Assessment of Oral Health in Elders with and without Alzheimer's Disease: A Cross-Sectional Study

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ABSTRACT

Objective: The aim of the study was to assess and compare the oral health status in elders with and without Alzheimer's disease (AD).

Methods: This age and gender-matched cross-sectional study included thirty-six elders with AD and 37 elders without AD from an Alzheimer's daycare center and a nursing home. Mental state, oral health and periodontal parameters, Geriatric Oral Health Assessment Index (GOHAI), unstimulated salivary flow rate (USFR), and other dry mouth conditions were examined. Group comparisons and correlation analysis were performed with T-test, Mann-Whitney U test, chi-square test, Fisher's Exact test, and Spearman's rank correlation.

Results: Probing depth (PD) and clinical attachment loss (CAL) were lower and the percentage of the subjects with non-periodontitis was higher in elders with AD than without AD (p=0.017 and p=0.028, respectively). Both groups had similar GOHAI scores and USFR levels (p>0.05). However, the elders with AD had higher use of mouth-drying medication and presence of halitosis complaint than without AD (p<0.001). In both groups number of missing teeth was positively correlated with the DMF-T score (p<0.001). In AD group, age was positively related to the gingival index and bleeding on probing (p=0.005 and p=0.001, respectively). USFR level was positively correlated with GOHAI score (p=0.027) in AD group, but it was negatively correlated with the DMF-T score (p=0.031) in without AD group.

Conclusion: Personalized care and supporting oral care education of the caregivers could maintain the oral health of elders with AD.

Keywords: Alzheimer disease, oral health, quality of life, dementia, periodontitis

1. INTRODUCTION

Alzheimer's disease (AD) is one of the main causes of dementia in the geriatric population which represents more than half of the dementia cases. The disease is a progressive neurodegenerative disease of the central nervous system (1,2). Impaired memory and failure to learn new information are the most prominent clinical features of the disease. Despite the memory loss in the early stage of the disease, the patient can continue his daily life activities independently. In the middle stage of the disease, the independence in daily living activities is gradually lost, and psychiatric and behavioral symptoms begin to appear. In the last stage of the disease, the patient becomes completely dependent on his caregiver in daily living activities, and serious psychiatric disorders may occur (1).

Various risk factors are associated with AD. The incidence of AD increases with older age, lower education, and female gender. Also hereditary, and environmental factors play a role in the etiology of the disease. History of previous head injury has also been linked with the increased risk of developing AD (3). It has been reported that the incidence of the disease increases in case of blood vessel damages due to hypertension, heart disease, stroke, and diabetes. (4).

Oral health problems are frequently seen because of the behavioral effects of dementia, which could make it difficult for a patient to perform oral care (5). The deterioration of oral, and dental care lead to plaque accumulation, and dental caries (6). Also, dementia patients suffer from gingival bleeding, periodontal pockets, mucosal lesions, and reduced salivary flow. Elders with dementia experience poor oral health, which can be improved with an oral care education for caregivers, and regular professional dental care of the patients (7). However dental treatment of AD patients becomes challenging due to their reduced ability to cooperate (8).

Periodontal disease is an inflammatory status that could lead to tooth loss when it is left untreated (9). The disease is known to be linked with many systematic diseases. Recent

findings showed that the periodontal pathogens' effect on neural inflammation could lead to cognitive decline, and sporadic late-onset AD (10).

Dry mouth is another factor affecting the oral health of individuals, especially in AD. Sreebny and Schwartz reported that 80% of the commonly prescribed drugs cause dry mouth, and more than 400 drugs cause salivary gland dysfunction as a side effect (11). Thus, the dysfunction in the antibacterial effect of saliva leads to disorders such as lack of lubricant, and buffering function, caries and periodontal disease, difficulty in chewing and swallowing (12,13).

The aim of this study is to compare the oral health of elders with and without AD, through oral examination, oral health quality of life assessment, and evaluation of dry mouth condition.

2. METHODS

This cross-sectional study was conducted in January 2018 – March 2019 in Istanbul, Turkey. A group of 73 elders participated in the study, 36 elders with AD, and 37 elders without AD. Firstly elders with AD were recruited, and the elders without AD were matched for age and gender. Nineteen of the elders with AD were living in the home with their family or caregivers and visiting the daycare center of the Turkish Alzheimer Association few days a week, where caregivers were educated on caring for the elders. The remaining 17 elders with AD and elders without AD were living in a public nursing home. Socio-demographic characteristics and use of medications were obtained via a questionnaire. The medications that cause dry mouth were determined from Sreebny and Schwartz's work (11). The oral health quality of life was examined with the Turkish version of the Geriatric Oral Health Assessment Index (GOHAI) (14). Elders with AD responded to the questionnaire and GOHAI with their caregivers, while elders without AD responded by themselves.

This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethical Committee of Marmara University School of Medicine (protocol number 09.2018.056/05.01.2018). Written informed consent has been obtained from the caregivers of the elders with AD, and the elders without AD involved in the study.

2.1. Mental State Evaluation

Participants' mental state was evaluated with the Mini-Mental State Examination test (MMSE). The test score was categorized as normal (between 24 and 30), mild or moderate dementia (between 23 and 18), and severe dementia (17 or lower) (15).

2.2. Oral and Periodontal Examination

The periodontal assessments were carried out for those who were dentate and gave consent for the examination

(23 elders with AD patients and 24 elders without AD). The oral and prosthesis care habits and halitosis complaints were recorded. The oral and periodontal examination was performed by a single dentist (DO) using the University of North Carolina 15 periodontal probe (Hu-Friedy, Chicago, IL), and a dental mirror. The decayed, missing, filled teeth (DMF-T) index (16), prosthetic situation, modified mucosal rating scale (MMRS) (17) were assessed. Plaque index (PI) (18), gingival index (GI) (19), probing depth (PD), bleeding on probing (BOP), and clinical attachment loss (CAL) (16) were recorded. Periodontal status was determined according to the Centers for Disease Control and Prevention-American Academy of Periodontology criteria set in 2012 (20).

2.3. Geriatric Oral Health Assessment Index

Geriatric Oral Health Assessment Index (GOHAI) is a 12-items scale, which evaluates the elders' oral health quality of life (21). Participants respond how often they experience a specific oral health issue stated in the item based on a 5-point Likert scale (1-always and 5-never). The total score was computed as the sum of item scores and ranges from 12 to 60. A higher GOHAI score indicates a better oral health quality of life (14). The scale has four dimensions which are functional restriction (eating, speaking, and swallowing), pain or discomfort (use of medication to relieve pain, eating without discomfort, and sensitivity to hot, cold, or sweets), psychological factors (worry or concern about oral health, dissatisfaction with appearance, self-consciousness about oral health, and feel uncomfortable eating in front of people), and behavioral effects (limiting the amount and kind of food, and avoidance of social contacts because of oral problems) (21).

2.4. Unstimulated Saliva Collection

The unstimulated saliva collection was performed at least one hour after the participant's food and beverage intake, except for water. The participants were requested to sit upright, not to swallow, and lean their head forward over a measuring cup to let the saliva drain in it. A one-minute pretest was performed, and the saliva collection trial lasted for five minutes. The unstimulated salivary flow rate (USFR) was computed by dividing the saliva level into collection period (ml per min). A value lower than 0.1 ml per min was considered as salivary gland hypofunction (22).

2.5. Statistical Analysis

The descriptive statistics were reported as frequency (n, %) for the discrete random variables. The continuous random variables were presented as mean and standard deviation (SD) when the data follow a normal distribution, otherwise reported as the median and interquartile range (IQR). The group comparisons between the elders with and without AD were evaluated with independent samples T-test, Mann-Whitney U test, Chi-square test, and Fisher's Exact test. Spearman's rank correlation analysis was performed for

each group. The statistical significance level was considered as p<0.05, and the analysis was carried out with IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, N.Y., USA).

3. RESULTS

The participant characteristics of the study groups are presented in Table 1. The mean age was 77.1 (±9.7) for elders with AD, and 77.4 (±7.8) for elders without AD (p=0.876). The mean age onset for AD was 72.6 (±10.6) years. Almost half of the elders with AD (17, 47.2%), and without AD (18, 48.7%) were female (p=0.903). There was no statistically significant difference between elders with and without AD in terms of education level (p=0.667), and smoking habit (p=0.226). More than half of the elders with AD were cared in-home and daycare center by their family or/and a personal caregiver

(19, 52.8%). The remaining elders with AD (17, 47.2%), and all elders without AD cared in the nursing home (p<0.001) (Table 1).

The elders with AD group had a significantly lower median MMSE score than the elders without AD group (p<0.001). Severe dementia (20, 55.6%) was observed in more than half of the elders with AD, while the remaining (16, 44.4%) had mild or moderate dementia. The median number of medications that cause dry mouth condition was higher in the elders with AD than the elders without AD (p<0.001). The use of neurotransmitter (p=0.358), antiepileptic (p=0.615), cardiovascular disease treatment (p=0.879), antidiabetic (p=0.113) medications were similar between the elders with and without AD groups. However, the elders with AD had more frequent use of nonsteroidal anti-inflammatory (p=0.046), psychiatric (p<0.001), and stomach (p=0.028) medications than the elders without AD (Table 1).

Table 1. Inter-group comparisons of the participant characteristics

Socio-demographic Parameters	Elders with AD (n=36)	Elders without AD (n=37)	p-value
Age years; mean±SD	77.1 ± 9.7	77.4 ± 7.8	0.876[a]
Age onset of the AD years; mean±SD	72.6 ± 10.6	-	
Female n (%)	17 (47.2%)	18 (48.7%)	0.903[b]
Education level n (%)			
Illiterate	7 (19.4%)	11 (29.7%)	
Primary school	12 (33.3%)	12 (32.4%)	
Secondary school	4 (11.1%)	6 (16.2%)	
High school	6 (16.7%)	4 (10.8%)	
University	7 (19.4%)	4 (10.8%)	0.667[b]
Smoking n (%)	4 (11.1%)	8 (21.6%)	0.226[b]
Place of Care n (%)			
Home and day care center	19 (52.8%)	-	
Spouse	7 (19.4%)	-	
Adult children	9 (25.0%)	-	
Family and personal caregiver	3 (8.3%)	-	
Nursing home	17 (47.2%)	37 (100.0%)	
MMSE (points; median (IQR)	16.5 (11.5–20.0)	28.0 (28.0–29.0)	**<0.001[d]**
Mental Status n (%)			
Normal mental status	-	37 (100%)	
Mild or Moderate dementia	16 (44.4%)	-	
Severe dementia	20 (55.6%)	-	
Number of medications that cause dry mouth median (IQR)	4.0 (2.0–5.0)	1.0 (1.0–2.0)	**<0.001[d]**
Use of Medication n (%)			
NSAI drugs	8 (22.2%)	2 (5.4%)	**0.046[c]**
Neurotransmitter drugs	3 (8.3%)	1 (2.7%)	0.358[c]
Psychiatric drugs	29 (80.6%)	3 (8.1%)	**<0.001[b]**
Antiepileptic drugs	2 (5.6%)	1 (2.7%)	0.6150[c]
Cardiovascular disease treatment drugs	23 (63.9%)	23 (62.2%)	0.8790[b]
Antidiabetic drugs	9 (25.0%)	4 (10.8%)	0.113[b]
Stomach drugs	10 (27.8%)	3 (8.1%)	**0.028[b]**

[a] Independent samples T-test; [b] Chi-square test; [c] Fisher's exact test; [d] Mann-Whitney U test. Abbreviations; AD: Alzheimer's disease, SD: Standard deviation, MMSE: Mini-mental state examination test score, IQR: Interquartile range, NSAI: Nonsteroidal anti-inflammatory.

The oral and periodontal findings of the study groups are presented in Table 2. More than one-third of elders with AD (12, 33.3%) and elders without AD (13, 35.1%) were edentulous (p=0.871). The prosthesis type used in the upper jaw and lower jaws were similar between the study groups (p>0.05). Oral and prosthetic care of the groups were also similar, almost 60% of the elders practice oral care at least once a day in both groups (p=0.732) (Table 2).

Table 2. Inter-group comparisons of the oral and periodontal findings

Oral Health Finding	Elders with AD (n=36)	Elders without AD (n=37)	p-value
Edentulousness n (%)	12 (33.3%)	13 (35.1%)	0.871 [c]
Upper jaw prosthesis type[a] n (%)			
Complete denture	21/31	22/28	0.350 [c]
Removable partial denture	6/31	5/28	0.883 [c]
Fixed prosthesis	4/31	1/28	0.199 [c]
Lower jaw prosthesis type[a] n (%)			
Complete denture	15/29	17/28	0.494 [c]
Removable partial denture	9/29	11/28	0.173 [c]
Fixed prosthesis	5/29	0/28	0.052 [d]
Oral and prosthesis care n (%)			
Less than twice a week	11 (30.6%)	12 (32.4%)	
At least twice a week	5 (13.9%)	3 (8.1%)	
At least once a day	20 (55.6%)	22 (59.5%)	0.732 [c]
Modified Mucosal Rating Scale n (%)			
Normal	32 (88.9%)	34 (91.9%)	
Mild	4 (11.1%)	3 (8.1%)	0.663 [c]
DMF-T median (IQR)	26.5 (18.3–28.0)	28.0 (22.5–28.0)	0.384 [e]
Decayed teeth	0.0 (0.0–0.0)	0.0 (0.0–0.5)	0.352 [e]
Missing teeth	24.5 (8.5–28.0)	25.0 (20.0–28.0)	0.467 [e]
Filled teeth	0.0 (0.0–2.8)	0.0 (0.0–0.0)	0.198 [e]
Number of Teeth	3.5 (0.0–19.5)	3.0 (0.0–8.0)	0.467 [e]
PI[b] median (IQR)	2.0 (1.5–2.0)	2.0 (1.6–2.0)	0.964 [e]
GI[b] median (IQR)	1.4 (1.3–1.8)	1.4 (1.3–1.7)	0.476 [e]
BOP[b] %; median (IQR)	33.3 (14.6–50.0)	33.3 (21.8–48.6)	0.558 [e]
PD[b] mm; mean±SD	2.8 ± 0.8	3.3 ± 0.6	**0.017** [e]
CAL[b] mm; median (IQR)	3.1 (2.5–5.3)	4.3 (3.3–5.7)	**0.028** [e]
Periodontal status[b] n (%)			
Non-periodontitis	10/23	2/24	**0.008** [d]
Moderate Periodontitis	8/23	11/24	0.440 [c]
Severe Periodontitis	5/23	11/24	0.081 [c]
GOHAI			
Total Score mean±SD	50.3 ± 4.9	49.7 ± 4.5	0.551 [e]
Functional Restriction Score median (IQR)	14.0 (11.0 – 15.0)	13.0 (11.0 – 15.0)	0.463 [e]
Pain and Discomfort Score median (IQR)	14.5 (13.0 – 15.0)	15.0 (13.0 – 15.0)	0.656 [e]
Psychological Factors Score median (IQR)	15.0 (14.0 – 17.0)	14.0 (13.0 – 17.5)	0.249 [e]
Behavioral Effects Score median (IQR)	8.0 (7.0 – 10.0)	8.0 (7.0 – 9.0)	0.614 [e]
USFR ml/min; median (IQR)	0.3 (0.1–0.4)	0.3 (0.1–0.5)	0.607 [e]
USFR ≥0.1 ml/min n (%)	27 (75.0%)	31 (83.8%)	-
USFR <0.1 ml/min n (%)	9 (25.0%)	6 (16.2%)	-
Halitosis Complaint n (%)	24 (66.7%)	8 (21.6%)	**<0.001** [c]

[a] *Analysis performed for those who wear prosthesis in the relevant jaw;* [b] *Assessment carried out for 23 AD patients and 24 elders without AD.* [c] *Chi-square test;* [d] *Fisher's exact test;* [e] *Mann-Whitney U test;* [f] *Independent samples T-test. Abbreviations; AD: Alzheimer's disease, DMF-T: Decayed missing filled teeth index score, IQR: Interquartile range, PI: Plaque index, GI: Gingival index, BOP: Bleeding on probing, PD: Probing depth, CAL: Clinical attachment loss, GOHAI: Geriatric Oral Health Assessment index, SD: Standard deviation, USFR: Unstimulated salivary flow rate.*

Most of the elders with and without AD had normal MMRS (p=0.663). The Median DMF-T index score was relatively high in both elders with AD (26.5, IQR:18.3 − 28.0) and without AD (28.0, IQR:22.5 − 28.0) groups (p=0.384). Both study groups had similar number of teeth (p=0.467), PI (p=0.964), GI (p=0.476), and BOP (p=0.5580). The mean PD and median CAL were significantly lower in elders with AD than elders without AD (p=0.017 and p=0.028, respectively). Patients having non-periodontitis were higher in AD group than the elders without AD (p=0.008). All participants had a relatively high mean GOHAI score of 50 points (out of 60), which was similar between the groups (p=0.551). The median USFR level was 0.3 ml/min for elders with and without AD (p=0.607). About 25% of elders with AD and 16% of elders without AD had a median USFR level below 0.1ml/min. Elders with AD had more frequently complained about halitosis than those without AD (p<0.001) (Table 2).

Correlation analysis between age, GOHAI scores, and selected oral health and periodontal findings of study groups was presented in Table 3. In both study groups, the higher number of missing teeth was positively correlated with DMF-T score (p<0.001).

In elders with AD the higher age was associated with the higher number of missing teeth (r=0.44, p=0.007), GI (r=0.57, p=0.005), and BOP (r=0.66, p=0.001). The higher GOHAI score was correlated with the higher level of USFR (r=0.37, p=0.027). Also, the higher GOHAI pain and discomfort score was associated with the lower GI (r=-0.45, p=0.031). The higher GOHAI psychological factors score was correlated with the lower PD (r=-0.49, p=0.018) and CAL (r=-0.48, p=0.020). The lower GOHAI behavioral effects score was associated with the higher BOP (%) (r=-0.46, p=0.029), PD (r=-0.42, p=0.044) and CAL (r=-0.53, p=0.009) in elders with AD. The number of missing teeth and DMF-T score were positively correlated with BOP, PD, and CAL (p<0.01) in AD group. (Table 3).

In elders without AD higher DMF-T score was negatively correlated with GOHAI total score (r=-0.41, p=0.011), GOHAI behavioral effects score (r=-0.36, p=0.028), and USFR level (r=-0.36, p=0.031). The higher CAL was positively correlated with GOHAI functional restriction score (r=0.41, p=0.050), and USFR (r=0.42, p=0.042) in elders without AD. (Table 3).

Table 3. Correlation between age, GOHAI scores, and selected oral health and periodontal parameter findings of study groups

Elders with AD	Age	GOHAI					USFR	DMFT	Number of Missing Teeth
		Total Score	Functional Restriction Score	Pain and Discomfort Score	Psychological Factors Score	Behavioral Effects Score			
PI [a]	0.24	0.03	0.12	0.02	0.05	0.10	-0.08	0.02	0.11
GI [a]	**0.57****	0.02	0.40	**-0.45***	0.01	-0.15	0.02	0.03	0.32
BOP [a]	**0.66****	-0.12	0.38	-0.29	-0.29	**-0.46***	-0.11	**0.56****	**0.54****
CAL [a]	0.34	-0.18	0.19	0.07	**-0.48***	**-0.53****	-0.02	**0.63****	**0.58****
PD [a]	0.29	-0.12	0.29	-0.14	**-0.49***	**-0.42***	0.16	**0.61****	**0.43***
USFR	0.04	**0.37***	0.31	0.17	0.13	0.29	-	-	-0.17
DMFT	0.33	-0.03	0.16	-0.14	-0.19	-0.14	-0.11	-	**-**
Number of Missing Teeth	**0.44****	-0.09	0.10	-0.14	-0.25	-0.11	-0.17	**0.87****	-

Elders without AD	Age	GOHAI					USFR	DMFT	Number of Missing Teeth
		Total Score	Functional Restriction Score	Pain and Discomfort Score	Psychological Factors Score	Behavioral Effects Score			
PI [Ƌ]	-0.03	-0.03	0.07	-0.02	0.05	-0.07	0.15	0.04	0.18
GI [Ƌ]	0.05	0.04	0.17	0.09	0.04	0.12	0.03	-0.03	0.22
BOP [Ƌ]	-0.02	-0.13	-0.10	-0.02	-0.12	0.06	0.13	-0.06	0.02
CAL [Ƌ]	0.17	0.04	**0.41***	-0.15	-0.11	-0.07	**0.42***	-0.09	0.04
PD [Ƌ]	-0.06	-0.07	0.17	0.14	-0.08	-0.22	0.14	0.05	0.23
USFR	0.18	0.27	0.23	0.13	0.14	-0.11	-	-	-0.19
DMFT	-0.04	**-0.41***	-0.19	-0.07	-0.19	**-0.36***	**-0.36***	-	**-**
Number of Missing Teeth	-0.04	-0.15	0.06	0.13	-0.08	-0.24	-0.19	**0.83****	-

Spearman's rank correlation test significant at *p<0.05 and **p<0.01 level. Analysis performed for [a] n=23 and [Ƌ] n=24. Abbreviations; AD: Alzheimer's Disease, GOHAI: Geriatric Oral Health Assessment index, PI: Plaque index, GI: Gingival index, BOP: Bleeding on Probing, PD: Probing depth, CAL: Clinical attachment loss, USFR: Unstimulated salivary flow rate, DMF-T: Decayed missing filled teeth index score.

4. DISCUSSION

In this cross-sectional study, oral and periodontal health, the oral health quality of life, and the dry mouth condition of the elders with and without AD were investigated. The participants were recruited on a voluntary basis from two different institutions by matching for age and gender. The edentulousness was not significantly different between elders with and without AD. Both group participants mostly use complete prosthetics, and the type of prosthesis use was similar between the study groups. These findings agree with the findings of previous studies (23,24).

The self-rated GOHAI scores were found relatively high, and there was no significant difference between the comparison groups, this finding is consistent with the study of Ribeiro et al. (23), and a recent systematic review (25). Although most of the elders with AD in our study were suffering from poor oral health conditions, GOHAI scores were reported relatively high. This finding could be due to the tendency of elders with AD to evaluate their perceived oral health better despite showing poor health indicators (26). Also, it has been reported that providing a personalized oral care routine and treatments to elders with AD would prevent the decline in the quality of life of the patient (27). This could be another reason for the high GOHAI scores of the participants with AD in our study since more than half of the cases were having personalized care in their homes.

Decayed, missing, filled teeth index score was not significantly different between the participants with and without AD, this finding is in concordance with some studies, where participants had similar age and gender characteristics (24,28). However few studies found higher DMF-T scores in AD patients (29,30,31). The number of teeth was not significantly different between the study groups, this finding is in line with the literature, where the study groups had similar age and gender features (24,26,32).

The periodontal health indicator GI was found similar between elders with and without AD in age, gender, and dentate matched study (26), our finding agrees with this literature finding. In this study, we found that the elders with AD had relatively lower PD and CAL, and a higher presence of non-periodontitis than the elders without AD, these findings are not consistent with the previous studies (7,32). It has been reported that nursing homes need improved oral care services (30), also a study in Turkey reported that the elders in the nursing home had poor oral health (33). Since all participants without AD, were residents of the nursing home, they may need more periodontal treatments. Also, the additional analysis showed that elders with AD who had institutional care had higher periodontal indicators of BOP, PD, and CAL than those AD patients who had personal care at home. In our study although elders with AD were using higher number of medications that cause dry mouth condition, the study groups had similar USFR levels. This finding is not in agreement with the literature findings of the lower level of salivary flow in elders with AD (4,7,29). However, the effect of dry mouth in our study could be seen in the higher halitosis complaint (34) in elderly people with AD than those elders without AD.

Although it was difficult to perform oral examinations in elders with AD, we investigated their oral quality of life with important clinical parameters such as PD, CAL, and dry mouth condition by comparing them with the elders without AD, therefore this can be stated as the strengths of our study.

The sample size may be considered relatively small as a limitation of this study, because of impaired memory and capabilities of elders with AD, we achieved a sample size greater than 30 in each group, which is the least acceptable sample size for clinical studies.

5. CONCLUSION

In conclusion, most of the oral health indicators were found similar between the elders with and without AD. The unfavorable effect of dementia on oral health could be seen in the higher presence of halitosis complaint among the elders with AD. However, periodontal health status of the elders with AD was relatively better than the elders without AD. This might arise from the difference in the type of care the elders received. Also, the education and information provided by Alzheimer's daycare center might help the caregivers to maintain the oral health condition of the patients. This emphasizes the importance of personalized oral care for elders with AD according to their capabilities, needs, and conditions.

Conflict of Interest

The authors declare no conflict of interest.

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