Correlation between vascular access satisfaction and demoralization syndrome in elderly patients with maintenance hemodialysis: a multi-center study

Xiangying Lv[1*], Hong Zhang[1], Lan Yang[1], Xinmei Xing[1] and Yao Huang[1]

Abstract

Objective This multi-center study aimed to investigate the correlation between vascular access satisfaction (VAS) and demoralization syndrome (DS) in elderly patients undergoing maintenance hemodialysis (MHD). Secondary objectives included identifying predictors of VAS and comparing DS severity between patients with high and low VAS scores.

Methods A retrospective analysis was conducted from April 2024 to October 2024, involving 350 elderly MHD patients from three tertiary hospitals in China. Participants were stratified into two groups based on VAS scores: the VA dissatisfaction group ($n = 220$) and the VA satisfaction group ($n = 130$). Data collection utilized the Short Form Vascular Access Questionnaire (VAQ) and the Chinese Version of the Demoralization Syndrome Scale. Binary logistic regression and independent t-tests were employed to analyze predictors of VAS and DS scores.

Results Significant differences in VAS scores were observed between the dissatisfaction and satisfaction groups ($p < 0.001$). Multivariate analysis identified living alone (OR = 2.1, 95% CI 1.4–3.2), prolonged dialysis duration (OR = 1.8, 95% CI 1.2–2.7), and elevated parathyroid hormone (PTH) levels (OR = 1.5, 95% CI 1.1–2.0) as independent risk factors for VAS, while higher hemoglobin levels (OR = 0.6, 95% CI 0.4–0.9) served as a protective factor. Notably, the dissatisfaction group exhibited markedly higher DS scores (73.6 ± 8.7 vs. 51.2 ± 6.9, $p < 0.01$), indicating a strong association between VAS and psychological distress.

Conclusion This study underscores a robust correlation between VAS and DS in elderly MHD patients. Interventions targeting social support optimization, anemia management, and mineral metabolism regulation may improve vascular access outcomes and mitigate demoralization, thereby enhancing quality of life.

Clinical trial number Not applicable.

Keywords Vascular access satisfaction, Maintenance hemodialysis, Demoralization syndrome, End-stage renal disease, Chronic kidney disease

*Correspondence:
Xiangying Lv
lvxiangying69844@sina.com
[1]Department of Nephrology, Baoding No. 1 Central Hospital, Baoding
Great Wall North Street No. 320, Baoding, Hebei 071000, China

Introduction

As the global population continues to age, the burden of chronic kidney disease(CKD), is rising significantly [1]. Over the past decade, there has been a notable increase in the number of elderly patients initiating dialysis, with the most significant rise observed among those aged 65 and older [2]. A functional vascular access (VA) is essential for delivering an adequate dialysis dose to patients with end-stage renal disease (ESRD). However, complications associated with VA are closely linked to increased morbidity and mortality rates. Current clinical practice guidelines, such as the 2019 Kidney Disease Outcomes Quality Initiative (KDOQI) Vascular Access guidelines, advocate for prioritizing arteriovenous fistula (AVF) creation in clinically suitable candidates, owing to its association with improved long-term patency, reduced mortality risk, and lower healthcare expenditures compared to arteriovenous grafts (AVG) or central venous catheters (CVC) [3]. However, these recommendations are contextualized within a patient-centered framework that mandates individualized risk-benefit evaluations and shared decision-making, particularly for elderly or comorbid populations where anatomical or functional limitations may influence access selection [4]. However, there remains a lack of specific guidelines tailored to the unique needs of elderly patients regarding vascular access. This gap underscores the need for further research and the development of specialized recommendations to optimize outcomes in this growing demographic.

Demoralization Syndrome (DS) is a psychological condition marked by significant distress, often triggered by a series of challenging life events [5]. It is characterized by an overwhelming sense of helplessness, an inability to cope, and a subjective feeling of inadequacy when confronted with stress. This syndrome is primarily manifested through feelings of powerlessness, profound loneliness, and deep despair. It is frequently observed in individuals with terminal illnesses, cancer patients, and those suffering from chronic conditions [6]. DS not only contributes to sleep disturbances, a decline in overall quality of life, and an increased burden on families but can also escalate to severe outcomes such as suicidal ideation or behaviors in extreme cases [7]. These factors collectively contribute to a reduction in life expectancy.

For long-term patients, DS can have detrimental effects on both physical and mental health, significantly impeding the recovery process and the effectiveness of treatment. A critical issue is that some patients with DS may be overlooked by healthcare providers, as their symptoms do not meet the diagnostic criteria for depression. While existing research has predominantly focused on cancer populations, emerging evidence highlights its prevalence in patients with CKD, including those undergoing maintenance hemodialysis (MHD) and kidney transplant recipients [8]. A study by Battaglia et al. demonstrated that kidney transplant recipients frequently experience DS, particularly during periods of graft dysfunction or immunosuppression-related complications [9]. Despite this, research specifically examining DS in elderly MHD patients remains scarce, with most studies concentrating on cancer cohorts. The correlation between vascular access satisfaction (VAS) and DS in elderly MHD patients remains under-explored, this multi-center retrospective study primarily aimed to investigate the correlation between VAS and DS in elderly MHD patients, and secondarily identify clinical and psychosocial predictors of VAS.The results of this research are expected to offer a scientific basis for designing targeted interventions that address psychological distress and enhance the overall quality of life for this specific patient population.

Materials and methods

Research subjects

Convenient sampling was used to select MHD patients from three tertiary hospitals in Baoding, Hebei Province in China, as the survey subjects from April 2024 to October 2024. Inclusion criteria: diagnosed with ESRD, undergoing MHD for at least 3 months; aged 60 or older; clear consciousness and capable of unobstructed communication. Exclusion criteria: (1) a history of mental illness (e.g., schizophrenia, bipolar disorder) diagnosed by a psychiatrist; (2) cognitive impairment, defined as a Mini-Mental State Examination (MMSE) score < 24, assessed during recruitment; (3) recent major life events (e.g., accidents, bereavement).This study was approved by the Ethics Committee of Baoding No.1 Central Hospital (Ethics Approval Number: 2024198), and all recruited patients were informed and willing participants in this study.Written informed consent was obtained from the patients for this study.

Research tools

Patient general information questionnaire

Designed by the researchers themselves, this questionnaire includes two parts. Part 1: Demographic information such as age, sex, smoking, drinking, BMI, marital status, living alone, and average monthly household income. Part 2: Disease-related information and lab test, including vascular access type, dialysis duration, dialysis frequency every week, complications, albumin, calcium, phosphorus, parathyroid hormone (PTH),and C-reactive protein (CRP).

Vascular access satisfaction

The Short Form Vascular Access Questionnaire (VAQ) is a 13-item instrument designed to evaluate the level of satisfaction among MHD patients regarding their VA [10]. Developed and validated in Toronto, Ontario, Canada,

Lv *et al. BMC Nephrology*   (2025) 26:265

Page 3 of 8

the VAQ has demonstrated high test-retest reliability and internal consistency through psychometric evaluations. The questionnaire takes approximately 10 min to complete and assesses four key domains of access satisfaction: overall satisfaction, physical symptoms, social functioning, and complications. Each item is rated by the patient on a Likert scale ranging from 1 to 7, where a score of 7 indicates the highest level of dissatisfaction. To classify patients into high and low satisfaction groups, VAQ scores of less than 7 were categorized as satisfied, while scores of 7 or higher were categorized as dissatisfied, as previously outlined in the literature [10]. In this study, based on the aforementioned VAQ scoring criteria, the participants were divided into two groups: VA satisfaction group and VA dissatisfaction group.

Chinese version of the DS scale
The DS Scale was developed by Hong Xiaoqi, et al. based on the English version of the Kissane DS Scale, with cultural adaptation by Liu Peipei, et al., to assess the condition of patients experiencing DS [11]. It includes items related to feelings of meaninglessness (5 items), depression (5 items), unrest (5 items), failure (5 items), and helplessness (4 items). Scores range from 0 to 4 based on the severity level, with a total score of 96. Higher scores indicate a more severe DS, with 0 to 30 points classified as low level, 31 to 60 points as moderate level, and 61 to 96 points as high level. The total Cronbach's α coefficient for the scale is 0.97.

Data collection methods
The data was collected using a combination of paper-based questionnaires and electronic surveys. The researchers provided uniform training to the surveyors, who used standardized guidelines to explain the requirements to the participants before conducting the surveys. Consistent answers were given to any queries raised by the participants. For those with difficulty in writing or reading, the surveyors read out each item in a non-leading manner and assisted them in filling out the questionnaire. Upon completion, the survey was collected on the spot, checked for any missing items, and promptly supplemented to ensure full completion.

Statistical methods
Binary logistic regression analysis will be employed in this study, requiring a sample size of 5–20 times the number of independent variables. With an estimated 20 independent variables and accounting for a 20% non-response rate, the calculated sample size should range from 80 to 360 cases. All statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY). Continuous variables were evaluated for normality using the Shapiro-Wilk test. Data conforming to a normal distribution are presented as mean ± standard deviation (SD) and analyzed with independent Student's t-tests or one-way analysis of variance (ANOVA). Non-normally distributed data are summarized as median (interquartile range, IQR) and analyzed using nonparametric tests (Mann-Whitney U or Kruskal-Wallis tests, as appropriate). Categorical variables are reported as frequencies (percentages) and compared using Pearson's chi-square or Fisher's exact tests. Demoralization syndrome (DS) outcomes, including total scores (range: 0–96) and sub-domain scores (meaninglessness, depression, unrest, failure, helplessness), were compared between VAS groups using independent t-tests, with effect sizes quantified by Cohen's d. Variables demonstrating a univariate association with VAS at $p < 0.05$ were included in the multivariable binary logistic regression model to identify independent predictors. Multicollinearity among covariates was assessed via variance inflation factors (VIF), with a threshold of VIF < 5.0 deemed acceptable. Missing data, accounting for < 5% of all variables, were managed through pairwise deletion to preserve statistical power while minimizing bias. A two-sided p-value < 0.05 was defined as statistically significant for all analyses.

Results
A comparative analysis of the baseline characteristics between the two groups
A total of 350 elderly MHD patients were ultimately included in this study, meeting the required sample size criteria for this research. The flowchart can be seen in Fig. 1. Among them, the dissatisfaction group consisted of 115 male patients (57.5%), while the satisfaction group included 70 male patients (53.8%). There was no significant difference between the two groups ($p > 0.05$). The average age in the dissatisfaction group was 72.4 years, compared to 74.3 years in the satisfaction group, with no significant difference between the two groups ($p > 0.05$). Additionally, there were no significant differences between the two groups in terms of smoking, drinking, BMI, marital status, vascular access type, dialysis frequency every week, albumin, calcium, phosphorus, and CRP ($p > 0.05$). However, significant differences were observed in average monthly household income, living alone, dialysis duration, complications, hemoglobin, and PTH ($P < 0.05$) (Table 1).

Scores of VAS between the two groups
This study showed that the VAS scores of patients in the dissatisfaction group were significantly higher compared to those in the satisfaction group, both in terms of individual item scores and overall scores ($P < 0.001$). The statistical significance ($P < 0.001$) underscores the robustness of this observation, highlighting a clear distinction
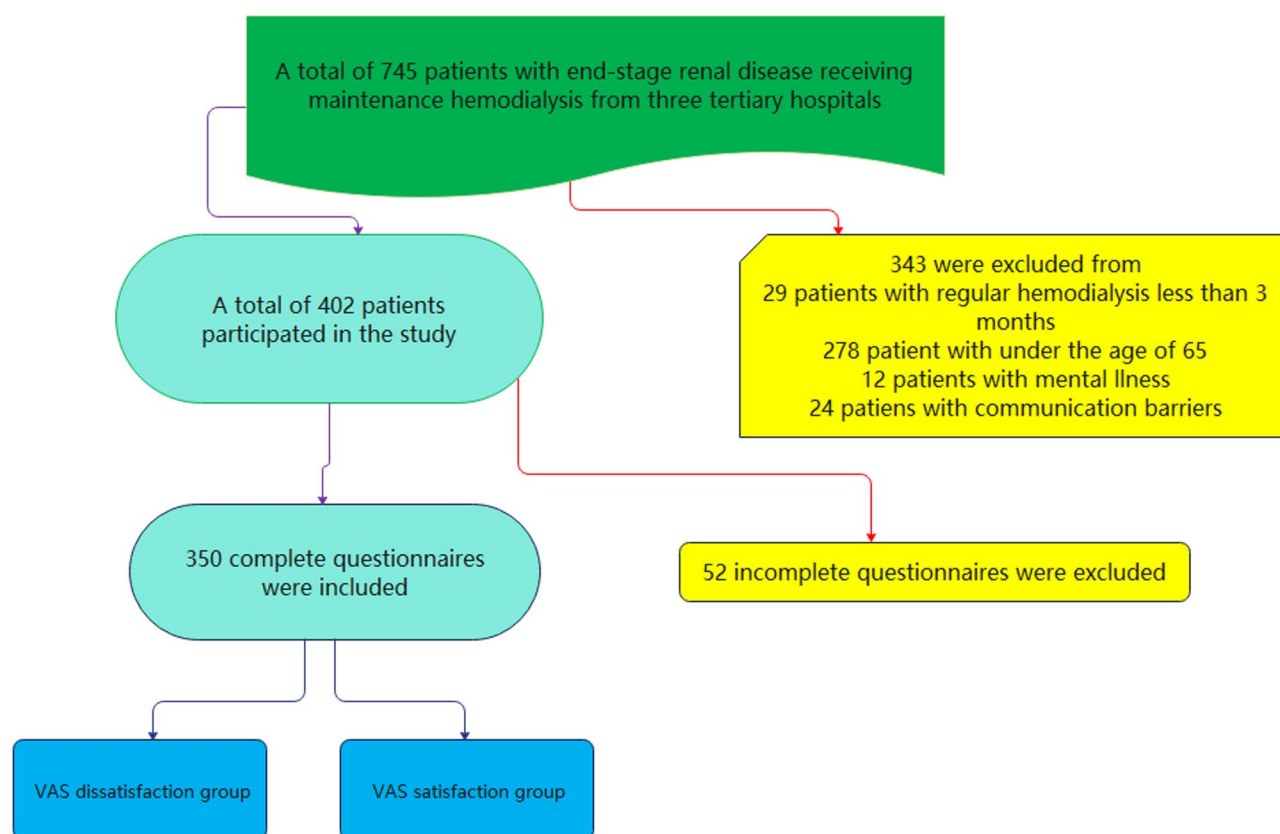
Lv *et al. BMC Nephrology*   (2025) 26:265

Page 4 of 8

Fig. 1 Flowchart of the study

in patient satisfaction levels as reflected in their VAS assessments (Table 2).

Analysis of independent factors influencing VAS in these MHD patients

The variables from Table 1 that demonstrated statistical significance ($p < 0.05$) were included in the subsequent binary logistic regression analysis. The results of this analysis revealed that living alone, dialysis duration, and PTH levels were identified as independent risk factors for VAS. Conversely, hemoglobin levels were found to be a protective factor for VAS. These findings suggest that while certain factors may increase the risk of VAS, maintaining higher hemoglobin levels could potentially mitigate this risk (Table 3).

A comparative analysis of DS levels between the two groups

The study revealed a significant difference in the total DS scores between the two groups. Specifically, the dissatisfaction group had a total DS score of 73.6 ± 8.7, while the satisfaction group scored 51.2 ± 6.9, with a statistically significant difference ($p < 0.01$). Furthermore, when comparing the scores of individual DS items, the dissatisfaction group consistently scored higher than the

satisfaction group across all items, and these differences were also statistically significant ($p < 0.05$) (Table 4).

Discussion

This study aimed to explore the correlation between VAS and DS in elderly MHD patients. The findings revealed significant differences in VAS scores between the VA dissatisfaction and VA satisfaction groups, with independent risk factors for VAS including living alone, longer dialysis duration, and higher parathyroid hormone (PTH) levels, while higher hemoglobin levels were identified as a protective factor. Additionally, the VA dissatisfaction group exhibited significantly higher DS scores compared to the VA satisfaction group, underscoring a strong correlation between VAS and DS in this patient population.

The results of this study align with previous research highlighting the multi-factorial nature of VAS in MHD patients [12]. Living alone emerged as a significant risk factor for VAS, consistent with findings from other studies that have emphasized the role of social support in patient satisfaction and overall well-being [13–15]. Elderly patients living alone often face challenges in managing their health, including adherence to dialysis schedules and coping with complications, which can exacerbate dissatisfaction with VA [15]. This underscores

Lv *et al. BMC Nephrology*   (2025) 26:265

Page 5 of 8

Table 1 Comparison of the general data between the two groups (*n* = 350)

Variables	VA Dissatisfaction Group n = 220	VA Satisfaction Group n = 130	p
Sex, n(%), Male	115(57.5)	70(53.8)	0.862
Age, (Years)	72.4 ± 10.8	74.3 ± 9.4	0.837
Smoking, n(%)	58(26.4)	38(29.2)	0.648
Drinking, n(%)	35(15.9)	22(16.9)	0.921
BMI(kg/m2)	25.3 ± 6.8	26.2 ± 6.2	0.249
Marital Status n(%), Married	173(78.6)	106(81.5)	0.607
Average Monthly Household Income (Yuan)	3638.7 ± 1236.1	5314.6 ± 1836.9	**< 0.001**
Living Alone, n(%)	47(21.4)	11(8.5)	**0.002**
Vascular Access Type, n(%)			0.146
AVF	175(79.5)	112(86.2)	
AVG	4(1.8)	2(1.5)	
TCC	41(18.7)	16(12.3)	
Dialysis Duration (Years)	7.6 ± 2.1	4.5 ± 1.9	**< 0.001**
Dialysis Frequency every week	2.9 ± 0.9	3.1 ± 0.7	0.076
Complications, n(%)			**< 0.001**
≤ 3	74(33.6)	84(74.6)	
> 3	146(66.4)	46(35.4)	
Hemoglobin (g/L)	83.2 (68.9,107.1)	108.9 (88.2, 117.6)	**< 0.01**
Albumin (g/L)	35.1 ± 10.9	37.2 ± 8.3	0.058
Calcium (mmol/L)	1.9 (1.2, 2.3)	2.1 (1.4, 2.5)	0.154
Phosphorus (mmol/L)	1.5 ± 0.7	1.6 ± 0.8	0.221
PTH (pg/mL)	558.7 ± 175.9	257.6 ± 98.3	**< 0.001**
CRP(mg/L)	9.2 (5.4,12.7)	8.8(5.7,11.9)	0.273

Note: VA (vascular access), BMI (body mass index), AVF (arteriovenous fistula), AVG (arteriovenous graft), TCC (tunneled cuffed catheter), PTH (parathyroid hormone), CRP (C-reactive protein), *p* < 0.05 showed in bold and italic type

Table 2 Score of VAS between the two groups in these elderly maintenance Hemodialysis patients

Item	Physical symptoms	social functioning	Dialysis-related complications	Overall satisfaction	Total socre
Scoring Range	0~28	0~28	0~28	0~7	0~91
Satisfaction Group Scoring (x ± s)	13.8 ± 2.5	12.5 ± 3.7	14.3 ± 4.8	4.4 ± 1.2	45.8 ± 11.4
Dissatisfaction Group Scoring (x ± s)	2.2 ± 0.4	1.7 ± 0.5	1.6 ± 0.3	1.2 ± 0.3	6.4 ± 1.4
p	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**

Note: VAS (vascular access satisfaction), *p* < 0.05 showed in bold and italic type

Table 3 Logistic regression of vascular access satisfaction among these elderly maintenance Hemodialysis patients (*n* = 350)

Variables	B	OR(95%CI)	P
Average Monthly Household Income (Yuan)	-0.389	0.786 (0.598 ~ 1.128)	0.125
Living Alone (Yes)	0.364	1.415(1.153 ~ 1.887)	**0.021**
Dialysis Duration (Years)	0.259	1.383(1.141 ~ 1.783)	**< 0.01**
Complications			
≤ 3		Reference	
> 3	0.542	1.535(1.241 ~ 2.137)	**< 0.01**
Hemoglobin (g/L)	-0.273	0.816(0.572 ~ 1.153)	0.243
PTH (pg/mL)	0.383	1.265(1.049 ~ 1.649)	**0.035**

Note: OR (odd ratio), CI (Confidence Interval), *p* < 0.05 showed in bold and italic type

the importance of addressing social determinants of health in the management of MHD patients.

Longer dialysis duration was also identified as an independent risk factor for VAS. This finding is consistent with studies that have shown a progressive decline in patient satisfaction over time, likely due to the cumulative burden of dialysis-related complications and the physical and emotional toll of long-term treatment [16, 17].The chronic nature of maintenance hemodialysis requires a sustained focus on patient-centered care, particularly in addressing the functionality of VA and its impact on patient satisfaction. VA complications, such as stenosis, thrombosis, and infections, are common among MHD patients and can significantly impair quality of life [18]. These complications not only disrupt the dialysis process but also contribute to patient frustration and dissatisfaction, underscoring the need for regular monitoring and timely interventions.The chronic nature of MHD

Table 4 Scores of demoralization between the two groups in these elderly maintenance Hemodialysis patients

Item	Unmeaning	Discouraged	Unrest	Failure	Helplessness	Total socre
Scoring Range	0~20	0~20	0~20	0~20	0~16	0~96
Satisfaction Group Scoring (x±s)	14.1±6.5	11.3±4.9	10.3±4.1	9.3±3.7	8.1±2.7	51.2±6.9
Dissatisfaction Group Scoring (x±s)	19.2±7.2	17.5±5.6	16.2±5.8	15.1±7.2	14.3±4.8	73.6±8.7
p	**<0.01**	**0.027**	**0.012**	**0.034**	**<0.01**	**<0.01**

(*p* < 0.05 showed in bold and italic type)

necessitates ongoing attention to patient-centered care, including regular assessments of vascular access functionality and patient satisfaction.

Higher PTH levels were another significant risk factor for VA dissatisfaction. Elevated PTH levels are often associated with secondary hyperparathyroidism (SHPT), a common complication in MHD patients, which can lead to vascular calcification (VC) and increased risk of VA failure [19]. The pathophysiology linking elevated PTH levels to VA dissatisfaction is multifaceted. PTH contributes to VC by promoting the deposition of calcium and phosphate in the vascular walls, leading to reduced elasticity and increased stiffness of blood vessels [20]. This calcification process not only impairs the patency of VA but also increases the risk of thrombosis and stenosis, further complicating the management of VA in MHD patients [21]. Moreover, the inflammatory milieu associated with SHPT exacerbates endothelial dysfunction, which is another critical factor in VA failure [22]. This highlights the need for effective management of mineral and bone disorders in MHD patients to optimize vascular access outcomes.

Conversely, higher hemoglobin levels were found to be a protective factor for VAS. This is consistent with research demonstrating the positive impact of adequate hemoglobin levels on patient quality of life and satisfaction with treatment [23]. Recent studies have consistently demonstrated that anemia, a common complication in MHD patients, is associated with poorer clinical outcomes and reduced patient satisfaction [24]. This is likely because adequate hemoglobin levels improve oxygen delivery to tissues, reduce fatigue, and enhance physical activity, thereby positively influencing patients' perception of their treatment and VA. Hence, Maintaining optimal hemoglobin levels through appropriate anemia management is therefore crucial in improving VAS and overall patient outcomes.

The study found a significant correlation between VAS and DS, with the VA dissatisfaction group exhibiting markedly higher DS scores compared to the VA satisfaction group. This finding is in line with previous research that has identified a strong link between physical health conditions and psychological distress in MHD patients [25]. The chronic and debilitating nature of MHD, coupled with the challenges associated with VA,

can contribute to feelings of helplessness, despair, and demoralization [26].

The higher DS scores in the VA dissatisfaction group suggest that VAS plays a critical role in the psychological well-being of MHD patients. Patients who are dissatisfied with their VA may experience greater physical discomfort, social limitations, and complications, all of which can exacerbate feelings of demoralization. This underscores the importance of addressing both the physical and psychological aspects of care in MHD patients to improve overall quality of life.

The findings of this study are consistent with previous research that has highlighted the impact of VA on patient satisfaction and psychological well-being. For instance, a study by Yuo TH et al. [27] found that patients with AVFs reported higher satisfaction and lower levels of psychological distress compared to those with CVCs. Similarly, a study by Balamuthusamy S et al. [28]. demonstrated that patients with lower VAS scores had better quality of life and lower levels of depression and anxiety.The study's findings have important implications for clinical practice and policy. Efforts to increase AVF utilization should focus on early referral, patient-centered education, and addressing disparities in access to care. Interventions tailored to specific demographic groups, such as culturally sensitive educational materials and targeted outreach programs, may help bridge the gap in AVF adoption. Furthermore, healthcare providers should engage patients in shared decision-making, ensuring that their preferences and concerns are adequately addressed [29].

Despite its contributions, this study has several limitations. First, the cross-sectional design limits the ability to establish causal relationships between VAS and DS. Longitudinal studies are needed to better understand the temporal dynamics of these relationships. Second, the study was conducted in a specific geographic region, which may limit the generalizability of the findings to other populations. Future research should include diverse patient populations to validate the results. Third, the reliance on self-reported measures for VAS and DS may introduce bias, as patients may under-report or over-report their experiences. Objective measures, such as clinical assessments of vascular access functionality, could provide a more comprehensive evaluation.

Conclusions

In conclusion, this study highlights the significant correlation between VAS and DS in elderly MHD patients and identifies key factors influencing VAS. To our knowledge, this is the first clinical study to demonstrate a significant correlation between VAS and DS in elderly MHD patients. Addressing these factors through targeted interventions, such as improving social support, optimizing dialysis management, and controlling PTH and hemoglobin levels, may enhance VAS and reduce DS, ultimately improving the quality of life for this patient population. Future research should focus on longitudinal studies and diverse populations to further elucidate these relationships and inform clinical practice.

Data availability
In accordance with ethical guidelines and to ensure the confidentiality of participants, any inquiries regarding access to the raw dataset should be formally submitted to the corresponding author.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of the Baoding No. 1 Central Hospital. All methods were performed in accordance with the relevant guidelines and regulations. Informed consent was obtained from all individual participants included in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

References
1. Evans M, Lewis RD, Morgan AR, et al. A narrative review of chronic kidney disease in clinical practice: current challenges and future perspectives. Adv Ther. 2022;39(1):33–43. https://doi.org/10.1007/s12325-021-01927-z.
2. Inaba M, Okuno S, Ohno Y. Importance of considering malnutrition and sarcopenia in order to improve the QOL of elderly Hemodialysis patients in Japan in the era of 100-Year life. Nutrients. 2021;13(7):2377. https://doi.org/10.3390/nu13072377.
3. Yan T, Gameiro J, Grilo J, et al. Hemodialysis vascular access in elderly patients: A comprehensive review. J Vasc Access. 2024;25(1):27–39. https://doi.org/10.1177/11297298221097233.
4. Lok CE, Yuo T, Lee T. Hemodialysis Vascular Access: Core Curriculum 2025. Am J Kidney Dis. 2024:S0272-6386(24)00976-4. https://doi.org/10.1053/j.ajkd.2024.05.021
5. Fava M, Sorg E, Jacobs JM, et al. Distinguishing and treating demoralization syndrome in cancer: A review. Gen Hosp Psychiatry. 2023;85:185–90. https://doi.org/10.1016/j.genhosppsych.2023.10.004.
6. Costanza A, Vasileios C, Ambrosetti J, et al. Demoralization in suicide: A systematic review. J Psychosom Res. 2022;157:110788. https://doi.org/10.1016/j.jpsychores.2022.110788.
7. Shao Q, Li Y, Lin L, et al. Demoralization syndrome and its impact factors among cancer patients in China. J Psychosoc Oncol. 2024;42(3):365–80. https://doi.org/10.1080/07347332.2023.2249895.
8. Taghilou E, Heidarzadeh M, Molaei B, et al. Determining psychometric properties of the Persian version of demoralization scale-II in patients with cancer. BMC Psychol. 2024;12(1):1. https://doi.org/10.1186/s40359-023-01507-6.
9. Battaglia Y, Zerbinati L, Piazza G, et al. The use of demoralization scale in Italian kidney transplant recipients. J Clin Med. 2020;9(7):2119. https://doi.org/10.3390/jcm9072119.
10. Li MT, Wu M, Xie QL, et al. The association between vascular access satisfaction and quality of life and depression in maintained Hemodialysis patients. J Vasc Access. 2024;25(2):439–47. https://doi.org/10.1177/11297298221113283.
11. Kissane DW, Wein S, Love A, et al. The demoralization scale: a report of its development and preliminary validation. J Palliat Care. 2004;20(4):269–76.
12. Besarab A, Frinak S, Margassery S, et al. Hemodialysis vascular access: A historical perspective on access promotion, barriers, and lessons for the future. Kidney Med. 2024;6(9):100871. https://doi.org/10.1016/j.xkme.2024.100871.
13. Thanabalasingam SJ, Akbari A, Sood MM, et al. Social determinants of health and dialysis modality selection in patients with advanced chronic kidney disease: A retrospective cohort study. Perit Dial Int. 2024;44(4):245–53. https://doi.org/10.1177/08968608241234525.
14. Wang Y, Qiu Y, Ren L, et al. Social support, family resilience and psychological resilience among maintenance Hemodialysis patients: a longitudinal study. BMC Psychiatry. 2024;24(1):76. https://doi.org/10.1186/s12888-024-05526-4.
15. Alatawi AA, Alaamri M, Almutary H. Social support and adherence to treatment regimens among patients undergoing Hemodialysis. Healthc (Basel). 2024;12(19):1958. https://doi.org/10.3390/healthcare12191958.
16. Liu CK, Seo J, Lee D et al. Mobility in Older Adults Receiving Maintenance Hemodialysis: A Qualitative Study. Am J Kidney Dis. 2022;79(4):539–48.e1. https://doi.org/10.1053/j.ajkd.2021.07.010
17. Viecelli AK, Howell M, Tong A, et al. Identifying critically important vascular access outcomes for trials in haemodialysis: an international survey with patients, caregivers and health professionals. Nephrol Dial Transpl. 2020;35(4):657–68. https://doi.org/10.1093/ndt/gfz148.
18. Fotheringham J, Vilar E, Bansal T, et al. Patient preferences for longer or more frequent In-Center Hemodialysis regimens: A multicenter discrete choice study. Am J Kidney Dis. 2022;79(6):785–95. https://doi.org/10.1053/j.ajkd.2021.09.012.
19. Zhang H, Li G, Yu X, et al. Progression of vascular calcification and clinical outcomes in patients receiving maintenance Dialysis. JAMA Netw Open. 2023;6(5):e2310909. https://doi.org/10.1001/jamanetworkopen.2023.10909.
20. Duang S, Zhang M, Liu C, et al. Parathyroid hormone-induced vascular smooth muscle cells calcification by Endoplasmic reticulum stress. J Physiol Pharmacol. 2022;73(5). https://doi.org/10.26402/jpp.2022.5.03.
21. Izzo C, Secondulfo C, Bilancio G, et al. Chronic kidney disease with mineral bone disorder and vascular calcification: an overview. Life (Basel). 2024;14(3):418. https://doi.org/10.3390/life14030418.
22. Kaur R, Singh R. Mechanistic insights into CKD-MBD-related vascular calcification and its clinical implications. Life Sci. 2022;311:121148. https://doi.org/10.1016/j.lfs.2022.121148.
23. Karismaz A, Soysal P, Eren R, et al. The connection between anemia and limitations in daily activities among older males: the critical role of dynapenia. Aging Clin Exp Res. 2024;36(1):213. https://doi.org/10.1007/s40520-024-02859-8.
24. Kara O, Soysal P, Kiskac M, et al. Investigation of optimum hemoglobin levels in older patients with chronic kidney disease. Aging Clin Exp Res. 2022;34(12):3055–62. https://doi.org/10.1007/s40520-022-02246-1.
25. Al-Ghabeesh SH, Rayan A, Hattab F, et al. Mindfulness and psychological distress among Hemodialysis patients. Psychol Health Med. 2022;27(4):917–24. https://doi.org/10.1080/13548506.2021.1960395.
26. Özer Z, Bahçecioğlu Turan G, Uyman M, et al. The effects of mandala coloring on fatigue, psychological well-being, and coping with stress in patients receiving Hemodialysis treatment. Hemodial Int. 2024;28(3):367–76. https://doi.org/10.1111/hdi.13163.

Lv *et al. BMC Nephrology*   (2025) 26:265

Page 8 of 8

27. Yuo TH, Kim CY, Rajan DK, et al. Hemodialysis arteriovenous access cosmesis scale (AVACS): A new measure for vascular access. J Vasc Access. 2024;25(4):1194–203. https://doi.org/10.1177/11297298221141499.

28. Balamuthusamy S, Miller LE, Clynes D, et al. American association of kidney patients survey of patient preferences for Hemodialysis vascular access. J Vasc Access. 2020;21(2):230–36. https://doi.org/10.1177/1129729819870962.

29. Wu CK, Fang YW, Lin CH. A collaborative model between dialysis clinics and a hospital center improves the quality of vascular access care and intervention for Hemodialysis patients. Kidney Res Clin Pract. 2024;43(2):216–25. https://doi.org/10.23876/j.krcp.22.175.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.