

## Periodontal Parameters in Indonesian Elderly and its Association with Cognitive Impairment

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### Abstract

Periodontitis and cognitive impairment are very prevalent among the elderly. Increasing evidence indicates that there is a link between these two conditions. This study aimed to assess the association between periodontal health and cognitive function among nursing home residents in Jakarta, Indonesia. A cross-sectional study of 91 elderly subjects was conducted in a public nursing home in Jakarta, Indonesia. Subjects underwent cognitive and periodontal examinations. Cognitive function was assessed using the Hopkins Verbal Learning Test (HVLT). The following periodontal parameters were evaluated: plaque index (PII), oral hygiene index (OHI), papillary bleeding index (PBI), pocket depths, gingival recession, attachment loss, and tooth loss. Sixty-one subjects had cognitive impairment and 30 subjects were cognitively normal. There were significant differences ( $p < .05$ ) in age and education between the cognitively normal and cognitively-impaired subjects. However, there were no significant differences in gender between the two groups. There were significant differences in the plaque indices, OHI, papillary bleeding indices, pocket depths, gingival recession, attachment loss, and tooth loss between cognitively normal and cognitively-impaired subjects ( $p < .05$ ). There were significant correlations between all periodontal parameters and cognitive function scores ( $p < .05$ ). This study indicates that poorly periodontal health is significantly associated with cognitive impairment.

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### Introduction

The global population is aging at a rapid rate, including the population of Indonesia. Based on Indonesia's population projection data, the number of elderly people is projected to be 48.2 million by 2035.<sup>1</sup> The aging of the global population has increased the prevalence of chronic neurodegenerative diseases such as dementia. In 2018, fifty million people were living with dementia worldwide.<sup>2</sup> A survey of dementia in the Special Region of Yogyakarta, Indonesia (2016) showed that the prevalence of dementia

among elderly people  $\geq 60$  years of age reached 20.1%.<sup>3</sup>

Dementia is defined as a clinical syndrome that encompasses difficulties in memory, language, and behavior that leads to impairments in activities of daily living.<sup>4</sup> Persons with cognitive impairment are at higher risk of developing dementia.<sup>5</sup> Cognitive impairment is a syndrome defined as experiencing cognitive decline greater than expected for an individual's age and education level but not enough to interfere with activities of daily living.<sup>6</sup>

Periodontitis has also become more prevalent among an aging population. Eke et al. conducted a study using data from the 2009–2010 National Health and Nutrition Examination Surveys. The results showed that 64% of elderly people aged 65 years and more had moderate to severe periodontitis.<sup>7</sup> Other studies by Tadjoedin et al. (2017) showed a significant correlation between periodontal disease and age.<sup>8</sup>

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Periodontitis is a chronic inflammatory disease caused by infection of the supporting tissues around the teeth.<sup>9</sup> Periodontitis can impact the susceptibility of the host for acquiring other diseases.<sup>10</sup> Increasing evidence also indicates an association between periodontitis and cognitive impairment or dementia.<sup>11-13</sup> However, investigations related to this potential relationship are limited in Indonesia. The aim of this study was to assess the association between periodontal health and cognitive function among nursing home residents in Jakarta, Indonesia.

### Materials and methods

This cross-sectional study was conducted in a public nursing home in South Jakarta, Indonesia between May and June 2019. There were 285 elderly people living in the nursing home, but only 91 subjects were included in this study. Individuals  $\geq 60$  years of age were included in this study. Subjects with the following conditions were excluded from the study: hearing loss, diabetes mellitus, a history of periodontal treatment in the past six months, edentulous, and mental disorders. Written informed consent was obtained from the subjects or their caregivers. The study protocol was permitted by the Dental Research Ethics Committee, Faculty of Dentistry, Universitas Indonesia.

Subjects underwent cognitive examinations and assessment of periodontal parameters. Cognitive function was assessed using the Hopkins Verbal Learning Test (HVLT) that had been previously validated in Indonesia. The HVLT is a brief word-learning test measuring episodic verbal memory that consists of 12 words and is repeated three times. Subjects are asked to recall the words in any order after the list has been read. The HVLT score is the total number of words from all three trials that were recalled correctly. A scores between 0 and 14 indicated cognitive impairment while scores  $>14$  indicated a cognitively normal status.<sup>14,15</sup>

The periodontal parameters evaluated were as follows: plaque index (PII), oral hygiene index (OHI), papillary bleeding index (PBI), pocket depths, gingival recession, attachment loss, and tooth loss. The PII assesses the thickness of plaque at four gingival areas of the tooth (distofacial, facial, mesiofacial, and lingual/palatal surfaces). The OHI was obtained by calculating the sum of the debris and calculus

indices. Examinations of the debris and calculus indices were performed on the facial and lingual/palatal surfaces of each tooth. The PBI is determined based on the extent of bleeding that occurs after gentle probing of the interdental papilla. The maxillary right and mandibular left quadrants were probed lingually while the maxillary left and mandibular right quadrants probe buccally.<sup>16,17</sup>

The pocket depth was measured from the gingival margin to the pocket base, gingival recession was measured from the cemento-enamel junction to the gingival margin, and attachment loss was measured from the cemento-enamel junction to the pocket base. Pocket depths, gingival recession, and attachment loss were measured and recorded at six sites per tooth on the following surfaces: mesiobuccal, midbuccal, distobuccal, mesiolingual/palatal, midlingual/palatal, and distolingual/palatal.<sup>18</sup> The examination was performed using a mouth mirror and a standardized periodontal probe (UNC 15, Hu-Friedy Manufacturing Co., Chicago, IL, USA). The examination was performed on all teeth except for the third molar and the root gangrene.

Statistical analyses were performed with SPSS version 23 statistical software (IBM Corp., NY, USA). Descriptive statistics were obtained and tested for normality using the Kolmogorov-Smirnov test. Bivariate analyses were performed using the Student's t-test and Mann-Whitney U test to compare periodontal parameters between normal and cognitively-impaired subjects. Correlations between periodontal parameters and cognitive function scores were analyzed using the Pearson and Spearman tests. A *P*-value  $<.05$  was considered significant for bivariate analyses.

### Results

Among the 91 study subjects, 61 subjects were defined as having cognitive impairment and 30 subjects were cognitively normal. There were significant differences ( $P<.05$ ) in age and education levels between the cognitively normal and cognitively-impaired subjects. However, there was no significant difference in gender distribution between the two groups (Table 1).

Variable	Cognitive Function (HVL T Score)		p-value
	Normal (n=30)	Cognitive Impairment (n=61)	
Age (mean±SD) years	67.17±6.97	71.67±8.69	.022*
Gender			.224
Male	14 (46.7%)	19 (31.1%)	
Female	16 (53.3%)	42 (68.9%)	
Education			.000*
No	4 (13.3%)	33 (54.1%)	
Elementary	10 (33.3%)	14 (23%)	
Middle	8 (26.7%)	8 (13.1%)	
High	6 (20%)	5 (8.2%)	
Postgraduate	2 (6.7%)	1 (1.6%)	

**Table 1.** Comparison of characteristics of the study subjects.

Cognitive impairment if HVL T score ≤14 and Normal if HVL T score >14

\*Mann-Whitney U; Statistically significant (P<.05).

All subjects had been diagnosed with periodontitis. In general, the periodontal parameters in subjects with cognitive impairment were worse compared to the cognitively normal subjects. There were significant differences in the plaque indices, OHIs, papillary bleeding indices, pocket depths, gingival recession, attachment loss, and tooth loss between the cognitively normal and cognitively-impaired subjects (Table 2). There were also correlations between all periodontal parameters and cognitive function scores (Table 3). Pocket depth correlated more strongly with cognitive function scores than other periodontal parameters such as PII, OHI, PBI, gingival recession, attachment loss, and tooth loss (r=-.577).

Periodontal Parameters	Normal (n=30)	Cognitive Impairment (n=61)	p-value
	Mean (SD)	Mean (SD)	
Plaque Index	1.32 (0.88)	1.90 (0.69)	.003*
Oral Hygiene Index	2.31 (1.25)	3.17 (1.29)	.005**
Papillary Bleeding Index	0.86 (0.80)	1.76 (1.05)	.000**
Pocket Depth (mm)	1.27 (0.85)	3.04 (1.11)	.000**
Gingival Recession (mm)	2.14 (1.20)	3.08 (1.86)	.013**
Attachment Loss (mm)	3.39 (1.84)	6.09 (2.35)	.000**
Tooth loss	15.37 (7.96)	18.82 (7.24)	.023**

**Table 2.** Periodontal parameters according to cognitive function.

Cognitive impairment if HVL T score ≤14 and Normal if HVL T score >14

\*T-test; \*\* Mann-Whitney U; Statistically significant (p<.05).

	Periodontal parameters	Correlation coefficient (r)	p-value
HVL T score	Plaque Index	-0.261	.012*
	Oral Hygiene Index	-0.291	.005**
	Papillary Bleeding Index	-0.334	.001*
	Pocket Depth	-0.577	.000*
	Gingival Recession	-0.309	.003*
	Attachment Loss	-0.487	.000*
	Tooth loss	-0.225	.032*

**Table 3.** Correlation between periodontal parameters and cognitive function scores.

\* Spearman; \*\* Pearson; Statistically significant (p<.05).

## Discussion

In the present study, the association between periodontal health and cognitive function among the Indonesian elderly was assessed. This study showed that elderly adults with cognitive impairment have worse periodontal health compared to cognitively normal elderly adults. As cognitive function declines among the elderly, so does the ability to maintain effective oral hygiene. A study by Kurniawan et al. showed that poor oral health status among the elderly could be caused by poor salivary flow, low salivary pH, and decreased buffering capacity of saliva.<sup>19</sup>

Our findings are in accordance with several other studies. Gil-Montoya et al. found that oral hygiene, bacterial plaque, and gingival inflammation worsened with greater cognitive impairment among the elderly.<sup>20</sup> Subjects with a history of periodontitis were more likely to have cognitive impairment compared to subjects without a history of periodontitis (odd's ratio=2.14, 95% confidence interval=1.04–4.41).<sup>11</sup> A prospective cohort study indicated that the loss of multiple teeth was associated with the development of cognitive impairment.<sup>21</sup> Other studies showed a significant association between clinical attachment loss and cognitive impairment. However, no significant association was identified between tooth loss and cognitive impairment.<sup>12</sup>

This study showed correlations between all periodontal parameters and cognitive function scores. It is consistent with previous findings showing that community-dwelling elderly people with cognitive decline experience a greater deterioration in oral health.<sup>22</sup> Kusdhany et al. found a significant relationship between oral hygiene and cognitive function.<sup>23</sup>

The mean age of subjects with cognitive impairment was 71.67±8.69 years, which was compared to the mean age of cognitively normal subjects. This is relevant because advanced age is the most important risk factor for cognitive impairment.<sup>24</sup> Most of the cognitively-impaired subjects never went to school (54.1%) and 23% only attended the elementary school. People with more years of formal education have a lower risk of developing dementia than those with fewer years of formal education.<sup>25</sup> Although there were no significant differences in gender between cognitively normal and cognitive impairment

subjects, most of the cognitively-impaired subjects were female. The prevalence of dementia is higher among women compared to men. This may be due to hormonal influence and the fact that women have a longer life expectancy than men.<sup>3</sup>

The limitation of this study was its cross-sectional design, which makes it difficult to determine the direction of the causal relationship between periodontitis and cognitive impairment. In addition, this study did not include all risk factors associated with periodontitis and cognitive impairment. As it is known, the pathogenesis of periodontitis and cognitive impairment are multifactorial. Further studies are needed to prove the causality and biological mechanism between these two conditions.

## Conclusions

This study indicates that poor periodontal health is significantly associated with cognitive impairment. It also provides information on the need for special attention to periodontal health among the elderly.

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## Declaration of Interest

The authors declare no conflict of interest.

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