 1).

### Eligibility criteria

The eligibility criteria of the terms used for the research were based on the elements of the population (elderly individuals), exposition (institutionalized elderly), control (non-institutionalized elderly) and outcomes (oral health status).

Only observational studies were selected in this systematic review. Case reports, case series, *in vitro* studies, literature reviews, editorials, letters

to editor and randomized clinical trials (RCT) were excluded.

### **Screening, data extraction and qualitative synthesis**

Two independent reviewers (IPSF and YWC) retrieved relevant publications involving oral health status of institutionalized and non-institutionalized elderly. Titles and abstracts were analyzed during initial screening. Subsequently, full-texts articles that appeared to meet the inclusion criteria were retrieved for confirming eligibility. A reference manager and processing software (Mendeley® Desktop, Elsevier) was used to organize references, remove duplicates and reading titles and abstracts. Disagreements were resolved by consensus after discussion with a third reviewer (LFDA). Both reviewers also performed data extraction by computing information in an electronic spreadsheet.

The following information was retrieved from the included studies: authors, country, study design, number of elderly (institutionalized and non-institutionalized), age, exclusion criteria, outcomes included, statistical analysis, main results and conclusion. In the event that details were not clear to the reviewers, the authors were contacted by e-mail for clarification. Data were summarized in a data extraction table that shows an overview of included studies.

### **Quality assessment**

The methodological quality of the included studies was analyzed using the Fowkes and Fulton (1991) quality assessment tool<sup>12</sup>. The purpose of this guideline is to make a critical analysis of the included studies, considering the following aspects: study design, study sample, control group, quality of measurements and outcomes, completeness and distorting influence. Summarized questions assessed the risk of bias, the presence of confounding factors and if the results occurred by chance. Separately, two examiners (IPSF and YWC) performed the classification of the articles making a checklist. Any disagreements were resolved by consensus.

### **Quantitative synthesis (Meta-analysis)**

A quantitative synthesis (meta-analysis) was conducted for oral health status outcomes described within at least two of the included studies. Based on that, extracted data from the pro-

portion of edentulous individuals, prevalence of poor periodontal status, number of decayed teeth and number of missed teeth were analyzed into blocks. Meta-analyses were performed in the Open Meta-Analyst software v.10.12 (available at [www.cebm.brown.edu/openmeta/index.html](http://www.cebm.brown.edu/openmeta/index.html))<sup>13</sup>.

Prevalence data (dichotomous) were used to calculate the Odds Ratio (OR) and 95% Confidence Interval (95%CI) parameters, used for comparisons between institutionalized and non-institutionalized groups. Continuous data (means and standard deviations) were analyzed using the Mean Difference (MD) and 95%CI. All analyses were performed using the Random effect and the Hedge estimator methods, under 5% significance<sup>14</sup>. The heterogeneity parameter  $I^2$  was calculated for each meta-analysis.

## **Results**

Screening of eligible publications, according to each reference database, is shown in Figure 1 (Prisma Flow Diagram). The initial search identified 2734 potential articles. Following the removal of the duplicates, 1685 articles remained. After reading the titles and abstracts, 3 articles were selected for full-text reading. Two additional studies were found after manual search. Five studies were included for data extraction and qualitative synthesis, as shown in Table 2. All studies were used to perform, at least, one of the four meta-analyses.

### **Characteristics of included studies**

Included studies were published between 1999 and 2016 and involving a total number of 1936 aged people (999 institutionalized and 937 non-institutionalized). Full description of studies is presented on Table 2. Studies were conducted in Finland, Hong Kong, Italy, Greece and Netherlands, having all of them a cross-sectional study design<sup>15-19</sup>. One study included individuals 60 years and over<sup>16</sup>, three considered 65 years and over<sup>17-19</sup>, and one enrolled elders 70 years and over<sup>15</sup>.

The oral conditions evaluated within included studies were: edentulism (number of edentulous individuals), oral lesions, periodontal status, as well as dental caries experience, including the number of decayed, missed and filled teeth. The periodontal status was assessed through Community Periodontal Index (CPI). The dental caries experience, however, was not evaluated the same way along the different studies.

**Table 1.** Search strategy used for each database.

Database	Strategy
PubMed (Medline)	((((((((((((Aged[MeSH Terms]) OR Aged[Title/Abstract]) OR Elderly[Title/Abstract]) OR (Aged, 80 and over[MeSH Terms])) OR (Aged, 80 and over[Title/Abstract])) OR Oldest old[Title/Abstract]) OR Nonagenarians[Title/Abstract]) OR Nonagenarian[Title/Abstract]) OR Octogenarians[Title/Abstract]) OR Octogenarian[Title/Abstract]) OR Centenarians[Title/Abstract]) OR Centenarian[Title/Abstract])) AND (((((((((((Institutionalization[MeSH Terms]) OR Institutionalization[Title/Abstract]) OR Institutionalizations[Title/Abstract]) OR Institutionalized Persons[Title/Abstract]) OR Institutionalized Person[Title/Abstract]) OR Person, Institutionalized[Title/Abstract]) OR Persons, Institutionalized[Title/Abstract]) OR Homes for the aged[MeSH Terms]) OR Homes for the aged[Title/Abstract]) OR Old Age Homes[Title/Abstract]) OR Home, Old Age[Title/Abstract]) OR Homes, Old Age[Title/Abstract]) OR Old Age Home[Title/Abstract])) AND (((((((((((((((((((((((((((((((Dental caries[MeSH Terms]) OR Dental caries[Title/Abstract]) OR Dental Decay[Title/Abstract]) OR Caries, Dental[Title/Abstract]) OR Decay, Dental[Title/Abstract]) OR Carious Dentin[Title/Abstract]) OR Carious Dentins[Title/Abstract]) OR Dentin, Carious[Title/Abstract]) OR Dentins, Carious[Title/Abstract]) OR Dental White Spot[Title/Abstract]) OR White Spots, Dental[Title/Abstract]) OR White Spots[Title/Abstract]) OR Spot, White[Title/Abstract]) OR Spots, White[Title/Abstract]) OR White Spot[Title/Abstract]) OR Dental White Spots[Title/Abstract]) OR White Spot, Dental[Title/Abstract]) OR Tooth loss[MeSH Terms]) OR Tooth loss[Title/Abstract]) OR Loss, tooth[Title/Abstract]) OR Periodontitis[MeSH Terms]) OR Periodontitis[Title/Abstract]) OR Periodontitides[Title/Abstract]) OR Pericementitis[Title/Abstract]) OR Pericementitides[Title/Abstract]) OR Gingivitis[MeSH Terms]) OR Gingivitis[Title/Abstract]) OR Gingivitides[Title/Abstract]) OR Dental plaque[MeSH Terms]) OR Dental plaque[Title/Abstract]) OR Plaque, dental[Title/Abstract]) OR Dental plaque index[MeSH Terms]) OR Dental plaque index[Title/Abstract]) OR Index, Dental Plaque[Title/Abstract]) OR Dental Plaque Indexes[Title/Abstract]) OR Indexes, Dental Plaque[Title/Abstract]) OR Dental Plaque Indices[Title/Abstract]) OR Indices, Dental Plaque[Title/Abstract]) OR Stomatitis, denture[MeSH Terms]) OR Stomatitis, denture[Title/Abstract]) OR Denture Stomatitides[Title/Abstract]) OR Denture Stomatitis[Title/Abstract]) OR Stomatitides, Denture[Title/Abstract]))
Web of Science	TS=(Aged OR Elderly OR "Aged, 80 AND over" OR Oldest old OR Nonagenarians OR Nonagenarian OR Octogenarians OR Octogenarian OR Centenarians OR Centenarian) AND TS=(Institutionalization OR Institutionalizations OR Institutionalized Persons OR Institutionalized Person OR Person, Institutionalized OR Persons, Institutionalized OR Homes for the aged OR Old Age Homes OR Home, Old Age OR Homes, Old Age OR Old Age Home) AND TS=(Dental caries OR Dental Decay OR Caries, Dental OR Decay, Dental OR Carious Dentin OR Carious Dentins OR Dentin, Carious OR Dentins, Carious OR Dental White Spot OR White Spots, Dental OR White Spots OR Spot, White OR Spots, White OR White Spot OR Dental White Spots OR White Spot, Dental OR Tooth loss OR Loss, tooth OR Periodontitis OR Periodontitides OR Pericementitis OR Pericementitides OR Gingivitis OR Gingivitides OR Dental plaque OR Plaque, dental OR Dental plaque index OR Index, Dental Plaque OR Dental Plaque Indexes OR Indexes, Dental Plaque OR Dental Plaque Indices OR Indices, Dental Plaque OR Stomatitis, denture OR Denture Stomatitides OR Stomatitides, Denture)

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In example, Niestem *et al.* evaluated the prevalence of individuals with at least one carious tooth, whilst Pajukoski *et al.* and McMillan *et al.* considered the number (mean and standard deviation) of decayed teeth. The DMFT index (decayed, missed and filled teeth) was reported in McMillan *et al.* and Bitetti *et al.*, however the later did not present standard deviation values.

Most of studies presented a descriptive analysis and statistical comparison between groups using chi-square or t test, when applicable. Included stud-

ies showed greater number of edentulous individuals among institutionalized elderly<sup>15-18</sup>. In addition, the periodontal status did not differ significantly between institutionalized and non-institutionalized individuals<sup>15-17</sup>. Greater caries experience was observed among institutionalized individuals compared to non-institutionalized ones<sup>15-17,19</sup>. Additional outcomes were reported by Triantos<sup>18</sup> (oral lesions, denture stomatitis), and no differences were reported between groups. None of studies reported the use of dentures comprehensively.

**Table 1.** Search strategy used for each database.

Database	Strategy
Cochrane Library	#1Aged
	#2Elderly
	#3aged, 80 and over
	#4Oldest old
	#5Nonagenarians
	#6Octogenarians
	#7Centenarians
	#8#1 or #2 or #3 or #4 or #5 or #6 or #7
	#9Institutionalization
	#10Institutionalizations
	#11Institutionalized Persons
	#12Institutionalized Person
	#13Homes for the aged
	#14old age homes
	#15old age home
	#16#9 or #10 or #11 or #12 or #13 or #14 or #15
	#17dental caries
	#18dental decay
	#19cariou dentin
	#20dental white spots
	#21white spots, dental
	#22white spot
	#23spot, white
	#24tooth loss
	#25loss, tooth
	#26periodontitis
	#27pericementitis
	#28pericementitides
	#29periodontitides
	#30gingivitis
	#31gingivitides
	#32dental plaque
	#33plaque, dental
	#34dental plaque index
	#35index, dental plaque

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**Table 1.** Search strategy used for each database.

Database	Strategy
Cochrane Library	#36dental plaque indexes #37indexes, dental plaque #38dental plaque indices #39indices, dental plaque #40stomatitis, denture #41denture stomatitides #42denture stomatitis #43stomatitides, denture  #44#17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 #45#8 and #16 and #44
Scopus	(TITLE-ABS-KEY(Aged) OR TITLE-ABS-KEY(Elderly) OR TITLE-ABS-KEY(Aged, 80 AND over) OR TITLE-ABS-KEY(Oldest old) OR TITLE-ABS-KEY(Nonagenarians) OR TITLE-ABS-KEY(Nonagenarian) OR TITLE-ABS-KEY(Octogenarians) OR TITLE-ABS-KEY(Octogenarian) OR TITLE-ABS-KEY(Centenarians) OR TITLE-ABS-KEY(Centenarian)) AND (TITLE-ABS-KEY(Institutionalization) OR TITLE-ABS-KEY(Institutionalizations) OR TITLE-ABS-KEY(Institutionalized Persons) OR TITLE-ABS-KEY(Institutionalized Person) OR TITLE-ABS-KEY(Person, Institutionalized) OR TITLE-ABS-KEY(Persons, Institutionalized) OR TITLE-ABS-KEY(Homes for the aged) OR TITLE-ABS-KEY(Old Age Homes) OR TITLE-ABS-KEY(Home, Old Age) OR TITLE-ABS-KEY(Homes, Old Age) OR TITLE-ABS-KEY(Old Age Home)) AND (TITLE-ABS-KEY(Dental caries) OR TITLE-ABS-KEY(Dental Decay) OR TITLE-ABS-KEY(Caries, Dental) OR TITLE-ABS-KEY(Decay, Dental) OR TITLE-ABS-KEY(Carious Dentin) OR TITLE-ABS-KEY(Carious Dentins) OR TITLE-ABS-KEY(Dentin, Carious) OR TITLE-ABS-KEY(Dentins, Carious) OR TITLE-ABS-KEY(Dental White Spot) OR TITLE-ABS-KEY(White Spots, Dental) OR TITLE-ABS-KEY(White Spots) OR TITLE-ABS-KEY(Spot, White) OR TITLE-ABS-KEY(Spots, White) OR TITLE-ABS-KEY(White Spot) OR TITLE-ABS-KEY(Dental White Spots) OR TITLE-ABS-KEY(White Spot, Dental) OR TITLE-ABS-KEY(Tooth loss) OR TITLE-ABS-KEY(Loss, tooth) OR TITLE-ABS-KEY(Periodontitis) OR TITLE-ABS-KEY(Periodontitides) OR TITLE-ABS-KEY(Pericementitis) OR TITLE-ABS-KEY(Pericementitides) OR TITLE-ABS-KEY(Gingivitis) OR TITLE-ABS-KEY(Gingivitides) OR TITLE-ABS-KEY(Dental plaque) OR TITLE-ABS-KEY(Plaque, dental) OR TITLE-ABS-KEY(Dental plaque index) OR TITLE-ABS-KEY(Index, Dental Plaque) OR TITLE-ABS-KEY(Dental Plaque Indexes) OR TITLE-ABS-KEY(Indexes, Dental Plaque) OR TITLE-ABS-KEY(Dental Plaque Indices) OR TITLE-ABS-KEY(Indexes, Dental Plaque) OR TITLE-ABS-KEY(Stomatitis, denture) OR TITLE-ABS-KEY(Denture Stomatitides) OR TITLE-ABS-KEY(Denture Stomatitis) OR TITLE-ABS-KEY(Stomatitides, Denture))
Lilacs	((TW:(Aged)) OR (TW:(Elderly)) OR (TW:(Aged, 80 AND over)) OR (TW:(Oldest old)) OR (TW:(Nonagenarians)) OR (TW:(Nonagenarian)) OR (TW:(Octogenarians)) OR (TW:(Octogenarian)) OR (TW:(Centenarians)) OR (TW:(Centenarian))) AND ((TW:(Institutionalization)) OR (TW:(Institutionalizations)) OR (TW:(Institutionalized Persons)) OR (TW:(Institutionalized Person)) OR (TW:(Person, Institutionalized)) OR (TW:(Persons, Institutionalized)) OR (TW:(Homes for the aged)) OR (TW:(Old Age Homes)) OR (TW:(Home, Old Age)) OR (TW:(Homes, Old Age)) OR (TW:(Old Age Home))) AND ((TW:(Dental caries)) OR (TW:(Dental Decay)) OR (TW:(Caries, Dental)) OR (TW:(Decay, Dental)) OR (TW:(Carious Dentin)) OR (TW:(Carious Dentins)) OR (TW:(Dentin, Carious)) OR (TW:(Dentins, Carious)) OR (TW:(Dental White Spot)) OR (TW:(White Spots, Dental)) OR (TW:(White Spots)) OR (TW:(Spot, White)) OR (TW:(Spots, White)) OR (TW:(White Spot)) OR (TW:(Dental White Spots)) OR (TW:(White Spot, Dental)) OR (TW:(Tooth loss)) OR (TW:(Loss, tooth)) OR (TW:(Periodontitis)) OR (TW:(Periodontitides)) OR (TW:(Pericementitis)) OR (TW:(Pericementitides)) OR (TW:(Gingivitis)) OR (TW:(Gingivitides)) OR (TW:(Dental plaque)) OR (TW:(Plaque, dental)) OR (TW:(Dental plaque index)) OR (TW:(Index, Dental Plaque)) OR (TW:(Dental Plaque Indexes)) OR (TW:(Indexes, Dental Plaque)) OR (TW:(Dental Plaque Indices)) OR (TW:(Indices, Dental Plaque)) OR (TW:(Stomatitis, denture)) OR (TW:(Denture Stomatitides)) OR (TW:(Denture Stomatitis)) OR (TW:(Stomatitides, Denture)))

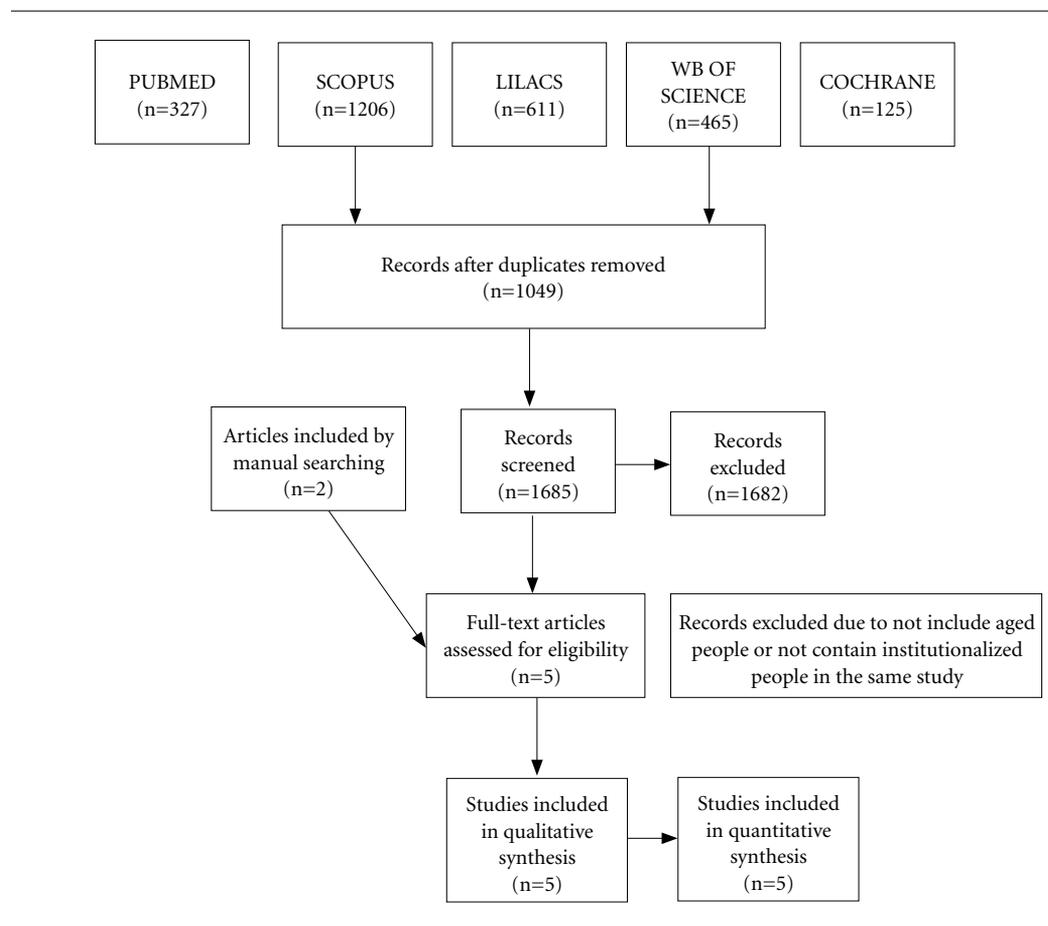


Figure 1. PRISMA flow-chart Diagram.

### Quality assessment

The quality assessment of included studies revealed that all of them do not have any important issues that would compromise the quality of those investigations. As observed in Table 3, none of studies present any risk of bias or any confounding factors. In addition, it was judged that results did not occur by chance<sup>12</sup>.

### Quantitative synthesis (Meta-analysis)

Meta-analysis of all included studies<sup>15-19</sup> revealed that institutionalized elderly have a greater proportion of edentulous individuals (OR = 2.28, 95%CI = 1.685-3.073) compared to non-institutionalized (Figure 2A). This meta-analysis exhibited an acceptable heterogeneity index ( $I^2 = 47,81\%$ ,  $p = 0.147$ ). Only one of the studies<sup>19</sup> did not reject the null hypothesis.

With regards to the periodontal status, three studies were considered for meta-analysis<sup>15-17</sup> (Figure 2B). Although the heterogeneity can be considered high ( $I^2 = 88,20\%$ ,  $p < 0.001$ ), summarized conclusion showed no differences between the institutionalized and non-institutionalized elderly (OR = 0.635, 95%CI = 0.305-1.324). High heterogeneity may be due to the variation on number of teeth within groups.

Meta-analyses also revealed that institutionalized individuals had greater number of decayed (Figure 2C) and missed (Figure 2D) teeth. The mean difference on the number of decayed teeth was 0.878 (95%CI = 0.708-1.048) and the heterogeneity for this was considered adequate ( $I^2 = 37,83\%$ ,  $p = 0.205$ ). The mean difference on the number of missed teeth was 4.580 (95%CI = 1.890-7.271), but the heterogeneity was high ( $I^2 = 89,83\%$ ,  $p = 0.002$ ).

Table 2. Data extracted from the included studies.

Author	Geographic Location	Study Design	Number of elderly	Age	Exclusion criteria	Outcomes included	Statistical analysis	Main Results	Conclusion
Pajukoski et al. (1999)	Finland	Cross sectional	435 elderly (181 institutionalized and 254 non-institutionalized)	70 years and over	Elderly < 70 years old and those that didn't sign the term or didn't had verbal permission	Number of dentate patients and edentulous	Chi-square test t test (when applicable).	<p><b>Edentulous:</b>  <b>IP:</b> 66.3% (n=120) / <b>NIP:</b> 42.1% (n=107) (p &lt; 0.001)</p> <p><b>Mean number of teeth:</b>  <b>IP</b> (11.3 ± 7.6) / <b>NIP</b> (16.3 ± 7.4) (p &lt; 0.001)</p> <p><b>Mean number of decayed teeth:</b>  <b>IP</b> (1.3 ± 2.2) / <b>NIP</b> (0.6 ± 0.9) (p &lt; 0.01)</p> <p><b>CPI score:</b>  <b>IP:</b> 0-1 (5.2%) / 2 (35.1%) / 3 (33.3%) / 4 (26.3%)  <b>NIP:</b> 0-1 (1.4%) / 2 (44.6%) / 3 (27.7%) / 4 (26.4%) (p &gt; 0.05)</p>	The results of this study confirmed the hypothesis that Institutionalized elderly patients who had many concomitant diseases and used many drugs daily had worse dental health than Non-Institutionalized people
McMillan et al. (2003)	Hong Kong	Cross sectional	586 elderly (268 institutionalized and 318 non-institutionalized)	60 to 80 years old	Elderly people with communication difficulties or suffering from any psychiatric disease including dementia	Edentulous people Caries Experience (DMFT) Periodontal status (CPI scores)	Chi-square and independent t tests	<p><b>Edentulous:</b>  <b>IP:</b> 19% (n=51) / <b>NIP:</b> 10% (n=32) (p&lt;0.05)</p> <p><b>DMFT:</b>  <b>IP:</b> (D: 2.05 ± 0.20 / M: 19.04 ± 0.59 / F: 0.25 ± 0.05) – Total: 21.35 ± 0.56  <b>NIP:</b> (D: 1.13 ± 0.09 / M: 15.70 ± 0.51 / F: 0.84 ± 0.09) – Total: 17.67 ± 0.49 (p&lt;0.001)</p> <p><b>CPI score:</b>  <b>IP:</b> 0-1 (0.5%) / 2 (40.1%) / 3 (39.6%) / 4 (19.8%)  <b>NIP:</b> 0-1 (3.4%) / 2 (23.4%) / 3 (54.0%) / 4 (19.2%) (p&lt;0.001)</p>	The institutionalized group had experienced more dental disease in the past and consequently had more missing teeth than the non-institutionalized elderly. Untreated dental conditions were more common in the institutionalized elderly.

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Table 2. Data extracted from the included studies.

Author	Geographic Location	Study Design	Number of elderly	Age	Exclusion criteria	Outcomes included	Statistical analysis	Main Results	Conclusion
Bitetti et al. (2004)	Italy	Cross sectional	364 elderly institutionalized and 106 non-institutionalized)	65 years and over	Elderly < 65 years old	Mean number of permanent teeth	Chi-square test	<b>Edentulous:</b> IP: 49.6% (n=128) / NIP: 28.3% (n=30) (p<0.001) <b>DMFT:</b> IP: (D: 1.03 / M: 23.84 / F: 0.12) – Total: 24.99 NIP: (D: 1.07 / M: 18.17 / F: 0.51) – Total: 19.75 <b>CPI score:</b> IP: 0-1 (51.92%) / 2 (23.25%) / 3 (8.52%) / 4 (0.38%) NIP: 0-1 (42.44%) / 2 (33.96%) / 3 (16.98%) / 4 (4.71%)	The value of the DMFT in Non-Institutionalized people (NIP) is less than in hospitalized patients, therefore, decay presents a greater prevalence in institutionalized (IP).
Triantos (2005)	Greece	Cross sectional	316 elderly (166 institutionalized and 150 non-institutionalized)	65 years and over	Elderly ≤ 65 years old and those that didn't want to participate	Number of Edentulous Oral lesions	Fisher's exact two-sided test	<b>Edentulous:</b> IP: 88.5% (n=145) / NIP: 68% (n=102) (p<0.001) <b>Oral Lesions:</b> IP: 46.2% (n=77) / NIP: 47.2% (n=71) (p>0.05) <b>Denture-induced stomatitis:</b> IP: 9.64% (n=16) / NIP: 11.33% (n=17) (p>0.05)	The present study demonstrated that among elderly people, either living in long-term care facilities or independently in the society, general health problems and oral health issues are common, variable and coexistent, necessitating the daily administration of multiple medications. Prevalence of oral health disorders does not vary significantly between institutionalized and non-institutionalized people

it continues

Table 2. Data extracted from the included studies.

Author	Geographic Location	Study Design	Number of elderly	Age	Exclusion criteria	Outcomes included	Statistical analysis	Main Results	Conclusion
Niestem et al. (2016)	Netherlands	Cross sectional	235 elderly (126 institutionalized and 109 non-institutionalized)	65 years and over	Cognitively depressed individuals	Number of dentate patients and edentulous	t-test and multiple linear regression	<p><b>Edentulous:</b>  <b>IP:</b> 46% (n=58) / <b>NIP:</b> 39% (n=43) (p&gt;0.05)</p> <p><b>Mean number of missed teeth:</b>  <b>IP:</b> 16.8 ± 8.2 / <b>NIP:</b> 10.7 ± 5.1 (p&lt;0.001)</p> <p><b>Subjects with one or more carious teeth</b>  <b>IP:</b> 57% (n=39) / <b>NIP:</b> 7% (n=11) (p&lt;0.001)</p>	Clinical oral health outcomes of care-dependent participants were significantly worse than those of care-independent participants
						Number of missed teeth (among dentate)			
						Number of individuals with one or more carious teeth (among dentate)			

IP: Institutionalized People, NIP: Non-Institutionalized People, DMFT: Decayed, Missed Filled Teeth Index, CPI: Community Periodontal Index.

**Table 3.** Quality assessment of included studies, according to Folkes and Fulton (1991).

Guideline	Checklist	Pajukoski et al. (1999)	McMillan et al. (2003)	Bitteti et al. (2004)	Triantos (2005)	Niestem et al. (2016)
Study design appropriate?	Cross-sectional (prevalence)	Yes	Yes	Yes	Yes	Yes
	Cohort (prognosis)	NA	NA	NA	NA	NA
	Controlled Trial (treatment)	NA	NA	NA	NA	NA
	Case-control, cross-sectional (cause)	NA	NA	NA	NA	NA
Study sample representative?	Source of sample	+	0	+	+	+
	Sampling method	0	0	0	0	0
	Sample size	0	0	0	0	0
	Entry criteria and exclusions	0	0	0	0	0
Control group acceptable?	Definition of control	0	0	0	0	0
	Source of control	0	0	0	0	0
	Matching/randomization	NA	NA	NA	NA	NA
	Comparable characteristics	0	0	0	0	0
Quality of measurements and outcomes?	Validity	0	0	0	0	0
	Reproducibility	0	0	0	0	0
	Blindness	NA	NA	NA	NA	NA
	Quality control	0	0	0	0	0
Completeness?	Compliance	0	0	0	0	0
	Drop out	NA	NA	NA	NA	NA
	Death	NA	NA	NA	NA	NA
	Missing data	0	0	0	0	0
Distorting influence?	Extraneous treatments	NA	NA	NA	NA	NA
	Contamination	NA	NA	NA	NA	NA
	Changes over time	NA	NA	NA	NA	NA
	Confounding factors	0	0	0	0	0
	Distortion reduced by analysis	0	0	0	0	0
Summary questions	Bias – Are the results erroneously biased in a certain direction?	No	No	No	No	No
	Confounding – Are there any serious confounding or other distorting influences?	No	No	No	No	No
	Chance – Is it likely that the results occurred by chance?	No	No	No	No	No

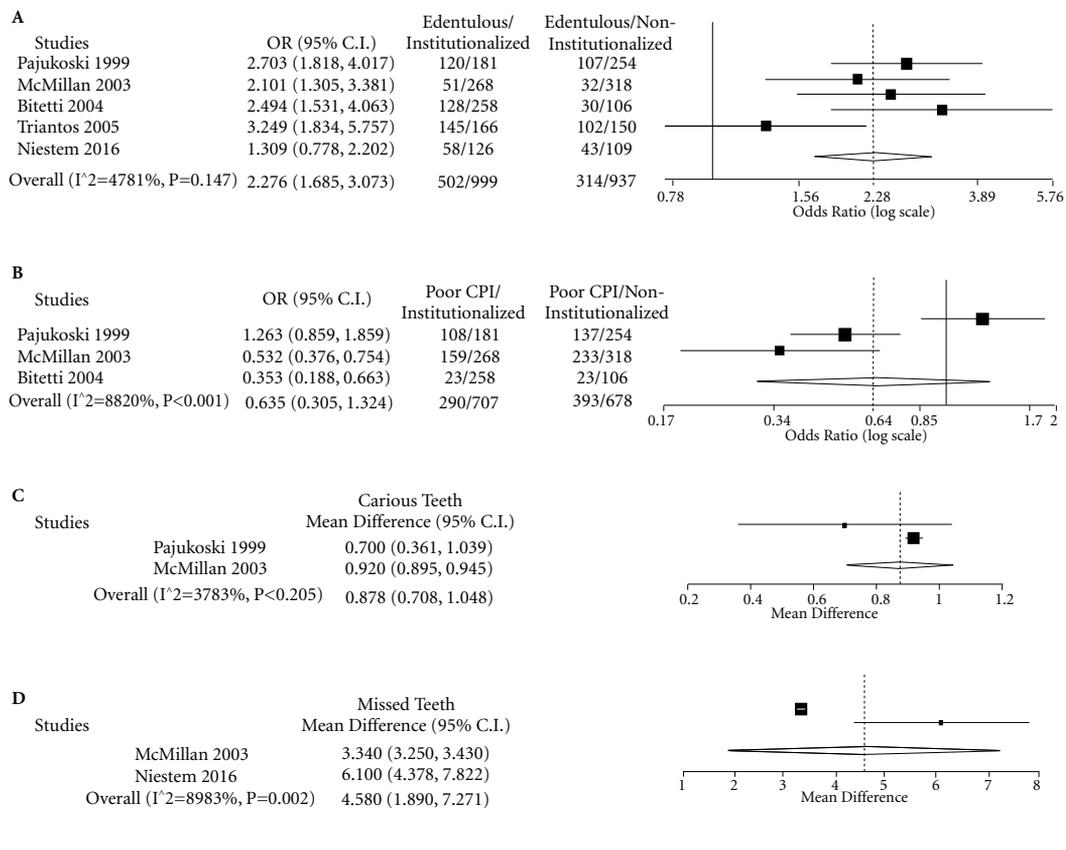
0: No Problem, +: Minor Problem, ++: Major Problem. NA: Not Applicable.

## Discussion

The increasing number of institutionalized elderly is due, in part, to the proportional growth of the elderly population. In view of the worsening of the health status of the elderly and the impossibility of families offering full-time care, the elderly are often referred to long-term care homes. Since these elderly people present greater morbidity associated with their health status, a higher prevalence of systemic and oral diseases is expected<sup>20-24</sup>. In this sense, the results of this systematic review and meta-analysis point out that institutionalized

elderly present a poorer oral health status compared to non-institutionalized ones.

First of all, the poorer oral health status detected in this meta-analysis may not be considered due to the process of institutionalization. All of the included studies presented a cross-sectional design, which is not accurate to detect cause-effect relationship. Nevertheless, poorer oral health status may be a result of the poorer general health condition, which leads to the elder's institutionalization<sup>20-22</sup>. Besides that, most of the nursing care homes are not prepared to provide full dental health care<sup>23-25</sup>.



**Figure 2.** Meta-analyses and respective forest-plots of the comparison between institutionalized and non-institutionalized individuals within included studies. Oral health status was compared regarding following outcomes: frequency of edentulous individuals (A), prevalence of poor periodontal status (B), number of decayed teeth (C) and number of missed teeth (D). Odds Ratio (OR) parameter estimated the chance of institutionalized elderly being edentulous (A) or having poor periodontal status (B). Mean Difference parameter estimated the outcome's difference between institutionalized and non-institutionalized elderly for carious (C) and missed (D) teeth.  $I^2$  index indicate the heterogeneity of included studies.

With regards to the oral care provided within long term facilities, some factors can contribute to the deterioration of the oral health of the elderly: first, caregivers often present limited knowledge about the oral priorities of the elderly, in addition to insufficient time to perform them; secondly, access to dental care centers is limited, especially related to situations of mobility difficulties; finally, oral problems are of little importance for the elderly, considering the context of the multi-morbidity of these<sup>25,26</sup>.

In addition to logistical challenges in getting homebound elderly to a dentist, medical-care usually does not cover dental costs. Although nursing facilities must provide or arrange for the provision of dental services for residents<sup>27</sup>, there is no law mandating provision of oral health care

for institutionalized elderly<sup>28</sup>. The arrangements within each long-term care facilities depends if it is public or private, in addition to have well prepared staff to provide oral care, in example of technical oral health professionals<sup>29</sup>. However, these aspects were not considered within the studies included in the present systematic review and meta-analysis.

Another important factor is that the institutionalized elderly present physical limitations and/or cognitive impairment that make them unable to perform their own oral hygiene or remove their prosthesis, favoring the onset or worsening of dental caries, oral infections and pain. Such situations can lead to potentially negative consequences, such as nutritional deficiencies, weight loss and systemic problems, leading

to a decrease in the quality of life. These aspects put into evidence the conditions of systemic repercussion, in detriment of oral health<sup>29</sup>. Physical and cognitive impairment are frequently the main reason for institutionalization. The critical condition of such individuals leads to a higher dependency, which usually impact the provision of oral health care<sup>29-31</sup>.

With regards to the service offered by long-term care institutions, it is observed absence of oral care protocols and high employee turnover, which results in a lack of the continuity of care. In addition, employees report that oral care is a burden and a physically demanding work<sup>29</sup>. Factors involving dentists include: lack of adequate equipment; reduction of the time available for private practice; and apathy of administrators and employees of the institutions in relation to dental activities<sup>30,31</sup>.

Although the included studies in this systematic review and meta-analysis indicate that institutionalized elderly have poorer oral status, the prevalence of oral disorders among non-institutionalized elderly is also considered high<sup>16,17</sup>. The missing teeth consists the most evident finding of dental care experience among elderly people<sup>16,17,19</sup>. It is important to highlight that institutionalized individuals might have poorer oral status before being admitted into institutional long-term care<sup>32-34</sup>. Therefore, results of this study may be evaluated with care, since higher caries experience may not be due to institutionalization, but associated with poor general health during life course<sup>34,35</sup>.

The high caries experience observed in the elderly population, in general, is due to the inefficiency of the methods of prevention and dental treatment received during the course of life<sup>36</sup>. Poor periodontal status was also present in institutionalized and non-institutionalized elderly. Although dental practice has been transformed and advanced over the last few years, it is necessary to assume that the elderly accumulates signs of a denaturing and iatrogenic dental practice<sup>37</sup>.

From the results of this study, it can be suggested that institutionalized elders may experience a poorer oral status, which calls attention to their general health. Sometimes, increased number of edentulous individuals is related to the lack of knowledge of family members and other health professionals, who suggest the removal of teeth in the elderly with neurodegenerative diseases or in a condition of dependence<sup>38</sup>. The loss of teeth may impact the nutrition of elders, resulting into other systemic complications. Be-

sides that, poor periodontal status may also be associated with other systemic illness.

The difference in the caries experience between institutionalized and non-institutionalized elderly people is generally due to the lack of personal motivation, historical less self-care, past low access to health services and greater systemic impairment, which leads to direct attention to other aspects than the oral health. Although this meta-analysis did not show differences on the periodontal status, two of three included studies exhibited higher prevalence of periodontal pockets. This can also be a result of neglecting the own oral health during life course.

Non-institutionalized elderly people are more often inserted in the social context, being more attentive with their personal care and, consequently, with their oral hygiene<sup>17</sup>. In addition, community-dwelling elderly have the autonomy to maintain their adequate health levels, presenting greater perception about oral health<sup>39</sup>.

A limitation of the included studies of this systematic review rests on the absence of socioeconomic variables. A study carried out with Lebanese elderly showed that oral health condition can be influenced by socioeconomic status, including the following variables: level of schooling, housing level (based on property prices and real estate), work experience (past or recent)<sup>40</sup>. In addition to these, other socio-demographic variables should be added, besides age and sex: marital status, number of members in the residence and use of dental services<sup>40</sup>. Only one of the included studies in this meta-analysis considered the effect of socio-economical status, however the dependent variable were not the oral health status, but the oral-health related quality of life<sup>19</sup>.

Another limitation of the included studies consists the age of the elderly participants, in which the minimum age for the elderly to be included was 65 years, considering three of five included studies. The World Health Organization (WHO) establishes that the minimum age to be considered as elderly is 60 years<sup>41</sup>. Only one of the included studies considered the age of 60 years and over<sup>19</sup>. This may be due to increased life expectancy in developed countries.

The cross-sectional design may also represent a limitation to associate the process of institutionalization to poorer oral health. However, no cohort studies compared the oral status of institutionalized and non-institutionalized elderly. Overall, few studies had compared the oral health status of institutionalized and non-institutionalized elderly. More epidemiological surveys with

standardized methods, and with a cohort perspective, are recommended to allow future meta-analysis regarding the oral health of elderly population. It is important that further studies can be conducted in this direction, providing enough data for other more robust systematic reviews.

Although some of the meta-analyses reported in the present study presented a high heterogeneity index, conclusions regarding the comparison of the oral health status can be considered sound. Higher dental caries experience and greater prevalence of edentulous are evident within institu-

tionalized population. These aspects may also impact the general health, including the masticatory efficiency, nutritional status and frailty of institutionalized elderly.

## Conclusion

Considering the results of the included studies in this systematic review and meta-analysis, we conclude that institutionalized elderly have poorer oral status compared to non-institutionalized ones.

## Collaborators

IPS Farias, LFD Almeida, BM Santiago and YW Cavalcanti designed the study. IPS Farias and YW Cavalcanti performed electronic database searches, applied appropriate eligibility criteria and performed the quality assessment of included studies. SA Sousa, BM Santiago, AC Pereira and YW Cavalcanti performed and interpreted meta-analysis. IPS Farias, LFD Almeida and SA Sousa drafted the manuscript. BM Santiago, AC Pereira and YW Cavalcanti revised the manuscript for important intellectual content.

## Acknowledgment

The first author received support by the Brazilian Agency CAPES. The authors deny any conflicts of interest related to this study.

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Article submitted 25/05/2018

Approved 03/10/2018

Final version submitted 05/10/2018