ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 3, Issue – 6, December - 2020, Page No. : 403 - 412

Oral Health Related Quality of Life (OHRQoL) in older adults suffering from Alzheimer's disease: a Hospital based, Cross sectional study

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Citation of this Article: Dr. Ambar Khan, Dr. Basavaraj Patthi, Dr. Ashish Singla, Dr. Ravneet Malhi, Dr. Pankaj Kumar Chaudhary, Dr. Divyangi Goel, "Oral Health Related Quality of Life (OHRQoL) in older adults suffering from Alzheimer's disease: a Hospital based, Cross sectional study", IJDSIR- December - 2020, Vol. – 3, Issue - 6, P. No. 403 – 412.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Alzheimer's disease (AD) is a progressive and fatal neurodegenerative disorder, characterized by the loss of intellectual functions, including dementia as well as by the frequent occurrence of behavioral abnormalities. The disorder is seen most commonly after the age of 60 years and these elderly patients suffering with Alzheimer's disease experience a progressive decline in their cognitive and behavioral abilities.

Objective: The objective of this study was to assess the Oral Health Related Quality of Life (OHRQoL) in elderly patients suffering with Alzheimer's disease as compared to the subjects without Alzheimer's disease or any other kind of dementia.

Study Design: 100 elderly subjects with Alzheimer's disease (mild to moderate) and 150 subjects without Alzheimer's disease were included in the study. The subjective assessment of OHRQoL was done using the General Oral Health Assessment Index (GOHAI). Demographic and oral characteristics were assessed, including the number of natural teeth; number of Decayed, Missing, and Filled teeth (DMFT); Oral Health Index (OHI); Prosthesis use; Xerostomia and presence of oral pathologies.

Results: GOHAI values were found to be statistically higher (P = 0.0003) in the subjects with Alzheimer's disease. Compared with the controls, the subjects with Alzheimer's disease had a higher DMFT (Mean difference = 4.11), OHI scores (Mean difference = 1.54), Xerostomia (P = 0.0128) and number of oral pathologies. However, the educational level (P = 0.2603) and number of natural teeth (P = 0.0006) was found to be lower in the group with Alzheimer's disease.

Conclusion: Elderly subjects suffering with Alzheimer's disease had poorer oral health related quality of life than those without the disease. Despite the positive self-

perception of their oral health in the subjects with Alzheimer's disease, their oral health tended to decline as their disease progressed. There is a need to comprehensively evaluate the oral health conditions of elderly patients with Alzheimer's disease and actively provide management to improve their OHRQoL.

Keywords: Alzheimer's disease, Oral Health, Oral Health Related Quality of Life, Dementia and Prosthesis.

Introduction

The various improvements in the general health condition of the elderly observed in the second half of the last century have increased the average age of death in the developed countries. According to the WHO, the global population is increasing at the annual rate of 1.7%, while the population of those over 65 years is increasing at a rate of 2.5%. Both the developed, as well as the lesser-developed countries, are expected to experience significant shifts in the age distribution of the population by 2050. [1] Thus, the survival rate of the elderly population will reach explosive levels in the following years.

On the contrary, the incidence of tumors or degenerative diseases has been raised to alarming levels. [1,2] Alzheimer's disease (AD) is a progressive and fatal neurodegenerative disorder characterized by the loss of intellectual functions, including dementia as well as by the frequent occurrence of behavioral abnormalities. The disorder is seen most commonly after the age of 60 years, and the disease causes patients to lose the ability to care even for their own self. [3,4] The neural dysfunction preferentially affects cholinergic synaptic transmission, which is responsible for attention and learning processes. [4,5] The multifactorial etiology of Alzheimer's disease involves genetic and environmental risk factors, such as family history, apo-lipoprotein E, Down's syndrome, advanced age, lower educational level, history of head injury, cardiovascular disease, and female gender. [5,6]

Elderly people suffering from Alzheimer's disease are highly prone to be exposed to unique factors that could lead to the development of advanced oral diseases. Impaired cognition, apathy and apraxia in the middle stages of the disorder are responsible for a disinterest in and an inability to perform appropriate oral hygiene techniques. [7] Concomitant hyposalivation in unmedicated elderly patients as well as the hyposalivation induced by many of the medications is commonly seen. [8] This paucity of saliva leads to increased prevalence of dry and chapped lips, plaque, gingival bleeding, calculus, periodontal disease and coronal and cervical caries in the current patient population. [9]

Increasing the Oral Health Related Quality of Life (OHRQoL) and general health among the elderly is related to maintaining natural teeth and having well-fitted prostheses. [10] Such elderly patients usually become dependent on their caregivers, who may not have the skills or knowledge necessary to provide dental care. [11] The dentists must understand that oral care is often not high on the caregiver's priority list, given the patient's other extensive needs and because oral hygiene practices may cause the patient to become resistive or combative. [12]

Thus, it is important to improve the oral health related quality of life and its impact on the elderly patients suffering from Alzheimer's disease, as it can be used to provide patients and their caregivers with accurate approaches for oral and dental care. Therefore, this study was aimed to assess the Oral Health Related Quality of Life (OHRQoL) of the elderly diagnosed with Alzheimer's disease, objectively using oral assessments and subjectively using the General Oral Health Assessment Index (GOHAI).

Materials And Method

Study design and study setting: A Hospital based, cross sectional study was conducted in the Max Super Specialty Hospital, Vaishali, Ghaziabad to assess the Oral Health Related Quality of Life (OHRQoL) in the elderly people suffering from Alzheimer's disease. The study participants were selected based on a population of outpatients diagnosed with mild to moderate Alzheimer's disease, according to the criteria of International Classification of Diseases (ICD-10) [13] and Diagnostic and Statistical Manual of Mental Disorders. [14] Only those patients with mild or moderate Alzheimer's disease, according to the Clinical Dementia Rating [15] (CDR = 1 or 2, respectively) and Mini-mental State Examination (MMSE) [16] scores ≥ 13, were included in the study.

Cognitive status examination was carried out and diagnosis was established by the neurologists and consulting psychiatrists. The subjects included were in the age group of 65 to 74 years (69.544 ± 2.919). Participants were excluded if they presented with any head trauma, alcohol abuse, aphasia, uncontrolled medical problems, such as diabetes and hypertension, and other overlapping mental disorders. The study was conducted for a period of 4 months; from 1st August to 31st November 2019. The ethical clearance was obtained from the Institutional Review Board. (Ref no: DJD/IEC/2019/A179).

For the collection of data, permission was taken from the Dean along with that of the Head of the Department of Neurosciences of the hospital. Complete details and information regarding the study being conducted, the methods and the purpose of the study was explained to them. This was also explained to the caregivers of study participants or the subjects themselves and written informed consents were taken from them. Oral consent was also taken from the study participants before conducting oral examinations and responding to the questionnaire. The present study followed the Helsinki Declaration and the consent forms were approved by the Institutional Review Board of college and signed by all the study participants.

Study Subjects

A pilot study consisting of interviewing and examining 10 subjects with Alzheimer's disease and 15 subjects without AD was performed for calibration of the examiner and to establish the sample size for the study. These subjects were later not included in the main study. With the prevalence rate of Alzheimer's disease as **6%** (5-7%) in the age group of 65 to 74 years [17], and 5% allowable error; the sample size was calculated to be 90.24, which was rounded off to 100. A total of 250 subjects were included in the study, divided in 2 groups – 100 subjects suffering from Alzheimer's disease (Cases) and 150 subjects without Alzheimer's disease or any other forms of dementia (Controls), i.e. in a ratio of 1:1.5. All the subjects who visited the OPD and fulfilled the Inclusion criteria were selected in the study till the final study sample was reached. The control group was recruited from family caregivers and was proportionally matched to the cases by the variables age and sex.

Subjective Assessment

The socio demographic details of the participants including age, educational status, dental and medical history was recorded. The study was conducted using the General Oral Health Assessment Index (GOHAI) to carry out the subjective assessment for OHRQoL of all the subjects. The GOHAI is a 12-item questionnaire, which assesses OH-related problems affecting people in three dimensions: physical function, psychosocial function and pain or discomfort. Each item was scored on a closed-option 5-point Likert scale (1 = Always, 2 = Often, 3 = Sometimes, 4 = Seldom and 5 = Never). Potential simple count scores ranged from 12 to 60, a low score indicating

negative OH influence on QoL. The range of scores for the dimensions were 4–20 = physical, 5–25 = psychosocial and 3–15 = pain or discomfort. [18]

Questionnaire validation

A prevalidated Hindi version of the GOHAI questionnaire [19] was utilized for the purpose of the study. The investigator distributed the questionnaires to the study participants present at the Department of Neurosciences of the hospital and ample amount of time was given for filling the questionnaire. While filling the questionnaire by the participants, investigator waited there itself to collect the questionnaire on the same day. Majority of the participants were able to read Hindi, so they answered on their own. For some participant's doubts regarding the questions were clarified at the same point. After collection of the questionnaire, a small health talk was also given to the caregivers as well the study subjects regarding maintenance of oral health oral hygiene habits in the elderly people. The data collected was compiled and was checked for its completeness.

Clinical Assessment

Clinical examinations were performed to objectively assess the OHRQoL in all of the subjects. The clinical examinations were carried out using a WHO probe, mouth mirror, and flashlight to evaluate each subject's teeth, any prosthesis, and presence of oral conditions, such as ulceration, stomatitis or inflammatory changes. [20] The number of teeth present in the mouth of each subject was registered, and the teeth were recorded decayed, missing, and filled teeth according to the DMFT index. [20] The sum of the decayed, missing, and filled teeth was cumulatively taken as the DMFT scores for each subject. The extent and position of plaque and calculus on buccal and lingual surfaces of the teeth were recorded in accordance with the Oral Hygiene Index (OHI) as given by Greene and Vermillion. [21] The dentition status, the presence of any oral lesions and Xerostomia is also checked for and assessed in the subjects of the Case and Control groups.

Statistical Analysis

The findings obtained were coded and entered into Microsoft Excel (2010). The collected data were analyzed using Statistical Package for Social sciences (SPSS) 21.0 (SPSS Inc., Chicago, IL, USA). By carrying out the Normality testing, the data was found to be normally distributed. Thus, Mean, Standard deviation, Chi square test and Independent T test was used for the statistical analysis of the oral characteristics and the presence of oral pathologies in the subjects. Statistical significance was measured for qualitative variables at $P \leq 0.05$.

Results

Demographic factors: The present study consisted of 250 elderly patients divided in 2 groups as – Case group suffering from Alzheimer's disease (n = 100, Mean age = 69.53 ± 2.89 years) and Control group without Alzheimer's disease or other forms of dementia (n = 150, Mean age = 69.56 ± 2.98 years). The study participants were between the ages of 65 to 74 years (69.544 ± 2.919 years). Among the group with Alzheimer's disease, the frequency of female patients was 62% (62) and that of the male patients was 38% (38). Similarly, in the group without Alzheimer's, the number of female patients was 78.7% (118) and that of the male patients was 21.3% (32), which was found to be non significant. Most of the study participants in the group with Alzheimer's (60%) and without Alzheimer's (52.7%) had received education at the Primary level. The Monthly income (Real Minimum Wage) among the study participants was found to be (4.27 ± 2.6849) in the group with Alzheimer's patients and (4.8 ± 2.5303) in the group with patients without Alzheimer's, which was found to be non-significant. **(Table 1)**

Table 1: Demographic factors of the Study subjects with and without Alzheimer's disease:

Variable	Subjects With Alzheimer's Disease (N = 100)	Subjects Without Alzheimer's Disease (n = 150)	Mean Difference	P value
1. Age (Mean ± SD)	69.56 ± 2.98	69.53 ± 2.89	0.03	3.6219
2. Gender				
Female	62 (62%)	118 (78.7%)	-	0.064
Male	38 (38%)	32 (21.3%)		
3. Educational Status				
Illiterate	20 (20%)	23 (15.3%)	-	0.2603
Primary	60 (60%)	79 (52.7%)		
Secondary	10 (10%)	20 (13.3%)		
Higher	10 (10%)	28 (18.7%)		
4. Monthly income (Real Minimum Wage)	4.27 ± 2.6849	4.8 ± 2.5303	- 0.53	0.0686

*Significant

Oral health status

The comparison between the 2 groups showed that the GOHAI scores for the group with Alzheimer's was (69.56 ± 2.98) and the group without Alzheimer's was (69.53 ± 2.89), which was found to be statistically significant (P = 0.0003). This comparison demonstrated that the subjects with Alzheimer's disease had a positive self-perception of their oral health as compared to the subjects without Alzheimer'. Similarly the subjects with Alzheimer's were found to have a fewer number of natural teeth (9.09 ± 5.92) as compared to the group without Alzheimer's (11.7 ± 3.96), which was again found to be statistically significant (P = 0.0006).

On the clinical assessment of the subjects, the number of completely dentate patients in the Alzheimer's disease group was nil (0%) while that in the group without Alzheimer's was 6% (P = 0.4125). While the number of partially edentulous patients was (50%) in the patients with Alzheimer's and (60%) in the group without Alzheimer's (P = 0.1196). However the number of completely edentulous patients was (50%) in the patients with Alzheimer's and (60%) in the group without Alzheimer's, which was found to statistically significant (P = 0.0114).

The DMFT scores in the group with Alzheimer's (25.14 ± 2.01) and without Alzheimer's (21.03 ± 4.77) was found to be statistically significant (P = 0.0046). The OHI status of the group with Alzheimer's disease (3.99 ± 2.25) and without the disease (5.53 ± 2.35) was again found to be statistically significant (P = 0.0046). The presence of oral lesions in the group with Alzheimer's (46%) and without Alzheimer's (16.7%) was not found to be statistically significant. On the contrary, Xerostomia in the subjects with Alzheimer's (35%) and without Alzheimer's (20%) was found to be statistically significant (0.0128). **(Table 2)**

Table 2: Subjective and objective variables in the subjects with and without Alzheimer's disease

Variable (Mean ± SD)	Subjects With Alzheimer's Disease (n=100)	Subjects Without Alzheimer's Disease (n=150)	Mean Difference	P value
1. GOHAI	69.56 ± 2.98	69.53 ± 2.89	0.03	0.3204
2. Number of teeth present	9.09 ± 5.92	11.7 ± 3.96	1.96	0.0006*
3. Completely dentate	0 (0%)	9 (6%)	-	0.4125
4. Partially edentulous	50 (50%)	90 (60%)	-	0.1196
5. Completely edentulous	50 (50%)	51 (34%)	-	0.0114*
6. DMFT	25.14 ± 2.01	21.03 ± 4.77	4.11	0.0046*
7. OHI	3.99 ± 2.25	5.53 ± 2.35	1.54	0.0128*
8. Presence of Oral lesions	46 (47%)	25 (16.7%)	-	2.6281
9. Xerostomia	35 (35%)	30 (20%)	-	0.0128*

*Significant

Prosthetic use

Assessment of the use of various prosthetic replacements between the subjects with Alzheimer's disease (3%) and without the disease (8.7%) revealed that a significant relationship was seen only for the use of fixed prosthesis. As the use of removable prosthesis in subjects with Alzheimer's (45%) and in subjects without Alzheimer's (50%) was found to be non-significant (P = 0.2777). Similarly, the use of complete denture prosthesis in subjects with Alzheimer's (48%) and in subjects without Alzheimer's (33.3%) was found to be non-significant (P = 0.2777). A comparably similar pattern of no prosthesis use was observed among the subjects with Alzheimer's (4%) and without Alzheimer's (14.6%), which was found to be non-significant (P = 0.0086). Thus, it can be established that prosthetic need in the subjects with or without Alzheimer's disease was found to be similar.

Table 3: Use of various types of Prosthesis in the subjects with and without Alzheimer's disease

Type Of Prosthesis Use	Subjects With Alzheimer's Disease (N = 100)	Subjects Without Alzheimer's Disease (n = 150)	P value
1. Fixed prosthesis	3 (3%)	13 (8.7%)	0.0461*
2. Removable prosthesis (RPD)	45 (45%)	75 (50%)	0.2777
3. CD prosthesis	48 (48%)	50 (33.3%)	0.9102
4. No use of prosthesis	4 (4%)	12 (14.6%)	0.0086
TOTAL	100	150	

*Significant

Discussion

Oral health related quality of life (OHRQoL) is not well established in the literature for the elderly suffering with Alzheimer's disease, specifically in the Indian population. The present study assessed the OHRQoL in subjects only in the mild and moderate stages of Alzheimer's disease. In the study to obtain reliable responses related to their oral problems and to reduce the possibility of error, all subjects with Alzheimer's disease were assessed in the presence of their respective caregivers. As most of these caregivers were included in the group without Alzheimer's, it was easier to interview both sets of the subjects together. The information regarding the subjects who were unable to respond was obtained from the respective caregivers as well as their corresponding medical files.

In the current study, a higher percentage of subjects with Alzheimer's were found to be females in comparison to the group without the disease. These findings are in agreement with the studies conducted by Katzman R [22] et al and Lautenschlager NT [23] et al as females have been shown to have an increased risk of Alzheimer's disease. It was also found that the subjects with Alzheimer's disease had a lower educational level than the subjects without Alzheimer's. This is also in accordance with the literature, as a lower educational level has been shown to increase the risk of Alzheimer's disease. [24,25,26]

Regarding the subjective assessment, a mean difference of (2.40) was observed between the two groups for the GOHAI values. The GOHAI scores were higher for the subjects with Alzheimer's as compared to the subjects without Alzheimer's, which was found to be statistically significant (P = 0.0003). This is in accordance with the study conducted by Campos CH [27] et al which reported that the participants with Alzheimer's had significantly higher GOHAI scores than the group without Alzheimer's disease. The studies conducted by Ribeiro GR [25] et al and Campos CH [28] et al also showed similar results, however these findings were not found to be statistically significant.

In the present study, the higher GOHAI values showed that the subjects with Alzheimer's disease had a positive self-perception, indicating that the elderly participants judged their oral health status using criteria different from dentists.[29] In addition, the self-perception of oral health in the elderly may also be influenced by the belief that some pain and disability are inevitable in old age, which might lead subjects to overestimate their oral health status [29,30] and account for the positive perception of oral health in the present study.

On the clinical assessment of the subjects, the number of completely edentulous patients in the two groups had a mean difference of (-0.10) which was also statistically significant (P = 0.0114). Absence of all or a few teeth has been suggested to be a major factor affecting the OHRQoL of patients with Alzheimer's disease.[28] A systematic review conducted by Ming Y [31] et al reported that the loss of more than 2 molar teeth could decrease masticatory ability and affect overall QoL. All of these studies concluded that patients suffering with Alzheimer's disease presented with fewer number of natural teeth as compared to the subjects without Alzheimer's disease.

The current study indicated that participants with Alzheimer's disease presented with significantly higher values for both the DMFT (P = 0.0046) and Oral Hygiene Index (P = 0.0128) than the participants without the disease. In comparing the number of natural teeth, DMFT and OHI values, the subjects with Alzheimer's disease presented with worse values than the controls. Because dementia results in cognitive and voluntary motor skill impairments, it compromises the adequate oral hygiene of the patients [11] which may explain these results. Thus, the assessment of the objective variables in the present study,

such as the number of teeth, DMTF, and OHI, demonstrated worsening oral health condition with the progression of Alzheimer's disease, which was in agreement with the results of the previous studies.[20,25,32]

A higher percentage of oral mucosal lesions were observed in the subjects with Alzheimer's disease as compared to the subjects without Alzheimer's, however this difference was not found to be statistically significant. This was in accordance with the study conducted by Ribeiro GR [25] et al. However, a statistically significant increase in Xerostomia was seen in the patients with Alzheimer's disease, being consistent with a review by Ortega-Martínez J [33] et al. The prosthesis use in subjects with and without Alzheimer's disease was found to be similar, which was also in accordance with the study by Ribeiro GR [25] et al.

Generally the studies using GOHAI require a larger sample size. Also the number of participants in the Case and Control groups is not equal as they follow a ratio of 1:1.5. Because the present study evaluated a small number of subjects, this could be considered as a limitation of this study. However, it is important to note that this study had a cross-sectional design, and the results of this study could provide important data about the oral health related quality of life of the patients with Alzheimer's disease. Thus, a well-designed, longitudinal study with a larger sample size is required to explore the effects of oral health related quality of life among patients with Alzheimer's disease.

Conclusion

The study concluded that the General Oral Health Assessment Index (GOHAI) is a subjective assessment tool for the elderly patients suffering from Alzheimer's disease. Patients with Alzheimer's disease should regularly receive oral examinations and necessary treatments to maintain a good OHRQoL. The results of the present study demonstrate that the oral health was poorer in elderly subjects with Alzheimer's disease than in those without the disease. Although the subjects with Alzheimer's disease reported a positive self perception of their oral health, however these subjects showed declining oral health conditions with the disease progression. Thus, there is a strong need for repeated comprehensive examinations for the Alzheimer's patients to help them improve their Oral Health Related Quality of Life (OHRQoL) and also their Quality of life in general.

Recommendations

1. Dentists should comprehensively evaluate the oral health conditions of elderly patients with Alzheimer's disease by using both the subjective and objective examinations.
2. They should actively manage oral health problems and discomfort to improve the OHRQoL in the patients suffering with Alzheimer's disease.
3. There is a need to educate the caregivers of the patients with Alzheimer's disease to improve their knowledge and skills relating to oral health care.
4. Dentists need to support early detection and timely treatment of oral problems among patients with Alzheimer's disease to improve their OHRQoL and also Quality of Life in general.

References

1. World Health Organization. United Nations. Department of Economic and Social Affairs, Population division. World population Ageing. Highlights. 2019. (ST/ESA/SER. A/348).
2. Cicciù M, Matacena G, Signorino F, Brugaletta A, Cicciù A, Bramanti E. Relationship between oral health and its impact on the quality life of Alzheimer's disease patients: a supportive care trial. Int J Clin Exp Med. 2013;6(9):766-772.
3. Cummings JL. Alzheimer's disease. N Engl J Med 2004;35(1):56-67.

4. Friedlander AH, Norman DC, Mahler ME, Norman KM, Yagiela JA. Alzheimer's disease: psychopathology, medical management and dental implications. J Am Dent Assoc. 2006;137(9):1240-1251.
5. Reiman EM, Caselli RJ. Alzheimer's disease. Maturitas 1999;15:185-200.
6. Kocaelli H, Yaltirik M, Yargic LI, Ozbas H. Alzheimer's disease and dental management. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;93:521-524.
7. Arai K, Sumi Y, Uematsu H, Miura H. Association between dental health behaviours, mental/physical function and self-feeding ability among the elderly: a cross-sectional survey. Gerodontology. 2003;20(2):78-83.
8. Chiappelli F, Bauer J, Spackman S, et al. Dental needs of the elderly in the 21st century. Gen Dent 2002;50(4):358-363.
9. Friedlander AH, Jarvik LF. The dental management of the patient with dementia. Oral Surg Oral Med Oral Pathol 1987;64(5):549-553.
10. Montenegro FL, Marchini L, Brunetti RF, Manetta CE. The importance of the proper functioning of the masticatory system for the digestive process of the elderly. Revista Kairós: Gerontology. 2007; 10 (2):245-257
11. Henry RG, Wekstein DR. Providing dental care for patients diagnosed with Alzheimer's disease. Dent Clin North Am. 1997;41:915-943.
12. Klotz AL, Hassel AJ, Schröder J, Rammelsberg P, Zenthöfer A. Oral health-related quality of life and prosthetic status of nursing home residents with or without dementia. Clinical interventions in aging. 2017;12:659-665.
13. World Health Organization. The ICD-10 classification of mental and behavioral disorders. Geneva: WHO; 1992.
14. Bell CC. DSM-IV: Diagnostic and Statistical manual of Mental disorders. 4th ed. Washington: Am Psychiatr Assoc. Jama. 1994;272(10):828-829.
15. Folstein MF, Folstein SE, McHugh PR. Mini-Mental State. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12:189-198.
16. Hughes CP, Berg L, Danziger WL, Coben LA, Martin RL. A new clinical scale for the stating of dementia. Br J Psychiatry. 1982;140:566-72.
17. Chandra V, Pandav R, Dodge HH, Johnston JM, Belle SH, DeKosky ST, Ganguli M. Incidence of Alzheimer's disease in a rural community in India: the Indo–US study. Neurology. 2001;57(6):985-989.
18. Atchison KA, Dolan TA (1990) Development of the geriatric oral health assessment index. J Dent Educ. 54(11):680–687.
19. Mathur VP, Jain V, Pillai RS, Kalra S. Translation and validation of Hindi version of Geriatric Oral Health Assessment Index. Gerodontology. 2016;33(1):89-96.
20. Adam H, Preston AJ. The oral health of individuals with dementia in nursing homes. Gerodontology. 2006;23:99-105.
21. Greene J, Vermillion J. The Oral Hygiene Index: a method for classifying oral hygiene status. J Am Dent Assoc 1960;61:172-179.
22. Katzman R, Kawas C. Epidemiology of dementia and Alzheimer's disease. In: Terry RD, Katzman R, Bick KL, editors. Alzheimer Disease. New York: Raven Press, 1994:105–22.
23. Lautenschlager NT, Cupples LA, Rao VS, et al. Risk of dementia among relatives of Alzheimer's disease

patients in the MIRAGE study: what is in store for the oldest old? Neurology. 1996;46:641–650.

24. Reiman EM, Caselli RJ. Alzheimer's disease. Maturitas – Eur Menopause J. 1999;15:185-200.
25. Ribeiro GR, Costa JL, Ambrosano GM, Garcia RC. Oral health of the elderly with Alzheimer's disease. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012;114(3):338-343.
26. Cummings JL, Vinters HV, Cole GM, Khachaturian ZS. Alzheimer's disease: etiologies, pathophysiology, cognitive reserve, and treatment opportunities. Neurology. 1998;51:S2-17.
27. Campos CH, Ribeiro GR, Garcia RC. Mastication and oral health–related quality of life in removable denture wearers with Alzheimer disease. J Prosthet Dent. 2018;119(5):764-768.
28. Campos CH, Ribeiro GR, Rodrigues Garcia RC. Oral health-related quality of life in mild Alzheimer: patient versus caregiver perceptions. Spec Care Dentist. 2016;36:271-276.
29. Silva DD, Souza MLR, Wada RS. Self-perception and oral health conditions in an elderly population (Portuguese). Cad Saude Publica 2005;21:1251-1259.
30. Kiyak HA. Age and culture: influences on oral health behaviour. Int Dent J. 1993;43:9-16.
31. Ming Y, Hsu SW, Yen YY, Lan SJ. Association of oral health–related quality of life and Alzheimer disease: A systematic review. J Prosthet Dent. 2019;124(2):168-175.
32. Ship JA. Oral health of patients with Alzheimer's disease. J Am Dent Assoc. 1992;123:53-58.
33. Ortega-Martínez J, Cedeño-Salazar R, Requena C, Tost M, Lluch A. Alzheimer's disease: oral manifestations, treatment and preventive measures. J Oral Res. 2014. 30;3(3):184-189.