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Research Paper

Influencing factors associated with oral health among older hospitalized patients with ischemic stroke: A cross-sectional survey

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ABSTRACT

Objective: To investigate the oral health status of older patients with ischemic stroke and analyze the influencing factors, providing valuable insights for developing effective oral health management strategies tailored for this population.

Methods: A cross-sectional survey was conducted from January to June 2022, selecting 350 older patients with ischemic stroke from two tertiary hospitals in Chongqing. The Barthel Index (BI), Eating Assessment Tool (EAT-10), and Oral Health Assessment Tool (OHAT) were used to assess patients' self-care ability, swallowing function, and oral health status, respectively. A self-designed questionnaire was used to collect demographic information, disease-related information, and oral health behaviors of the patients. Binary logistic regression analysis was performed to analyze related influencing factors.

Results: A total of 346 older patients with ischemic stroke were included, with 199 males and 147 females. The median total score of OHAT was 5 (total score range 0–16). Dental decay (91.7%, 278/303) and poor oral hygiene (92.2%, 319/346) were the main oral health problems in this population. Binary logistic regression analysis showed that sex, hyperlipidemia, stroke severity, stroke events, oral health behaviors, and care dependency were influencing factors for the oral health of this population ($P < 0.05$).

Conclusion: The study revealed that healthcare professionals should strengthen the oral health assessment of older patients with ischemic stroke and implement individualized health education and management measures based on the characteristics of high-risk groups to promote their oral health.

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What is known?

- Stroke, of which ischemic stroke constitutes 87% of all events, stands as the second most prevalent cause of mortality globally.
- Oral health plays a crucial role in the process of stroke recovery. Prompt identification and targeted interventions for those exhibiting poor oral health can potentially enhance their food consumption, curtail the incidence of pneumonia, and possibly expedite the overall recovery from stroke.

What is new?

- This study demonstrated a high prevalence of poor oral health among older patients with ischemic stroke. Inadequate oral hygiene and the presence of tooth decay stood out as the most significant challenges.
- Oral health of older patients with ischemic stroke was associated with sex, hyperlipidemia, stroke severity, number of stroke events, oral health behaviors, and care dependency.

1. Introduction

Globally, stroke ranks as the second major cause of mortality. Each year, it influences approximately 13.7 million individuals and results in around 5.5 million deaths. The most common type, ischemic strokes, account for approximately 87% of all stroke cases

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[1]. In China, stroke remains the predominant cause of mortality and disability. Despite advances in healthcare and increased awareness, stroke continues to pose a significant health challenge [2]. According to the Centers for Disease Control and Prevention (CDC) Stroke Statistics, approximately two-thirds of hospitalized stroke patients are aged 65 years or older, and the absolute number of stroke incidents is projected to increase in the upcoming decades owing to the aging population [3]. Consequently, emphasizing rehabilitation for this age group is of paramount importance in clinical practice.

According to the World Dental Federation, oral health is defined as follows: “Oral health is multifaceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow, and convey a range of emotions through facial expressions with confidence and without pain, discomfort, and disease of the craniofacial complex.” [4] This definition highlights the importance of oral health as an essential component of overall health and well-being.

In recent years, the importance of oral care for stroke patients has been increasingly emphasized, with research highlighting this critical aspect in the promotion of patient recovery [5]. Owing to its sequelae and prevalence, stroke remains a substantial cause of disability in the elderly population, with approximately 75% of stroke survivors experiencing dysfunction and 15%–30% suffering from severe disability [6]. Upper limb hemiparesis among affected individuals hinders them from performing oral hygiene [7]. In addition to these challenges, stroke-associated orofacial motor deficits, including weak lip force, diminished tongue pressure, and reduced chewing efficiency, adversely affect the clearance of food debris from the oral cavity and exacerbate poor oral hygiene [8]. The accumulation of food debris can further lead to halitosis, tooth decay, and a heightened risk of various microbial infections [9]. Notably, the colonization of diverse microorganisms in the oral cavity heightens the risk of pneumonia among stroke patients [10]. According to a previous study, stroke-associated pneumonia (SAP) is a leading cause of mortality in this population, accounting for up to 21.4% of deaths [11]. In addition, poor oral health in stroke patients can contribute to reduced food intake and malnutrition, potentially impairing recovery from stroke [12,13].

Oral health conditions encompass an extensive range of risk factors. Unmodifiable risk factors are intrinsic to an individual and include age, sex, and genetic predispositions [9]. Modifiable risk factors encompass elements such as suboptimal living conditions, unhealthy living behaviors/habits, poor socioeconomic status, limited physical activity, and restricted access to oral health care services [14]. Furthermore, systemic diseases such as hypertension, diabetes, and hyperlipidemia also exert a substantial impact on oral health outcomes [14].

Previous studies have identified factors such as age, oral hygiene practices, socioeconomic status, education, dysphagia, and dependence as being associated with the oral health status of stroke patients [8,15–17]. Due to differences in economic levels and lifestyle habits, the oral health conditions and influencing factors among older patients with ischemic stroke in the mainland of China may vary. Moreover, stroke severity and the number of stroke events can influence patients' physical and cognitive functions as well as their recovery process [18]. Although these factors are known to influence patients' overall health, the association between these variables and the oral health status of older stroke patients remains unclear. Therefore, this study aimed to describe the oral health conditions of older stroke patients and determine the associated risk factors for poor oral health.

2. Methods

2.1. Study design and participants

This study used a cross-sectional design. Convenience sampling was conducted to select ischemic stroke patients in the neurology and rehabilitation departments of two tertiary hospitals from January 2022 to June 2022. Inclusion criteria included 1) patients aged 65 years or older, 2) patients with a clinical diagnosis of ischaemic stroke, 3) patients with the ability and willingness to provide informed consent, and 4) patients with adequate cognitive functioning (defined as a Mini-Mental State Examination score >25) [19]. In our pre-experiment, we included 50 participants who met the inclusion criteria, of whom 38 presented with poor oral health. Therefore, the prevalence of poor oral health was approximately 76%. Thus, the required sample size was determined using the single population proportion formula ($n = Z^2P(1-P)/d^2$) by taking an estimated prevalence of poor oral health of 76% ($P = 0.76$) from a pre-experiment conducted by our research group, with the assumption of a 95% CI ($Z = 1.96$) and 5% margin of error ($d = 0.05$). As such, a minimum sample size of 280 was needed.

2.2. Measurements

The instruments employed in this study consisted of three existing assessment tools and a self-designed questionnaire. The instruments were used to gather comprehensive data regarding demographic details, disease-related information, oral health behaviors, care dependency, dysphagia, and oral health status.

2.2.1. Oral Health Assessment Tool

The Oral Health Assessment Tool (OHAT) is a comprehensive assessment tool of oral health developed among residential care facility (RCF) residents by Chalmers et al., in 2005 [20]. Due to its applicability to patients with cognitive impairment, the scale has been widely used by researchers worldwide to assess the oral health of stroke patients [12]. The OHAT comprises eight sub-categories: lips, tongue, gums and tissues, saliva, natural teeth, dentures, oral cleanliness, and dental pain. Each category is graded on a three-point scale (healthy = 0, oral changes = 1, unhealthy = 2). The total score ranges from 0 to 16, with higher scores indicating poorer oral health. The Chinese version of OHAT, translated in 2015 by Tsai et al. for use with dementia patients in care homes, was used for this study. Its Cronbach's α coefficient was 0.60, and the kappa value (3.162–4.337) was significantly correlated ($P < 0.05$) [21]. In our study, Cronbach's α coefficient of the scale was 0.686.

2.2.2. Eating Assessment Tool

The Eating Assessment Tool (EAT-10) [22], developed by Belafsky et al., in 2008, was implemented for dysphagia screening. This self-administered questionnaire consists of ten questions related to swallowing difficulties; each scored on a scale from 0 to 4. The total score ranges from 0 to 40, with higher scores indicating worse swallowing function. A total score of 3 or more suggests a probable swallowing disorder. The Cronbach's α coefficient for the EAT-10 in this study was 0.910, demonstrating high reliability.

2.2.3. Barthel Index for Activities of Daily Living

The Barthel Index (BI) for Activities of Daily Living (ADL) [23] was utilized to gauge the level of care dependency. This tool consists of ten components, including feeding, bathing, grooming, dressing, bowel control, bladder control, toilet use, bed and chair transfers, walking on level surfaces, and stair-climbing. The scores range from 0 to 100, classifying care dependency into four degrees:

no dependence (100 points), slight dependence (61–99 points), moderate dependence (41–60 points), and severe dependence (≤ 40 points). The Chinese version of the BI has a Cronbach's α coefficient of 0.92, indicating a high internal consistency [24].

2.2.4. Self-designed questionnaire

The self-designed questionnaire included two parts. The first part incorporated questions about demographic and disease-related information. These included the participants' age, sex, education level, monthly income, smoking status (defined as at least one cigarette per day for six months or longer), number of chronic illnesses (e.g., diabetes, hypertension, hyperlipidemia), number of stroke occurrences, length of stay, and stroke severity.

The second section of our self-designed questionnaire focused on oral health behaviors. These were based on oral care recommendations by authoritative bodies, including the US CDC [25,26] and National Health Service (NHS) England [27]. These recommendations advocate for comprehensive oral care, which includes twice-daily thorough teeth brushing, daily flossing, regular dental check-ups, and cleanings, brushing sessions exceeding 2 min, replacing toothbrushes every three months, and the use of mouthwash, etc. Six questions were incorporated into this section of the questionnaire, including tooth brushing frequency (< 2 times daily/ ≥ 2 times daily), mouthwash use (yes/no), dental floss use (yes/no), duration of each brushing session (< 2 min/ ≥ 2 min), toothbrush replacement frequency (< 3 months/ ≥ 3 months), and dental check-up frequency (rarely/regularly). The initial version was subjected to a review process by a panel of five clinical dental experts, each with more than a decade of practical experience in their respective fields. The central aim of this expert panel was to ensure the appropriateness and relevance of the questionnaire.

2.3. Data collection

Potential participants were identified by ward nurses, using established inclusion and exclusion criteria. One nursing graduate student (author C. W.) and one supervisor (RN) conducted surveys after seven days of training. The data collection process was initiated by explaining the study from the nursing graduate student (C. W.). Those who agreed to participate provided their affirmation through signed written informed consent forms. The data were collected through one-on-one, face-to-face surveys, and questions were asked individually. In the survey process, the nursing graduate student (C. W.) was primarily responsible for data collection, while the RN served a supervisory role, ensuring the coordination and standardization of the process. Each survey was carried out at the patient's bedside and took approximately 20 min to complete. This period was broken down into around 10–15 min for the questions, with the remaining time allocated for conducting the oral examination and providing the patient with oral health education. Participants were free to take a break during the process to minimize possible physical discomfort. In cases of unclear questionnaire responses, the participant was asked to clarify or, if necessary, the caregiver's assistance was sought to elucidate the participant's responses.

2.4. Statistical analysis

SPSS version 24.0 (SPSS Inc., Chicago, IL, USA) was used for data analysis. The Shapiro–Wilk test was used to test the normality of continuous numerical variables. Continuous variables that conformed to a normal distribution were tested using the independent t -test and expressed as the means and standard deviations (SDs). Nonnormally distributed continuous numerical variables were tested using the Mann–Whitney U test and are reported as the

medians and interquartile ranges (IQRs). Categorical variables were tested using the chi-square test (χ^2) and are presented as frequencies (%). Binary logistic regression models were used to identify influencing factors. A two-sided P value ≤ 0.05 was considered statistically significant.

2.5. Ethical considerations

The study protocol was approved by the Ethics Committee of Chongqing Medical University (No. 2022-K17). Only when accompanied by qualified internal staff, did investigators have access to the participants' medical records and contact with the participants. The names of the participants were replaced by coded sequential numbers, and only the investigators had access to the list. All participants provided oral or written consent.

3. Results

3.1. Participants' characteristics

A total of 350 participants completed the face-to-face survey questionnaire, of which 4 were eliminated for having five or more missing answers. Thus, 346 questionnaires were available for the final analysis, with a 98.8% response rate. The median age of the participants was 71 years, ranging from 65 to 91 years. The majority of participants were male (57.5%, 199/346), had a monthly income of more than 3,000 CNY (49.7%, 172/346), had a high school education or above (35.3%, 122/346), smoked (46.8%, 162/346), had experienced their first stroke (60.1%, 208/346), had suffered a mild stroke (66.5%, 230/346), and did not have dysphagia (50.9%, 176/346). The median BI scores were 85.00 (65.00, 100.00) in the better oral condition group and 60.00 (30.00, 90.00) in the worse oral condition group (Table 1).

3.2. Oral health status in older patients with ischemic stroke

The median total OHAT score of the 346 older patients with ischemic stroke was 5. Most of the participants (84.1%) had healthy lips, while only 11.8% were assessed as having healthy tongues with normal moisture, roughness, and pink color. Of the 346 participants, 45.0% were recorded as having healthy gums and soft tissue, with 54.9% presenting with changes. Over three-fifths of the participants had signs or symptoms of dry mouth. Among the 303 participants with natural dentition, the prevalence of dental decay was high, with more than four-fifths (91.7%) having at least one decayed tooth. Of the 54 participants with removable dental prostheses, more than half (53.7%) were assessed as having unsatisfactory prostheses due to ill fit, discomfort, or breakages. Almost all the participants (92.2%) had an unsatisfactory oral cleanliness status due to plaque, food particles, or calculus present in their mouths or on their dentures. The details of the OHAT scores are shown in Table 2.

3.3. Influencing factors associated with poor oral health in older patients with ischemic stroke

Univariate analysis indicated that the prevalence of poor oral health among the participants was significantly different in terms of age, sex, education level, monthly income, smoking status, diabetes mellitus, hyperlipidemia, number of stroke events, severity of stroke, dysphagia, care dependency, and oral health behaviors, including tooth brushing frequency, mouthwash use, brushing two or more minutes each time, toothbrush replacement frequency and dental check-up frequency ($P < 0.05$).

The OHAT score was defined as the dependent variable, and the

Table 1
Risk factors related to oral health among older patients with ischemic stroke identified by univariate analysis (n = 346).

Variables	Category	Oral Health		Z/ χ^2	P
		OHAT score ≤ 5 (n = 193)	OHAT score >5 (n = 153)		
Age (years)		70.00 (66.00, 74.00)	72.00 (69.00, 76.00)	4.546 ^a	0.001
Sex	Male	86 (44.6)	113 (73.9)	29.977 ^b	<0.001
	Female	107 (55.4)	40 (26.1)		
Education	High school diploma/University	82 (42.5)	40 (26.1)	15.788 ^b	<0.001
	Middle school	47 (24.4)	50 (32.7)		
	Illiterate/Elementary school	64 (33.2)	63 (41.2)		
Monthly income (CNY)	$\leq 3,000$	76 (39.4)	98 (64.1)	24.291 ^b	<0.001
	>3,000	117 (60.6)	55 (35.9)		
History of smoking	Yes	65 (33.7)	97 (63.4)	30.275 ^b	<0.001
	No	128 (66.3)	56 (36.6)		
History of hypertension	No	143 (74.1)	120 (78.4)	0.881 ^b	0.348
	Yes	50 (25.9)	33 (21.6)		
History of diabetes mellitus	No	73 (37.8)	77 (50.3)	5.433 ^b	0.020
	Yes	120 (62.2)	76 (49.7)		
History of hyperlipidemia	No	25 (13.0)	41 (26.8)	10.596 ^b	0.001
	Yes	168 (87.0)	112 (73.2)		
Stroke event	First stroke	143 (74.1)	65 (42.5)	35.565 ^b	<0.001
	Recurrent stroke	50 (25.9)	88 (57.5)		
Severity of stroke	Mild	155 (80.3)	75 (49.0)	37.496 ^b	<0.001
	Moderate/Severe	38 (19.7)	78 (51.0)		
		7.00 (6.00,10.00)	9.00 (7.00,13.00)		
Dysphagia	Yes	60 (31.1)	110 (71.9)	36.395 ^b	<0.001
	No	133 (68.9)	43 (28.1)		
Barthel Index		85.00 (65.00, 100.00)	60.00 (30.00, 90.00)	-5.097 ^a	<0.001
Brushing frequency	<2 times daily	41 (21.2)	96 (62.7)	61.459 ^b	<0.001
	≥ 2 times daily	152 (78.8)	57 (37.3)		
Mouthwash use	Yes	107 (55.4)	57 (37.3)	11.320 ^b	0.001
	No	86 (44.6)	96 (62.7)		
Dental floss use	Yes	23 (11.9)	9 (5.9)	3.703 ^b	0.054
	No	170 (88.1)	144 (94.1)		
Brushing for two or more minutes	Yes	123 (63.7)	31 (20.3)	65.293 ^b	<0.001
	No	70 (36.3)	122 (79.7)		
Toothbrush replacement frequency	<3 months	111 (57.5)	35 (22.9)	41.978 ^b	<0.001
	≥ 3 months	82 (42.5)	118 (77.1)		
Dental check-up frequency	Rarely	176 (91.2)	150 (98.0)	7.348 ^b	0.007
	Regularly	17 (8.8)	3 (2.0)		

Note: Data are n (%), or Median (IQR). ^aMann–Whitney U test. ^bchi-square(χ^2)test. IQR = interquartile range. OHAT = Oral Health Assessment Tool.

Table 2
Oral health assessment categories as per OHAT for older patients with ischemic stroke (n = 346).

Categories	n	Healthy Condition (Scored 0)	Changed Condition (Scored 1)	Unhealthy Condition (Scored 2)
Lips	346	291 (84.1)	55 (15.9)	–
Tongue	346	41 (11.8)	304 (87.9)	1 (0.3)
Gums and soft tissue	346	156 (45.1)	177 (51.2)	13 (3.8)
Saliva	346	138 (39.9)	199 (57.5)	9 (2.6)
Natural teeth	303	25 (8.3)	149 (49.2)	129 (42.6)
Dentures	54	25 (46.3)	20 (37.0)	9 (16.7)
Oral cleanliness (oral hygiene status)	346	27 (7.8)	180 (52.0)	139 (40.2)
Dental pain	346	241 (69.7)	101 (29.2)	4 (1.1)

Note: Data are n (%). OHAT = Oral Health Assessment Tool.

independent variables that were statistically significant in the univariate analysis were entered into the binary logistic regression analysis. Independent variables were analyzed by dummy variables, and one of the classes was selected as a reference group. The results showed that sex, hyperlipidemia, stroke severity, number of stroke events, oral health behaviors, and care dependency were significantly associated with the level of oral health ($P < 0.05$), accounting for 62.4% of the total variance. Details are shown in Table 3.

4. Discussion

Our study offers a comprehensive exploration of oral health

status and its associated factors among older patients with ischemic stroke. We found that their oral health status was generally poor and influenced by six main factors. These findings can serve as a valuable reference, offering important considerations for clinical practice, as well as epidemiological and clinical research.

Based on the findings of our study, the oral health status of older stroke patients was poor, with the most prominent problems being inadequate oral hygiene and a high prevalence of dental decay. The median total OHAT score in our study was 5, which is higher than the score of 4 observed among acute stroke patients admitted to a university hospital in Japan [28]. This discrepancy may be related to the different timing of evaluation. Our univariate analysis results revealed that patients with a longer hospital stay had worse oral

Table 3
Binary logistic regression analysis of significant factors associated with oral health assessed by OHAT ($n = 346$).

Variables		OR	95% CI		P
			Lower	Upper	
Sex (Male as ref.)	Female	0.309	0.152	0.628	0.001
Smoking (Yes as ref.)	No	0.536	0.274	1.051	0.069
Hyperlipidemia (No as ref.)	Yes	5.532	2.406	12.721	<0.001
Stroke event (First stroke as ref.)	Recurrent stroke	3.917	2.036	7.537	<0.001
Severity of stroke (Mild as ref.)	Moderate/Severe	4.028	1.980	8.192	<0.001
Brushing frequency (<2 times daily as ref.)	≥2 times daily	0.285	0.147	0.551	<0.001
Duration of each brushing session (≥2 min as ref.)	<2 min	6.853	3.353	14.007	<0.001
Toothbrush replacement frequency (<3 months as ref.)	≥3 months	2.470	1.238	4.927	0.010
Dental check-up frequency (Rarely as ref.)	Regularly	0.147	0.029	0.741	0.020
Barthel Index		0.986	0.975	0.998	0.019

Note: OHAT = Oral Health Assessment Tool.

health status. Age may also be a contributing factor, as the average age in the Japanese study was 63, whereas our study focused solely on older adults aged 65 and above. Previous research has found that older adults are more susceptible to oral health problems, which may be attributed to factors such as declining immune function, reduced manual dexterity, and the presence of comorbid systemic diseases [29]. Additionally, cultural factors that influence patients' beliefs and attitudes toward oral health could contribute to variations in oral hygiene practices and dental service utilization between the two populations.

The necessity of better oral hygiene was recognized in our study among 319 patients (92.2%), which is similar to previous findings [30]. Studies have suggested that poor oral hygiene can increase the risk of pneumonia in stroke patients [31,32]. Clinical guidelines for stroke management in Canada and the United Kingdom highlight the importance of performing oral health assessments and advocating for effective oral care interventions post-stroke [33,34]. However, oral care is often overlooked by clinical healthcare professionals, patients, and their families [35,36]. Ferguson et al. reported that most staff felt they lacked sufficient knowledge, resources, and training to provide appropriate oral care for stroke patients in their care settings [35]. Furthermore, Van et al. found that patients did not prioritize oral care during hospitalization due to their illness and were unaware of its importance [36]. Hence, it is imperative to establish targeted training and education programs for health care providers, stroke survivors, and their families to improve oral care management for older stroke patients. A Cochrane review focusing on enhancing oral care for stroke patients reported that training provided for stroke patients and their caregivers can lead to improved oral care knowledge [37].

Our study identified a pressing need for dental treatment in older stroke patients. According to previous research, decreased saliva production, xerostomia, and neglected oral health care after a stroke may contribute to the progression of dental decay [38]. However, it is essential to consider that dental decay development is a long-term process, potentially taking several months to years [39]. Consequently, the high prevalence of dental decay observed in our study might be more associated with the patient's preexisting lifestyle habits and oral hygiene behaviors. Therefore, it is imperative for clinical nurses to collaborate with dentists to provide comprehensive dental treatment for older stroke patients.

Regarding unmodifiable factors, sex, the number of stroke events and stroke severity emerged as determinants. Our study results revealed that men were more likely to experience poor oral health than women. A similar finding was reported in the study by Moldvai et al., in which females had significantly fewer decayed teeth than males [8]. This sex difference may be attributed to better oral health literacy and oral health behaviors among females than among their male counterparts [40]. Ng et al. reported that patients

with recurrent strokes experienced higher rates of long-term disability, poorer physical and cognitive function, and less favorable functional recovery compared to first-time stroke patients [41]. This could potentially hinder their ability to care for themselves, including performing daily oral care routines. A retrospective cohort study suggested that a higher National Institutes of Health Stroke Scale (NIHSS) score was associated with poorer functional outcomes [18]. While research has demonstrated a link between oral and dental conditions and an increased risk of stroke, mainly due to the inflammatory process [42], the relationship between stroke severity and oral health remains underexplored. Further investigation is necessary to better understand this association and inform appropriate interventions. Clinically, although the number of stroke events and stroke severity are unmodifiable factors, health care professionals can still play a crucial role in addressing these patients' oral health needs. By being particularly vigilant in monitoring patients with recurrent strokes or higher stroke severity and focusing on promoting their overall recovery and rehabilitation, health care professionals can indirectly contribute to the improvement of their oral health and overall well-being.

Regarding modifiable factors, we identified oral health behaviors, care dependency, and hyperlipidemia as significant contributors. A study conducted by Huang et al. on the knowledge, attitudes, and practices (KAP) of stroke inpatients also demonstrated a concerning prevalence of suboptimal oral health behaviors within this population [43]. Andersen's health behavior model suggests that an individual's attitudes and health knowledge directly influence their health-seeking behavior [44]. Consequently, it is imperative for health care professionals to comprehend and enhance older stroke patients' oral health knowledge and attitudes to facilitate the adoption of optimal oral health practices and ultimately improve outcomes.

Considering the physical limitations and mobility impairments commonly faced by older stroke patients, it is crucial to adapt oral health behavior interventions to suit their individual needs and capabilities. Furthermore, health care providers can work with rehabilitation specialists, such as occupational therapists and physiotherapists, to develop strategies that help older stroke patients overcome their physical limitations and improve their ability to perform oral hygiene tasks. This may involve introducing adaptive equipment or modifying existing oral care techniques to accommodate patients' specific challenges [45].

In this study, we used the BI to measure care dependency and found that higher BI scores were correlated with better oral health. This is supported by the findings in the study by Kim et al., who reported that stroke patients with physical limitations or bedridden status had poorer self-perceived oral health and increased dental decay [9]. Dependent stroke patients may struggle with routine

oral hygiene tasks due to physical limitations or reduced manual dexterity. Additionally, older stroke patients may encounter difficulties with eating and swallowing, resulting in inadequate nutrient intake and malnutrition, which can further exacerbate oral health problems [12,46]. It is worth noting that a study reported that independence in oral care was associated with better oral health [47]. Therefore, personalized oral care interventions should be designed and implemented based on each patient's unique needs and level of dependence.

Notably, our results showed that patients with hyperlipidemia were 5 times more likely to have poor oral health. A previous review suggested a potential bidirectional relationship between periodontitis and hyperlipidemia, with evidence suggesting that the systemic effects of periodontal disease may contribute to the development of hyperlipidemia and that managing periodontal health may lead to improved lipid control [48]. The review indicated that periodontitis and hyperlipidemia might be connected through various pathways, including the release of inflammatory mediators such as TNF- α and IL-1 β , endotoxemia caused by bacterial infections, therapy effects, and shared risk factors. However, further research is needed to fully elucidate the complex relationship between these two conditions in the context of stroke patients. Clinically, it is imperative for nurses to pay special attention to the oral health of patients with hyperlipidemia and actively participate in monitoring and supporting their lipid control.

5. Limitations

This study has several limitations. First, a causal relationship could not be determined because of the cross-sectional design of this study. It would be beneficial for future research to adopt a longitudinal design to clarify the causality between the factors examined and oral health outcomes. Second, this study only investigated two hospitals in one city, which may not represent the general situation. Future research should include more diverse locations and hospitals to get a more comprehensive understanding of the oral health outcomes of older patients with ischemic stroke.

6. Conclusions

Our research findings revealed that the oral health status of older patients with ischemic stroke was suboptimal and influenced by factors including sex, hyperlipidemia, the number of stroke events, stroke severity, oral health behaviors, and care dependency. These findings underscore the necessity for implementing structural modifications and tailored oral health interventions for poststroke individuals. Integrating oral care into the clinical pathway for stroke care is essential to improve patient outcomes and overall well-being.

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Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

CRediT authorship contribution statement

Qinghua Zhao: Conceptualization, Validation, Supervision, Project administration. **Chengfei Wu:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing - original Draft. **Huanhuan Huang:** Conceptualization, Methodology, Validation, Writing - review & editing. **Wenxin Xu:** Validation, Data curation, Writing - review & editing. **Mei Chen:** Investigation, Resources, Supervision. **Jinghong Li:** Investigation, Resources, Supervision.

Declaration of competing interest

The funders had no role in the study design, data collection, management, analysis, interpretation, manuscript writing, or the decision to submit the report for publication. The authors declared there is no conflict of interest.

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Appendix A. Supplementary data

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