

Research Article

Association of Oral Health Literacy Measured Using the Held-29 With Oral Health Status and Oral Health Behavior Among Independent Older Adults in Depok

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ABSTRACT

Introduction: Oral health literacy is an important determinant of oral health, particularly among older adults who are vulnerable to oral diseases, tooth loss, and functional decline. This study aims to evaluate the association among oral health literacy, oral health status, and oral health behaviors among independent older people.

Materials and Methods: This cross-sectional study involved 195 independent older adults aged 60 years and above in Depok. The subjects completed a self-administered questionnaire collecting information on socio-demographics. Oral health literacy was assessed using the Health Literacy in Dentistry scale with 29 items (HeLD-29), and oral health behavior was assessed using an interviewer-administered questionnaire. Oral health status was recorded by clinical oral examination using the DMF-T index, CPI-modified, denture status, OHI-S, and masticatory performance was assessed subjectively.

Results and Discussion: Several HeLD-29 domains were significantly correlated with clinical oral health indicators. Significant differences were found between low and high oral health literacy groups in the number of missing teeth, filled teeth, and deep periodontal pockets ($p < 0.05$). Oral health literacy scores also differed significantly according to age group and educational level ($p < 0.05$). No significant association was found between oral health literacy and oral health behavior. However, DMF-T score was significantly associated with dental visit pattern, and gingival bleeding was significantly associated with smoking status.

Conclusion: Oral health literacy was associated with several indicators of oral health status and with sociodemographic factors, particularly age and educational level. An association was also found between oral health status and oral health behavior of independent older adults in Depok.

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INTRODUCTION

Oral diseases remain a major global public health concern due to their high prevalence, largely preventable nature, and substantial impact on general health and quality of life.¹⁻³ Poor oral health may impair essential daily functions such as eating, speaking, and smiling, and has been associated with nutritional compromise, social isolation, and reduced psychological well-being.⁴ The World Health Organization Global Oral Health Status Report estimated that oral diseases affect approximately 3.5 billion people worldwide, exceeding the burden of many other non-communicable diseases combined, and called for the urgent integration of oral health into universal health coverage and primary health care.^{5,6} The 2023 Indonesian Health Survey (*Survei Kesehatan Indonesia*) reported that 56.9% of the population aged ≥ 3 years experienced dental and oral health problems, while only a small proportion (11.2%) sought professional treatment, reflecting persistent underutilization of dental services in the country.⁷ These epidemiological findings underscore the need to strengthen preventive, community-based oral health programs and to ensure that essential oral health services are accessible within the national primary health care system.

Older adults are a vulnerable group for oral health problems because aging is commonly accompanied by cumulative dental caries experience, periodontal problems, tooth loss, reduced oral function, systemic diseases, and dependency on long-term self-care. Poor oral health in older adults may interfere with chewing ability, nutritional intake, speech, social interaction, and general well-being. Therefore, maintaining oral health among independent older adults is important not only to prevent disease progression, but also to

support healthy ageing and preserve functional capacity.^{2,3}

Oral health status is closely related to daily oral health behavior, including toothbrushing practices, denture hygiene, dietary habits, smoking, and dental service utilization. However, good behavior does not depend only on the availability of information but also on an individual's ability to access, understand, appraise, and use oral health information in daily decision-making. This ability is known as oral health literacy, which has been recognized as an important determinant of oral health behavior, preventive care, and treatment-seeking patterns.^{8,9}

The Health Literacy in Dentistry scale, known as HeLD-29, with 29 items, is a multidimensional instrument that assesses several components of oral health literacy, including communication, access, receptivity, understanding, utilization, support, and economic barriers.¹⁰ Previous studies have shown that lower oral health literacy is associated with poorer oral hygiene, greater dental treatment needs, less favorable oral health behavior, and lower utilization of preventive dental services.^{8,11} A recent scoping review among older adults also highlighted that oral health literacy may influence oral health behavior and outcomes, although the evidence remains varied and context specific.⁸

Despite increasing attention to oral health literacy, studies focusing on independent older adults in Indonesian community settings remain limited. Previous research has often examined oral health literacy in general adult populations, students, or specific patient groups, whereas fewer studies have examined multidimensional oral health literacy in relation to both clinical oral health status and oral health behavior among older adults.¹¹ Depok is an urban area with an aging

population, making it relevant for studying factors that may support preventive oral health programs for community-dwelling older adults. Therefore, this study aimed to analyze the association between oral health literacy, as measured by the HeLD-29, and oral health status and oral health behaviors among independent older adults in Depok.

MATERIALS AND METHODS

This study is an observational analytic design with a cross-sectional approach. The research was conducted in three subdistricts of Depok City, West Java, Indonesia (Beji, Sukmajaya, and Pancoran Mas), in collaboration with the Indonesian Association of Gerodontology at Depok City. These sub-districts were selected because they had the highest number of older residents in the city.

The study population comprised community-dwelling older adults aged 60 years and above who resided in Depok. Eligible participants were those able to communicate, free from significant mobility impairment, and willing to participate in all stages of the study, as documented by signed informed consent.

Participants were recruited using a non-probability purposive sampling technique. The minimum sample size was calculated using the formula for correlation analysis, applying a significance level (α) of 5%, a statistical power ($1 - \beta$) of 80%, and an estimated correlation coefficient (r) of 0.21 derived from a previous related study.¹² After adding 10% to anticipate non-response, the final minimum sample size was determined to be 195 participants.

Data collection was carried out through interviewer-administered questionnaires followed by clinical oral examinations. Before enrolment, eligible participants received a comprehensive explanation of the study objectives and procedures, after which written informed consent was obtained.

Sociodemographic data were collected first, followed by the administration of the HeLD-29 and the oral health behavior questionnaire. The HeLD-29 was used to measure oral health literacy as a multi-dimensional construct encompassing seven domains: communication, access, receptivity, understanding, utilization, support, and economic barriers.¹⁰ The Indonesian version of the questionnaire has been validated for use in the Indonesian adult population. Oral health behavior was assessed through structured interview questions covering toothbrushing habits, denture-cleaning practices, dental visit patterns, and smoking status. Clinical oral examinations were subsequently performed to assess dental caries experience using the Decayed, Missing, and Filled Teeth index,¹³ periodontal status using the modified Community Periodontal Index,¹³ denture status,¹³ oral hygiene status using the Simplified Oral Hygiene Index by Greene and Vermillion,^{14,15} and self-assessed masticatory ability using a structured food-intake questionnaire scored against a masticatory score reference.^{16,17}

Four calibrated examiners performed clinical examinations. Examiner calibration was conducted before data collection to standardize clinical assessment and minimize inter-examiner variability. The calibration process followed a slide-based method in which examiners jointly reviewed the diagnostic criteria and discussed clinical cases presented sequentially in a PowerPoint presentation until consensus was achieved on each diagnostic threshold.

Data obtained from interviews and clinical examinations were coded, entered, and analyzed using IBM SPSS Statistics version 24. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to present participants' sociodemographic characteristics, HeLD-29

domain scores, oral health literacy categories, oral health status, and oral health behavior.

Bivariate analyses were performed as follows. The Spearman rank-order correlation coefficient was used to examine the correlation between HeLD-29 domain scores and each oral health status variable, namely the number of decayed, missing, and filled teeth, the DMF-T score, gingival bleeding and periodontal pocket depth on CPI, denture status, the OHI-S, masticatory ability, and oral health behavior items. The Mann–Whitney U test was used to compare oral health status variables between participants with low versus high oral health literacy. Both the Mann–Whitney U and Kruskal–Wallis H tests were used to analyze differences in oral health literacy scores and oral health status according to sociodemographic characteristics and oral health behavior. Statistical significance was set at $p < 0.05$ for all tests.

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Dental Research Ethics Commission, Faculty of Dentistry, Universitas Indonesia, before data collection. All participants were provided with detailed information regarding the study objectives and procedures, the voluntary nature of participation, the confidentiality and anonymity of their data, and their unconditional right to withdraw from the study at any time without penalty. Written informed consent was obtained from every participant before any study procedure was performed.

RESULTS AND DISCUSSIONS

A total of 195 independent older adults participated in this study. Most participants were female (154, 79.0%), while 41 (21.0%) were male. Most

participants were aged 60–69 years (72.3%), followed by 70–79 years (24.1%) and 80 years or older (3.6%). The mean age of the participants was 66.8 years. Based on educational background, the largest proportion of participants had completed senior high school (40.5%), followed by elementary school (22.1%), junior high school (13.3%), no formal or incomplete basic education (12.8%), and higher education (11.3%), as presented in Table 1.

Table 1. Sociodemographic characteristics of participants (n=195)

Variable	Category	n (%)
Sex	Male	41 (21.0)
	Female	154 (79.0)
Age group, years	60-69	141 (72.3)
	70-79	47 (24.1)
	>=80	7 (3.6)
Education	No formal or incomplete basic education	25 (12.8)
	Elementary school	43 (22.1)
	Junior high school	26 (13.3)
	Senior high school	79 (40.5)
	Higher education	22 (11.3)

Mean age of participants was 66.8 years.

The mean HeLD-29 score among participants was 3.45, with scores ranging from 0.62 to 4.00. Among the seven HeLD-29 domains, the highest mean score was found in the receptivity domain (3.69 ± 0.49), followed by utilization (3.67 ± 0.64), support (3.41 ± 0.89), communication (3.37 ± 0.91), economic barrier (3.36 ± 1.01), understanding (3.32 ± 1.17), and access (3.18 ± 1.25). Since there is no standardized cut-off point for HeLD-29, participants were categorized into low and high oral health literacy groups based on the median score of 3.72. A total of 96 participants (49.2%) were categorized as having low oral health literacy, while 99 participants (50.8%) were categorized as having high oral health literacy, as shown in Table 2.

Table 2. Oral health literacy scores based on HeLD-29 domains

HeLD-29 domain or OHL category	Mean (SD) or n (%)
Receptivity	3.69 (0.49)
Understanding	3.32 (1.17)
Support	3.41 (0.89)
Economic barrier	3.36 (1.01)
Access	3.18 (1.25)
Communication	3.37 (0.91)
Utilization	3.67 (0.64)
Overall HeLD-29 score	3.45 (range 0.62-4.00)
Low OHL	96 (49.2)
High OHL	99 (50.8)

OHL = oral health literacy; HeLD-29 = Health Literacy in Dentistry scale with 29 items. Low and high OHL categories were based on the median score of 3.72.

The mean number of natural teeth was 20.94 ± 8.08 . The mean number of decayed teeth was 6.36 ± 4.42 , the mean number of missing teeth was 11.02 ± 8.12 , and the mean number of filled teeth was 0.42 ± 1.28 . The mean DMF-T index was 17.80 ± 8.04 . The DMF-T index was higher among

female participants, participants aged 80 years or older, and those with elementary school as their highest educational level. The distribution of natural teeth and dental caries status according to sociodemographic characteristics is presented in Table 3.

Table 3. Natural teeth and dental caries status according to sociodemographic characteristics

Variable	Category	Natural teeth, mean (SD)	DT, mean (SD)	MT, mean (SD)	FT, mean (SD)	DMF-T, mean (SD)
Sex	Male	22.39 (6.71)	7.22 (4.53)	9.61 (6.71)	0.27 (1.00)	17.10 (8.16)
	Female	20.56 (8.39)	6.13 (4.37)	11.40 (8.43)	0.46 (1.35)	17.99 (8.02)
Age group, years	60-69	21.93 (7.47)	5.94 (3.40)	10.02 (7.52)	0.42 (1.13)	16.42 (7.60)
	70-79	18.85 (8.71)	6.89 (5.15)	13.15 (8.71)	0.47 (1.73)	20.47 (8.11)
	≥ 80	15.14 (11.35)	10.71 (11.15)	16.86 (11.35)	0.14 (0.38)	27.71 (4.39)
Education	No formal or incomplete basic education	20.20 (9.07)	7.28 (6.33)	11.80 (9.07)	0.04 (0.20)	19.12 (7.18)
	Elementary school	18.93 (8.54)	7.21 (4.64)	13.05 (8.55)	0.07 (0.26)	20.40 (8.16)
	Junior high school	19.31 (7.69)	5.23 (2.79)	12.69 (7.69)	0.50 (1.27)	18.42 (8.50)
	Senior high school	22.51 (7.77)	6.20 (3.99)	9.46 (7.81)	0.65 (1.69)	16.30 (8.03)
	Higher education	22.05 (6.74)	5.41 (4.03)	9.82 (6.90)	0.64 (1.36)	15.86 (7.09)
Total		20.94 (8.08)	6.36 (4.42)	11.02 (8.12)	0.42 (1.28)	17.80 (8.04)

DT = decayed teeth; MT = missing teeth; FT = filled teeth; DMF-T = decayed, missing, and filled teeth index.

Periodontal status was assessed among 190 participants who still had natural teeth. Gingival bleeding was found in 176 participants (92.6%), while 109 participants (57.4%) had shallow periodontal pockets of 4–5 mm and 17 participants (8.9%) had deep periodontal pockets of ≥ 6 mm. Regarding denture status, 186 participants had tooth loss, consisting of 181 partially edentulous participants and 5 fully edentulous participants. Among participants with

tooth loss, only 44 participants (22.6%) wore dentures. Oral hygiene status was assessed in 183 participants, with a mean OHI-S score of 2.82 ± 1.26 . Most participants had fair oral hygiene (43.6%), followed by poor oral hygiene (40.0%) and good oral hygiene (10.3%). Self-assessed masticatory ability was good in 119 participants (61.1%), fair in 49 participants (25.1%), and poor in 27 participants (13.8%), as presented in Table 4.

Table 4. Periodontal status, denture status, oral hygiene status, and self-assessed masticatory ability

Clinical domain	Category	n (%)	Natural teeth mean (SD)
Periodontal status (n = 190)	No gingival bleeding	14 (7.4)	21.6 (7.5)
	Gingival bleeding	176 (92.6)	21.5 (7.4)
	No periodontal pocket	80 (42.1)	21.9 (7.0)
	Periodontal pocket 4-5 mm	109 (57.4)	21.4 (7.7)
	Periodontal pocket ≥ 6 mm	17 (8.9)	19.7 (8.7)
Denture status (n = 195)	Complete natural dentition	9 (4.6)	31.7 (1.0)
	Partially edentulous with denture	39 (20.0)	16.0 (7.8)
	Partially edentulous without denture	142 (72.8)	22.4 (6.5)
	Fully edentulous with denture	5 (2.6)	0.0 (0.0)
	Fully edentulous without denture	0 (0.0)	0.0 (0.0)
Denture provider among denture wearers (n = 44)	Dentist	24 (54.5)	13.8 (8.6)
	Dental technician	20 (45.5)	14.7 (9.6)
Oral hygiene status (n = 183)	Good	20 (10.3)	-
	Fair	85 (43.6)	-
	Poor	78 (40.0)	-
Self-assessed masticatory ability (n = 195)	Good	119 (61.1)	24.3 (6.3)
	Fair	49 (25.1)	16.8 (7.4)
	Poor	27 (13.8)	13.6 (8.0)

Mean OHI-S score was 2.82 (SD 1.26). OHI-S categories: good = 0.0-1.2, fair = 1.3-3.0, poor = 3.1-6.0. Good masticatory ability indicates ability to chew both hard and soft foods; fair indicates ability to chew soft foods and some hard foods; poor indicates ability to chew soft foods only.

Oral health behavior was assessed based on toothbrushing or denture-cleaning frequency, dental visit pattern, and smoking status. Most participants brushed their teeth or cleaned their dentures more than twice a day (51.8%), while 41.5% did so twice a day and 6.7% did so less than twice a day. Only 19 participants (9.7%) visited a dentist for

routine check-ups, while 176 participants (90.3%) visited a dentist only when they experienced problems with their teeth or dentures. Most participants were non-smokers (81.5%), followed by former smokers (12.3%) and active smokers (6.2%), as shown in Table 5.

Table 5. Oral health behavior of participants (n = 195)

Behavior variable	Category	n (%)
Toothbrushing or denture-cleaning frequency	>2 times/day	101 (51.8)
	2 times/day	81 (41.5)
	<2 times/day	13 (6.7)
Dental visit pattern	Routine check-up within 6 months, 1 year, or 2 years	19 (9.7)
	Only when having problems with teeth or dentures	176 (90.3)
Smoking status	Non-smoker	159 (81.5)
	Former smoker	24 (12.3)
	Active smoker	12 (6.2)

The comparison of clinical oral health status between low and high oral health literacy groups is presented in Table 6. Participants with low oral health literacy had higher mean numbers of decayed teeth, missing teeth, gingival bleeding, deep periodontal pockets, and higher OHI-S scores than those

with high oral health literacy. Statistically significant differences were found in the number of missing teeth, filled teeth, and deep periodontal pockets between the low and high oral health literacy groups ($p < 0.05$).

Table 6. Clinical oral health status according to the oral health literacy category

Clinical oral health status	Low OHL, mean (SD)	High OHL, mean (SD)	p-value
DT	6.96 (5.14)	6.09 (3.38)	0.498
MT	12.63 (8.67)	9.46 (7.25)	0.010*
FT	0.15 (0.53)	0.69 (1.69)	0.006*
Gingival bleeding	8.26 (6.02)	7.66 (6.06)	0.392
Periodontal pocket 4-5 mm	3.29 (4.76)	3.62 (5.38)	0.825
Periodontal pocket ≥6 mm	0.46 (1.48)	0.09 (0.43)	0.048*
OHI-S score	2.94 (1.26)	2.71 (1.24)	0.272

Mann-Whitney U test. *Significant at $p < 0.05$. OHL = oral health literacy; DT = decayed teeth; MT = missing teeth; FT = filled teeth; OHI-S = Simplified Oral Hygiene Index.

Spearman correlation analysis showed several significant associations between HeLD-29 domains and clinical oral health status. The mean oral health literacy score was significantly correlated with the number of missing teeth, number of filled teeth, DMF-T score, and self-assessed masticatory ability. Among the HeLD-29 domains, communication was significantly correlated with missing teeth, filled

teeth, DMF-T score, denture status, and self-assessed masticatory ability. Access was significantly correlated with missing teeth, DMF-T score, and self-assessed masticatory ability, while utilization was significantly correlated with DMF-T score and self-assessed masticatory ability. The detailed correlation results are presented in Table 7.

Table 7. Correlation between oral health literacy and clinical oral health status

HeLD-29 domain	DT	MT	FT	DMF-T	BOP	Pocket 4-5 mm	Pocket ≥6 mm	Denture status	OHI-S	Masticatory ability
Receptivity	-0.2**	ns	ns	-0.2**	ns	ns	ns	ns	ns	0.2*
Understanding	ns	ns	0.2**	ns	ns	ns	ns	ns	ns	-0.2**
Support	ns	ns	ns	ns	ns	ns	ns	ns	ns	-0.1*
Economic barrier	ns	ns	ns	-0.1*	ns	ns	-0.1*	ns	ns	-0.3**
Access	ns	-0.2*	ns	-0.2**	ns	ns	ns	ns	ns	-0.2**
Communication	ns	-0.2*	0.2**	-0.2**	ns	ns	ns	0.2*	ns	-0.3**
Utilization	ns	ns	ns	-0.2**	ns	ns	ns	ns	ns	-0.2**
Mean OHL score	ns	-0.2**	0.2*	-0.3**	ns	ns	ns	ns	ns	0.3**

Spearman correlation test. Values represent Spearman correlation coefficients for significant associations. * $p < 0.05$; ** $p < 0.01$; ns = not significant. DT = decayed teeth; MT = missing teeth; FT = filled teeth; BOP = bleeding on probing; OHI-S = Simplified Oral Hygiene Index.

The mean oral health literacy score tended to be higher among participants who brushed their teeth or cleaned their dentures more than twice a day, visited the dentist for routine check-ups, and were non-smokers. However, there were no statistically significant differences in oral health literacy scores according to toothbrushing or denture-cleaning frequency, dental visit pattern, or smoking status ($p > 0.05$). Spearman correlation analysis also showed no significant correlation between

oral health behavior variables and HeLD-29 domains or mean oral health literacy score.

Oral health literacy scores differed significantly according to age group and educational level. Participants aged 60–69 years had the highest mean oral health literacy score, while participants aged 80 years or older had the lowest score. Based on education, participants with higher education had the highest mean oral health literacy score, while those with no formal or incomplete basic education had the lowest score. These

differences were statistically significant for age group and educational level ($p < 0.05$), but not for sex.

The association between clinical oral health status and oral health behavior is presented in Table 8. A significant difference in DMF-T score was found between participants who visited a dentist for routine check-ups and those who visited only

when they had oral health problems ($p < 0.05$). Participants who visited the dentist only when problems occurred had a higher mean DMF-T score. A significant difference in gingival bleeding was also found according to smoking status ($p < 0.05$). No significant differences were found between oral health behavior variables and OHI-S score, shallow periodontal pockets, or deep periodontal pockets.

Table 8. Oral health literacy and clinical oral health status according to sociodemographic characteristics and oral health behavior

Panel	Variable, p-value	Category or clinical outcome	n (%)	Mean OHL score (SD)
A. OHL by sociodemographic characteristics	Sex $p = 0.984$	Male	41 (21.0)	3.46 (0.70);
		Female	154 (79.0)	3.45 (0.67)
	Age group, years $p = 0.005^*$	60-69	141 (72.3)	3.50 (0.61);
		70-79	47 (24.1)	3.46 (0.68)
		≥ 80	7 (3.6)	2.36 (1.04)
		No formal or incomplete basic education	25 (12.8)	2.80 (0.96);
	Education $p < 0.001^*$	Elementary school	43 (22.1)	3.05 (0.73)
		Junior high school	26 (13.3)	3.68 (0.38)
		Senior high school	79 (40.5)	3.70 (0.39)
		Higher education	22 (11.3)	3.81 (0.27)
B. OHL by oral health behavior	Toothbrushing or denture-cleaning frequency $p = 0.322$	> 2 times/day	101 (51.8)	3.49 (0.63)
		2 times/day	81 (41.5)	3.47 (0.62)
		< 2 times/day	13 (6.7)	3.08 (1.11)
	Dental visit pattern $p = 0.398$	Routine check-up	19 (9.7)	3.69 (0.29)
		Only when having problems	176 (90.3)	3.43 (0.70)
	Smoking status $p = 0.562$	Non-smoker	159 (81.5)	3.47 (0.66)
		Former smoker	24 (12.3)	3.35 (0.82)
		Active smoker	12 (6.2)	3.45 (0.49)
C. Clinical oral health status by behavior	Toothbrushing or denture-cleaning frequency	DMF-T; OHI-S; BOP; pocket 4-5 mm; pocket ≥ 6 mm	-	$p = 0.127; 0.682; 0.407; 0.824; 0.621$
		DMF-T; OHI-S; BOP; pocket 4-5 mm; pocket ≥ 6 mm	-	$p = 0.021^*; 0.177; 0.295; 0.783; 0.158$
	Dental visit pattern	DMF-T; OHI-S; BOP; pocket 4-5 mm; pocket ≥ 6 mm	-	$p = 0.725; 0.866; 0.041^*; 0.305; 0.168$
		DMF-T; OHI-S; BOP; pocket 4-5 mm; pocket ≥ 6 mm	-	
	Smoking status	DMF-T; OHI-S; BOP; pocket 4-5 mm; pocket ≥ 6 mm	-	

Panel A: Mann-Whitney U test for sex and Kruskal-Wallis test for age and education. Panel B: Mann-Whitney U test for dental visit pattern and Kruskal-Wallis test for toothbrushing or denture-cleaning frequency and smoking status. Panel C: Mann-Whitney U test for dental visit pattern and Kruskal-Wallis test for toothbrushing or denture-cleaning frequency and smoking status. *Significant at $p < 0.05$. Spearman tests showed no significant correlations between HeLD-29 domains or mean OHL score and oral health behavior variables (all $p > 0.05$).

This study examined the association between oral health literacy, clinical oral health status, and oral health behavior among independent older adults in Depok. The findings indicate that oral health literacy was associated with several clinical oral health indicators, particularly missing teeth, filled teeth, DMF-T score, periodontal pocket status, denture status, and self-assessed masticatory

ability. However, oral health literacy was not significantly associated with toothbrushing or denture-cleaning frequency, dental visit pattern, and smoking status. These findings suggest that oral health literacy may be more strongly reflected in cumulative oral health outcomes than in simple self-reported behavioral indicators among older adults.

The sociodemographic profile of the participants should be considered when interpreting the findings. Most participants were women and were in the younger-old age group of 60–69 years. This pattern may be related to the data collection setting and schedule, as community activities conducted during working days may be more accessible to older adults who are retired, not formally employed, or active in community-based older adult programs. The predominance of women may also influence the distribution of several behavioral variables, particularly smoking status, which was uncommon in this sample.

The lowest HeLD-29 domain score was found in the access domain, while the highest score was found in the receptivity domain. This pattern suggests that many participants were willing to receive and respond to oral health information, but still experienced barriers in identifying, contacting, or visiting dental care providers. This finding is important because oral health literacy is not limited to understanding information, but also includes the ability to navigate the health system and use services appropriately. The WHO has emphasized that improving oral health requires stronger integration of oral health into primary health care and universal health coverage, particularly for vulnerable groups such as older adults.^{2,3}

Age and educational level were significantly associated with oral health literacy. Older participants tended to have lower oral health literacy scores, which may reflect the combined influence of reduced visual ability, memory, concentration, information processing, and confidence in communicating with health professionals. Participants with higher educational attainment had better oral health literacy, suggesting that formal education may support the ability to understand health information, evaluate health messages, and make

decisions regarding oral health care. These findings are consistent with previous studies showing that oral health literacy varies according to age and education, and that older adults with lower literacy may face greater difficulty in understanding oral health information and accessing preventive services.^{8,9}

No significant difference in oral health literacy was found between male and female participants. Although some previous studies reported higher oral health literacy among women, this finding may differ across social and cultural contexts. In the present study, the unequal proportion of male and female participants may have reduced the ability to detect a meaningful sex-based difference. It is also possible that access to oral health information and dental care among older adults in this setting is influenced more by education, age, family support, and service availability than by sex alone.

The DMF-T score in this study was high and was mainly contributed by missing teeth. This reflects the cumulative nature of oral disease among older adults, where untreated caries and periodontal problems over the life course may eventually lead to tooth loss. The higher number of missing teeth among participants with lower oral health literacy supports the view that limited ability to understand and use oral health information may delay treatment-seeking and reduce the use of preventive or restorative services. Previous studies have similarly reported that individuals with lower oral health literacy tend to have poorer oral health status, greater dental treatment needs, and less favorable dental care utilization.^{8,9,11,18}

The positive association between oral health literacy and filled teeth is also noteworthy. A higher number of filled teeth among participants with better oral health literacy may indicate greater use of restorative dental care rather than delayed treatment that ends in extraction. This finding suggests

that older adults with better oral health literacy may be more capable of recognizing dental problems, communicating with dental professionals, and accepting restorative treatment. In contrast, older adults with lower oral health literacy may seek dental care only when symptoms become severe, which may increase the likelihood of tooth extraction rather than tooth preservation.

The association between oral health literacy and self-assessed masticatory ability shows that oral health literacy may be related not only to disease indicators, but also to functional oral outcomes. Masticatory ability is important for older adults because it may influence dietary choices, nutritional status, and quality of life. Tooth loss without adequate prosthetic replacement can reduce chewing ability and may limit the consumption of harder but nutritious foods. Previous research in Indonesian older adults has shown that functional tooth units are related to nutritional status, indicating the importance of maintaining oral function in later life.¹⁰ These findings are consistent with recent local evidence showing that oral health is significantly related to quality of life among older adults, and that tooth loss may interfere with chewing function, aesthetics, and quality of life when denture use remains low.^{19,20}

Denture-related findings also provide an important public health message. Although most participants had tooth loss, only a small proportion used dentures. Some participants also obtained dentures from non-professional providers, which may reflect economic barriers, limited access to dentists, and a lack of understanding regarding appropriate prosthodontic care. This situation indicates that oral health literacy interventions should not only provide information about tooth loss, but also help older adults understand the need for safe, functional, and professionally made prostheses.

Addressing denture access is particularly relevant in community-based gerodontology programs where tooth loss is common and may affect daily function.

The relationship between oral health literacy and periodontal indicators was less consistent than its relationship with dental and functional indicators. Participants with lower oral health literacy had more deep periodontal pockets, but oral hygiene status measured by OHI-S was not significantly associated with oral health literacy. This may be partly due to measurement limitations because OHI-S requires specific index teeth, which may be missing in older adults with reduced dentition. Therefore, although OHI-S is widely used, it may not fully capture oral hygiene conditions in older populations with extensive tooth loss or denture use. Future studies involving older adults may consider complementary assessments such as full-mouth plaque scores, full-mouth bleeding scores, denture hygiene assessment, and assessment of prosthesis cleanliness and fit.^{14,15} Further research should also examine whether specific oral health literacy domains, particularly access, communication, understanding, and utilization, are associated with periodontal treatment need, denture hygiene practice, and regular periodontal maintenance visits.⁸ A longitudinal or intervention study would be useful to determine whether improving oral health literacy can lead to better plaque control, enhanced denture hygiene, reduced periodontal inflammation, and increased utilization of preventive periodontal care among older adults.¹⁴

This study did not find a significant association between oral health literacy and oral health behavior. Although participants with higher oral health literacy tended to brush or clean dentures more frequently, visit dentists for routine check-ups, and be non-smokers, these differences were not statistically significant. This may suggest that oral health

behavior among older adults is not determined by literacy alone. Behavioral practices may also be influenced by long-standing habits, perceived need, financial ability, transportation, family support, dental anxiety, availability of services, and previous experiences with dental care. A recent scoping review also highlighted that the relationship between oral health literacy, behavior, and outcomes among older adults is complex and may vary depending on context, measurement tools, and population characteristics.⁸

The absence of a significant association between oral health literacy and dental visit pattern should be interpreted carefully. Most participants sought dental care only when they experienced oral health problems, which limited variability in the data. This pattern suggests that dental service utilization among older adults in this setting may remain problem-oriented rather than prevention-oriented. Even when older adults understand oral health information, they may still face practical barriers to routine dental care, including cost, distance, mobility, fear, or the perception that dental visits are unnecessary when there is no pain. Therefore, improving literacy should be accompanied by service-level strategies that make preventive dental care more accessible and acceptable for older adults.

The significant difference in DMF-T score according to dental visit pattern indicates that routine dental attendance may be related to better cumulative oral health status. Participants who visited dentists only when problems occurred had higher DMF-T scores than those who attended routine check-ups. This finding supports the need to shift older adults' dental care pattern from symptomatic visits to preventive and maintenance-oriented care. Community-based education should therefore emphasize not only toothbrushing, but also the importance

of regular dental examination, early detection, denture maintenance, and periodontal care.

Smoking status was significantly associated with gingival bleeding, although the interpretation requires caution because the number of active smokers was small and the sample was dominated by women. Smoking is a known risk factor for periodontal disease and may affect gingival inflammation, periodontal pocket formation, and treatment response. However, in older adult populations, the relationship between smoking and periodontal indicators may be influenced by cumulative exposure, oral hygiene, systemic disease, medication use, and tooth loss. Further studies with a more balanced sample and detailed smoking history are needed to clarify this relationship.

The findings of this study have implications for oral health promotion among older adults. Oral health literacy programs should be designed using simple language, visual aids, repetition, and interactive communication that are appropriate for older adults. Health workers should avoid assuming that written or verbal instructions are automatically understood. Practical guidance on accessing dental services, recognizing when to seek professional care, maintaining natural teeth and dentures, and effectively communicating oral health concerns should be incorporated into community-based programs. These strategies are aligned with the global direction of integrating oral health promotion into primary health care and strengthening prevention across the life course.^{2,3}

This study has several limitations. The cross-sectional design prevents causal interpretation between oral health literacy, behavior, and clinical oral health status. The purposive sampling method and recruitment from selected districts may limit the generalizability of the findings to all older adults in Depok or other Indonesian settings. The imbalance

between male and female participants may also affect behavioral variables, particularly smoking. In addition, oral health behavior was assessed using self-reported questions, which may be influenced by recall bias or social desirability bias.

Another limitation is related to clinical measurement among older adults. Some oral health indices, such as OHI-S, may be difficult to apply when many index teeth are missing. The HeLD-29 questionnaire was administered by interview, which helped participants complete the instrument but may also have introduced interviewer-related bias. Although the questionnaire had been translated and tested, some older adults may still have had difficulty understanding certain items. Future studies should consider using simplified language, cognitive interviewing, and geriatric-friendly measurement approaches to ensure that older adults fully understand oral health literacy instruments.

Further research should involve a larger and more representative sample of older adults from different community and primary care settings. Longitudinal studies are needed to determine whether oral health literacy predicts changes in oral health behavior, service utilization, and clinical outcomes over time. Future intervention studies should also evaluate whether improving oral health literacy can increase preventive dental visits, reduce untreated dental disease, improve denture use, and support oral function among older adults. Combining oral health literacy intervention with accessible geriatric dental services may provide a more effective strategy than education alone.

CONCLUSION

This study highlights that oral health literacy is associated with clinical oral health status among independent older adults in Depok, particularly with cumulative and functional oral health

indicators. The findings suggest that improving oral health literacy may support better oral health maintenance in older populations, but improving oral health literacy alone may not be sufficient to change oral health behavior. Community-based geriatric oral health programs should therefore combine simplified oral health communication with improved access to preventive dental care, family or community support, and age-appropriate oral health services.

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