



Systematic Review of Influencing Factors for Oral Frailty in Maintenance Hemodialysis Patients

Wenhui Chang¹, Jia Xu^{2*}, Ying Yu², Yayu Zhao³, Xinru Wei³, and Xiaoqi Li³

¹Shanxi University of Chinese Medicine, Jinzhong, China

²Shanxi Bethune Hospital, China

³Shanxi University of Chinese Medicine, Jinzhong, China

Abstract

Background: There are over one million dialysis patients in China, 80% of whom receive maintenance hemodialysis. Long-term dialysis increases the risk of oral frailty. This study reviews its influencing factors to provide evidence for early prevention and control.

Objective: This study conducted a systematic review of the factors associated with the occurrence of oral frailty in maintenance hemodialysis (MHD) patients based on relevant literature, to provide a reference for the clinical prevention of oral frailty in this population.

Methods: Computerized searches were performed in CNKI, WanFang Data, VIP Database, CBM, PubMed, Web of Science, Embase, and Cochrane Library from the establishment of each database to February 9, 2026. Quality assessment and analysis were conducted on the included literature.

Results: A total of 7 studies involving 1450 participants were finally included. The results of the meta-analysis showed that advanced age, sarcopenia, and malnutrition were risk factors for oral frailty in MHD patients, while higher grip strength and higher educational level were protective factors.

Conclusion: The factors influencing the occurrence of oral frailty in MHD patients are diverse and complex. In clinical practice, nursing staff should pay attention to the oral health of patients, identify the influencing factors, and implement interventions as early as possible. In the future, a risk prediction model for oral frailty in MHD patients should be constructed and validated to provide further evidence in support of relevant clinical interventions.

Keywords: Hemodialysis; Oral Frailty; Oral Health; Systematic Review.

BACKGROUND

Data from the China Kidney Disease Network showed that by the end of 2023, there were 1.069 million dialysis-dependent patients in China, among whom approximately 80% relied on maintenance hemodialysis (MHD) [1]. Oral frailty (OF) is an emerging concept in geriatric syndromes, with no unified definition yet. The Joint Committee for Oral Frailty in Japan recommended an operational definition including a reduced number of teeth, difficulty chewing, dysphagia, xerostomia, and decreased oral motor skills [2].

Long-term dialysis leads to reduced saliva secretion, impaired immune function, and combined effects of various medications, resulting in poorer oral health status in most MHD patients, such as xerostomia, dental caries, and periodontitis, which increase the risk of OF [3-5]. Studies have demonstrated that OF is a critical determinant of malnutrition and sarcopenia progression in hemodialysis patients

[6]. Identifying influencing factors of OF and implementing early interventions may reduce adverse outcomes in MHD patients. Therefore, this study systematically reviewed the influencing factors of OF in MHD patients to provide evidence for early clinical prevention.

METHODS

Ethical Considerations

This systematic review is based solely on previously published studies and does not involve the collection of primary data from human participants or animals. Therefore, ethical approval was not required for this study. All included studies were conducted in accordance with relevant ethical guidelines, and A study protocol for this systematic review was registered in the PROSPERO database (CRD420261281051) but was not published in a peer-reviewed journal.

Search Strategy

Computerized searches were conducted in CNKI, WanFang Data, VIP Database, CBM, PubMed, Web of Science, Embase, and Cochrane Library from database inception to February 9, 2026. Chinese search terms included “肾透析”, “血液透析”, “维持性血液透析”, “口腔衰弱”, “口腔功能障碍”, “口腔功能减退”. English search terms included “renal dialysis”, “dialysis”, “hemodialysis”, “maintenance hemodialysis”, “oral frailty”, “oral weakness”, “oral asthenia”, “oral fragility”, “oral function”, and “oral health”. Taking CNKI as an example, the Chinese search formula was: (SU= ‘肾透析’ + ‘维持性血液透析’ + ‘血液透析’) AND (SU= ‘口腔衰弱’ + ‘口腔功能障碍’ + ‘口腔功

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***Corresponding author:** Jia Xu, Shanxi Bethune Hospital, Taiyuan, China, Tel: 13934517297

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能下降’). The detailed search strategy for PubMed is shown in Figure 1.

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#1 "renal dialysis"[MeSH]
#2 (((dialysis[Title/Abstract]) OR (renal dialysis[Title/Abstract])) OR (hemodialysis[Title/Abstract])) OR
(maintenance hemodialysis[Title/Abstract])
#3 #1 OR #2
#4 "oral health"[MeSH]
#5 (((oral health[Title/Abstract]) OR (oral frailty[Title/Abstract])) OR (oral weakness[Title/Abstract]))
OR (oral asthenia[Title/Abstract]) OR (oral fragility[Title/Abstract]) OR (oral function[Title/Abstract])
#6 #4 OR #5
#7 #3 AND #6
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Figure 1: PubMed search strategy

Inclusion and Exclusion Criteria

Inclusion criteria:(1)Study population:MHD patients;(2)Outcome measures:identification of potential influencing factors for oral frailty;(3) Study design:cohort studies, cross-sectional studies, and case-control studies;(4)Assessment tools:validated oral frailty measurement scales. And the exclusion criteria:(1)Duplicated publications;(2)Low-quality studies;(3)Non-Chinese and non-English literature;(4)Unavailable full-text articles.

Literature Screening and Data Extraction

Retrieved literatures were imported into Note Express 4.0.0 for deduplication. Two postgraduate nursing students(C and Z) independently screened the literature according to inclusion and exclusion criteria. Initially, irrelevant literatures were excluded by reading titles and abstracts. Potentially eligible studies were further assessed by full-text reading. Discrepancies were resolved via discussion or consultation with experienced teachers in evidence-based practice. Extracted data included author, country/region, publication year, study design, sample size, assessment tool, prevalence, influencing factors, etc.

Quality Assessment of Included Studies

Cross-sectional studies were evaluated using the Agency for Healthcare Research and Quality (AHRQ) scale [11 items, 1 point for “yes”, 0 points for “no”, “unclear” or “not applicable”; classified as low quality: 0–3, moderate quality: >3–7, high quality: >7–11] [7]. Cohort

studies were assessed using the Newcastle-Ottawa Scale (NOS) (9 items, 1 point for “yes”, 0 points for “no” or “unclear”; classified as high quality: ≥7, moderate quality: 5–6, low quality: 0–4) [8].

Statistical Analysis

RevMan5.4.1 was used for data analysis. Effect sizes were presented as pooled odds ratios (OR) with 95% confidence intervals (CI). Heterogeneity was evaluated using the I^2 statistic. A fixed-effects model was applied if $I^2 \leq 50\%$ and $P \geq 0.1$; otherwise, a random-effects model was used. Descriptive analysis was performed for influencing factors unsuitable for meta-analysis. $P < 0.05$ was considered statistically significant.

RESULTS

Literature Screening Results

A total of 1,538 records were initially retrieved. After screening, 7 studies were finally included.

The detailed process is shown in Figure 2.

Basic Characteristics of Included Studies

7 studies [6–14], published between 2023 and 2025 were included, with a total sample size of 1,450. The prevalence of oral frailty in MHD patients ranged from 38.8% to 61.2%. The basic characteristics are summarized in Table 1.

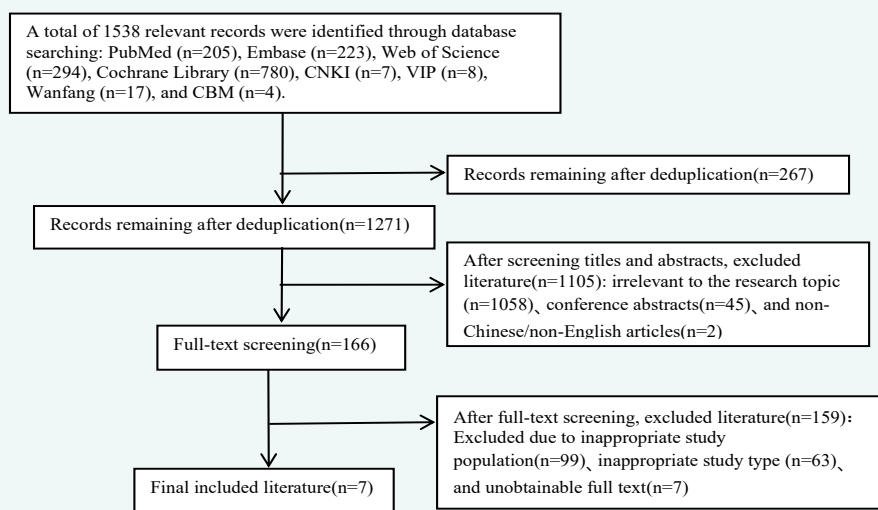


Figure 2: Literature Screening Flowchart



Table 1: Basic characteristics of included studies (n=7)

Author	Year	Country	Study type	Sample size	Assessment tool	Prevalence	Influencing factors	Quality assessment
Masanori[9]	2023	Japan	Cross-sectional study	152	Oral Frailty Index-5	61.2%	Age, malnutrition	8
Dou[10]	2024	China	Cross-sectional study	238	Oral Frailty Index-8	41.2%	Educational level, grip strength, age-adjusted Charlson Comorbidity Index (aCCI), appetite	6
Miyasato[6]	2024	Japan	Cohort study	201	Oral Frailty Index-8	38.8%	Age, frailty	8
Chen[11]	2024	China	Cross-sectional study	325	Oral Frailty Index-8	45.2%	Oral health knowledge, oral health behavior score, dialysis adequacy, number of teeth, OHAT score, swallowing abnormality	7
Mei[12]	2025	China	Cross-sectional study	237	Oral Frailty Index-8	40.9%	Sarcopenia, grip strength, walking speed	5
Wang[13]	2025	China	Cross-sectional study	182	Oral Frailty Index-8	51.7%	Age, educational level, xerostomia severity	5
li[14]	2025	China	Cross-sectional study	115	Oral Frailty Index-8	40.87%	Sarcopenia, malnutrition, smoking, hypertension, monthly household income, depression, cognitive impairment	5

Meta-Analysis Results

1. Demographic Factors: Pooled analyses were performed for factors reported in ≥ 2 studies. Three studies [6-13], identified age as an influencing factor for oral frailty in MHD patients. Among them, Wang's study [13], used 60 years as the cutoff point and found that MHD patients aged ≥ 60 years had a significantly higher risk of oral frailty than those aged < 60 years (OR=10.145, 95% CI: 1.754–58.659). The other two studies [9-13], did not use 60 years as the cutoff point; therefore, these 2 studies were included in the meta-analysis. The heterogeneity test showed $I^2=0\%$ and $P=0.76$, so a fixed-effects model was applied. The results indicated that older patients had a significantly higher risk of oral frailty than younger patients (OR=1.06, 95% CI: 1.04–1.09, $P<0.05$), suggesting that advanced age may be a risk factor for oral frailty in MHD patients (Figure 3).

Two studies [10-13], reported educational level as an influencing factor for oral frailty in MHD patients. The heterogeneity test showed $I^2=30\%$, $P=0.23$, so a fixed-effects model was used for analysis. The meta-analysis results demonstrated that patients with a higher educational level had a lower risk of oral frailty than those with a lower educational level (OR=0.55, 95% CI: 0.38–0.80, $P<0.05$), suggesting that a higher educational level may be a protective factor against oral frailty in MHD patients (Figure 4).

In addition, several studies [14], have reported that other demographic factors, including smoking history, hypertension history, and monthly household income, are also influencing factors for oral frailty in MHD patients.

2. Oral-Related Factors: Only one study was available for each oral-related factor; thus, descriptive analysis was conducted. Two studies

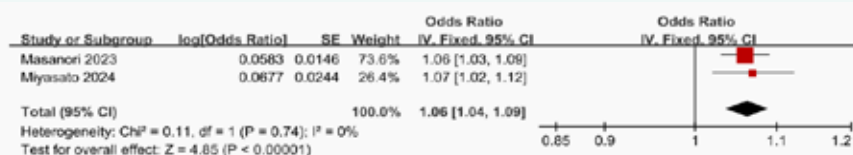


Figure 3: Meta-analysis of the effect of age on oral frailty in MHD patients

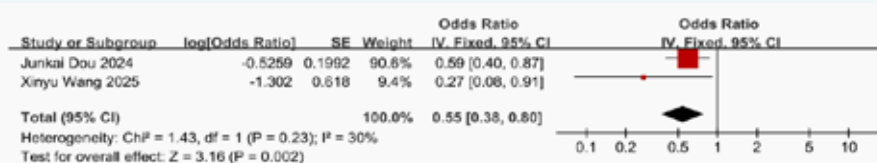


Figure 4: Meta-analysis of the effect of educational level on oral frailty in MHD patients



[11-13], reported that oral-related factors, including oral health literacy, xerostomia severity, number of teeth, and abnormal swallowing, were associated with the occurrence of oral frailty in MHD patients. Among them, Wang's study [13], found a strong correlation between oral frailty and xerostomia in MHD patients. Specifically, each 1-point increase in the SXI total score was associated with a 32.977-fold higher risk of oral frailty.

1.1.1 Disease and Treatment-Related Factors: Pooled analyses were conducted for factors reported in at least 2 studies. Two studies [10,12], identified grip strength as an influencing factor for oral frailty in MHD patients. The heterogeneity test showed $I^2=0\%$ and $P=0.62$, so a fixed-effects model was applied. The meta-analysis results indicated that patients with higher grip strength had a lower risk of oral frailty than those with lower grip strength ($OR=0.92$, 95% CI: 0.88–0.95, $P<0.05$), suggesting that higher grip strength may be a protective factor against oral frailty in MHD patients (Figure 5).

Two studies [9-14], reported malnutrition as an influencing factor for oral frailty in MHD patients. The heterogeneity test showed $I^2=57\%$ and $P=0.13$, so a random-effects model was used for analysis. The meta-analysis results demonstrated that patients with malnutrition had a higher risk of oral frailty than those with good nutritional status ($OR=3.63$, 95% CI: 1.29–10.22, $P<0.05$), suggesting that malnutrition may be a risk factor for oral frailty in MHD patients (Figure 6).

Two studies [12-14], identified sarcopenia as an influencing factor for oral frailty in MHD patients. The heterogeneity test showed $I^2=0\%$ and $P=0.86$, so a fixed-effects model was used for analysis. The meta-analysis results indicated that patients with sarcopenia had a significantly higher risk of oral frailty than those without sarcopenia ($OR=3.64$, 95% CI: 1.77–7.47, $P<0.05$), suggesting that sarcopenia may be a risk factor for oral frailty in MHD patients (Figure 7).

In addition, several studies [6-11], also reported that other disease and treatment-related factors, including dialysis adequacy, Charlson Comorbidity Index, and physical frailty, were also associated with oral

frailty in MHD patients.

7. Psychological and Cognitive Factors: Only one study was included for each psychological and cognitive factor; thus, descriptive analysis was performed. A study by Li [14], showed that cognitive impairment and depression were significantly associated with the occurrence of oral frailty in MHD patients ($P < 0.05$) and increased the risk of oral frailty in this population.

DISCUSSION

Advanced Age as a Risk Factor

The present study demonstrated that advanced age was a risk factor for oral frailty in MHD patients. With aging, the activity of alkaline phosphatase in periodontal ligament cells, as well as their regenerative and osteogenic capacity, decreases. In addition, elderly individuals experience physiological changes such as gingival atrophy, tooth demineralization, and cementum softening, which may increase the incidence of periodontitis and dental caries [15], thereby raising the risk of oral frailty. Meanwhile, MHD patients present with disorders of mineral and bone metabolism, alkalization of the oral environment, and suppressed immune function due to underlying disease and dialysis-related factors. These changes also increase the prevalence of oral health problems, including ammonia odor, xerostomia, and periodontitis [16,17], further elevating the risk of oral frailty. The combined effects of these two pathways significantly increase the risk of oral frailty in elderly MHD patients. Therefore, clinical practice should focus on oral problems in elderly MHD patients, conduct regular screening for oral frailty in this population, and provide early intervention for high-risk individuals to prevent the progression of oral frailty.

A higher educational level is a protective factor against oral frailty in MHD patients

The present study showed that a higher educational level is a

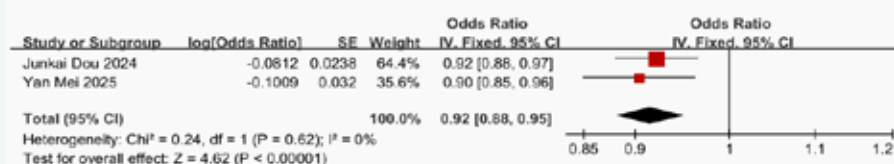


Figure 5: Meta-analysis of the effect of grip strength on oral frailty in MHD patients

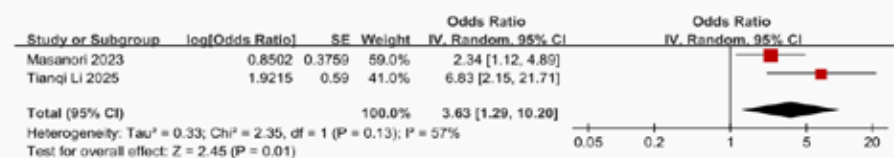


Figure 6: Meta-analysis of the effect of malnutrition on oral frailty in MHD patients



Figure 7: Meta-analysis of the effect of sarcopenia on oral frailty in MHD patients



protective factor against oral frailty in MHD patients. Individuals with lower educational attainment often have limited oral health knowledge and literacy, insufficient awareness of the importance of oral health, and thus develop unhealthy oral hygiene habits, leading to a series of oral problems [18], and increasing the risk of oral frailty. However, studies have shown that only 29.6% of the population has some understanding of oral frailty, indicating that public awareness of oral frailty and the importance of oral health needs to be improved [19]. Therefore, strengthening oral health education for this population is particularly important. Saengtibovorn implemented interventions including oral health consultation, individualized oral hygiene instruction, and intensive video-based education, which improved glycemic control and periodontal status in elderly patients with diabetes, demonstrating that oral health education can effectively modify oral health behaviors and reduce the occurrence of oral health problems [20]. This suggests that in clinical practice, we can prevent the occurrence of oral frailty by enhancing MHD patients' awareness of the importance of oral health and modifying their unhealthy oral hygiene habits and behaviors. We can strengthen patients' attention to oral health through measures such as producing and distributing oral health pamphlets, conducting free oral health screenings, and establishing WeChat groups to share videos and knowledge related to oral health.

Sarcopenia and Malnutrition are Risk Factors for the Development of Oral Frailty in MHD Patients

The present study demonstrated that sarcopenia and malnutrition are risk factors for the development of oral frailty in MHD patients. Grip strength is one of the important clinical indicators for the diagnosis of sarcopenia [21], and this study found that higher grip strength is a protective factor against oral frailty in MHD patients. Sarcopenia, also known as muscle atrophy or muscle wasting, is an age-related degenerative disorder characterized by reduced muscle mass, decreased muscle strength, and impaired physical function [22]. Studies have shown that sarcopenia leads to declines in multiple oral functions, including bite force, masticatory function, and swallowing function [23], thereby increasing the risk of oral frailty. Patients with poor oral function tend to avoid hard foods such as meat, fruits, and vegetables, which are major sources of dietary protein; long-term low-protein intake is unfavorable for muscle repair and growth [24], further exacerbating sarcopenia and forming a vicious cycle of "sarcopenia-oral frailty-malnutrition-worsening sarcopenia", with the three conditions interacting closely and inextricably linked. A study by Guo Zixin reported a 39.9% comorbidity rate of oral frailty and sarcopenia [23], and a cohort study indicated that oral frailty is a significant determinant of malnutrition and sarcopenia progression in MHD patients aged 65 years and older [6]. This suggests that clinicians should not overlook the importance of oral frailty, strengthen oral health education for patients, recognize the interactions between sarcopenia, oral frailty, and malnutrition, implement early combined screening and comprehensive interventions to break the vicious cycle, and further conduct large-sample, high-quality longitudinal studies to explore the underlying mechanisms, providing evidence-based support for targeted prevention and treatment strategies to improve the overall health of MHD patients.

CONCLUSIONS

This study systematically evaluated the influencing factors of oral frailty in MHD patients and comprehensively summarized the effects of demographic factors, oral-related factors, disease and treatment-related factors, as well as psychological and cognitive factors on oral frailty. Advanced age, sarcopenia, and malnutrition were identified as risk factors for oral frailty in MHD patients, while higher educational level and greater grip strength were protective factors. These findings may provide a reference for the clinical early prevention of oral frailty in MHD patients.

However, this study has certain limitations: the number of included literature for some influencing factors was relatively small, which may have a certain impact on the results. It is suggested that large-sample and high-quality studies be conducted in the future to further explore the pathogenesis and influencing factors of oral frailty in MHD patients, and to establish and validate a risk prediction model for oral frailty in this population, so as to provide further evidence for clinical interventions.

DECLARATIONS

Ethics Approval and Consent to Participate

This systematic review is based solely on previously published studies and does not involve the collection of primary data from human participants or animals. Therefore, ethical approval was not required for this study.

CONSENT FOR PUBLICATION

Some of the images and tables were included in our study, and we have published them with the consent of all authors.

AVAILABILITY OF DATA AND MATERIALS

The datasets related to this study are available upon contact with the corresponding author.

FUNDING

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AUTHORS' CONTRIBUTIONS

Wenhui Chang contributed to the conception and design, data analysis, and manuscript writing. Jia Xu and Ying Yu provided research guidance and revised the manuscript. Yayu Zhao participated in data collection and data analysis. Xinru Wei and Xiaoqi Li were involved in data collection. All authors have read and approved the final version of the manuscript.

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