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Knowledge, attitude, and practice toward arteriovenous fistulas among uremic patients on hemodialysis

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Knowledge, attitude, and practice toward arteriovenous fistulas among uremic patients on hemodialysis

Running title: KAP toward AVF

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Abstract

Objectives: This study aimed to investigate the relationship between knowledge, attitude, and practice (KAP) towards arteriovenous fistula (AVF) care in uremic patients undergoing hemodialysis.

Design: A web-based cross-sectional study was conducted on uremic patients receiving hemodialysis at the First Affiliated Hospital of Chongqing Medical University between April 2023 and June 2023.

Setting: The study took place at the First Affiliated Hospital of Chongqing Medical University.

Participants: A total of 522 valid questionnaires were collected from patients undergoing hemodialysis, representing 85.57% of the total 610 patients eligible for the study.

Interventions: Pathway analysis was employed to assess the interplay among knowledge, attitude, and practice scores related to AVF care in the participants.

Primary and Secondary Outcome Measures: The study evaluated KAP scores (ranging from 0-20, 8-40, and 6-30, respectively) to gauge patients' knowledge, attitude, and practice regarding AVF care.

Results: The findings indicated that patients exhibited adequate knowledge, positive attitude, and proactive practice towards AVF care. Patients' knowledge directly influenced their attitude and practice, with attitude also impacting practice positively. Additionally, knowledge indirectly affected practice through attitude.

Conclusions: Uremic patients undergoing hemodialysis displayed satisfactory understanding, favorable attitudes, and proactive behaviors concerning AVF care. The pathway analysis provided insights into the links between knowledge, attitude, and

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practice, illustrating the direct and indirect effects of these factors on each other in the context of AVF care among patients.

Keywords: Knowledge, attitude, practice; uremic; arteriovenous fistula; structural equation modeling; cross-sectional study

Strengths and limitations of this study

1. The study achieved a response rate of 85.57%, with 522 valid questionnaires collected, indicating strong engagement and participation from uremic patients undergoing hemodialysis at the hospital.
2. The utilization of pathway analysis allowed for a detailed assessment of the intricate relationships among knowledge, attitude, and practice scores related to AVF care, providing a comprehensive understanding of how these factors interact in the patient population.
3. The study's findings of patients exhibiting sufficient knowledge, positive attitude, and proactive practice towards AVF care offer actionable insights for healthcare providers to optimize patient education and interventions in hemodialysis settings, potentially improving outcomes and care quality.
4. This was a single-center study, with a sample size that was not sufficiently large, higher KAP scores might result from specific regional educational programs, and those results could not be directly compared to other areas.

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5. It was possible to overlook other barriers to treatment compliance due to initially high KAP scores and the inability to account for issues other than those covered by the questionnaire

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Introduction

The number of patients with end-stage renal disease (ESRD) has been steadily increasing worldwide, resulting in the increasing demand for hemodialysis (HD) as a renal replacement therapy [1]. Two main modalities of permanent vascular access for HD are central venous catheters and arteriovenous access, such as grafts and arteriovenous fistula (AVF)[2, 3]. Recently, AVF has been discussed as the gold standard for maintenance HD on account of superior patency and long-term durability[4, 5]. Moreover, it has been associated with lower complication rates, including thrombosis and infection [6], directly affecting the life quality of patients on HD [6]. Although lower complication rates and durability are important factors, better knowledge and practice of self-care methods for fistulas among maintenance HD patients can further improve the lifespan of vascular access [2, 7]. In addition, behavior modification should be based on the pragmatic, patient-centered approach; for shared decision-making, patients need access to relevant information about treatment options and reasonable alternatives to fully comply with their HD plan [1, 3]. Thus, sufficient knowledge and active participation are crucial for management.

KAP study is based on the notion that knowledge positively influences attitude, which in turn influences practice[8]. A few previous studies accessed KAP in different countries, reporting low or inadequate knowledge among HD patients [9, 10]. Liu *et al*. [11] suggested that the knowledge-attitude-behavior model is a valuable tool for the health education of HD patients. A recent meta-analysis revealed that adequate practice of AVF self-care ranged from 59% to 99% in southen Asian couentries [10], while AVF self-care behavior was at a low or moderate level in about 69.9% of HD patients in China [12]. Identifying gaps in KAP might help reveal barriers to treatment compliance and behavior changes relevant to maintence HD patients [13]. However,

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there are only few comprehensive studies with large samples focusing on Chinese patients, and KAP towards AVF is rarely discussed. Therefore, this study aimed to investigate KAP regarding AVF among uremic patients on hemodialysis.

Methods

Study design and patients

Uremic patients receiving hemodialysis in the First Affiliated Hospital of Chongqing Medical University between April 2023 and June 2023 were enrolled in this web-based cross-sectional study. Inclusion criteria were the following: 1) age 17-90 years old; 2) diagnosed as uremia according to the GFR <15ml/min 3) regular outpatient HD for more than 1 month. Exclusion criteria were: 1) concurrent peritoneal dialysis; 2) consciousness impairment, cognitive impairment, or severe complications, such as infection, thrombogenesis, stenosis.

The Ethical committee of the First Affiliated Hospital of Chongqing Medical University (K2023-103) approved the study, and informed consent was obtained from all the study participants.

Questionnaires and quality control

The questionnaire was designed based on the previously published studies on KAP in hemodialysis [14-16], expert consensus on the establishment and maintenance of AVF published by China Medical Education Association[13], and Vascular access guidelines by Kidney Disease Outcomes Quality Initiative (KDOQI) released in 2019[7]. A small pilot test (n=84) was conducted, and Cronbach's alpha was 0.776, indicating good reliability of the questionnaire. The results of the confirmatory factor analysis (n=522) indicated that the questionnaire has good reliability ((CFI=0.897 (>0.800 is good); RMSEA=0.066 (<0.08 is good); TLI=0.877 (>0.080 is good).

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The final questionnaire included 41 items. The demographic information section consisted of 15 items; the knowledge section consisted of 11 items, the attitude section of 9 items, and the practice section of 6 items. For the knowledge items, 2 points were added for the correct answer, and 0 points for wrong or unclear answers for item K1; for items K2-10; 2 points were assigned for "know well", 1 point for "partially know", and 0 points for "don't know "; item K11 served as a quality control item, which was only used to eliminate invalid questionnaires with logical contradiction. Thus, the possible score range for knowledge was 0-20. Item A9 investigated patients' attitudes toward the correlation between puncture pain and nurses' skills, which had no obvious positive or negative tendencies and therefore was not assigned a score. The items A2-8 were scored on a five-point Likert scale where: "strongly agree" = 5 points, "agree" = 4 points, "neutral" = 3 points, "disagree" = 2 points, and "strongly disagree" = 1 point; item A1 was reverse scored. Thus, the attitude score ranged from 8 to 40. The practice items were scored from "completely obedient" (5 points) to "never obedient" (1 point), with scores ranging from 6 to 30. A score of 70% or more of the maximum score for knowledge, attitude, and practice was considered an indicator of "sufficient knowledge", "positive attitude," and "proactive practice"[17].

Participants were recruited through ads posted on social media such as WeChat Messenger. Data were collected through the paper questionnaires given on-site by the nurses in the HD unit when the patient was undergoing HD. All data were collected anonymously. If difficulties were encountered during the process of answering, the nurse on duty timely addressed the issue. After data collection was completed, the questionnaires were checked for quality by team members. Obvious logical errors, such as mutually exclusive answers to the quality

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control items or a pattern of choosing exactly the same answer options, was considered invalid.

Sample size

According to the formula for calculating the sample size in cross-sectional surveys $n = \left(\frac{Z_{1-\alpha/2}}{\delta}\right)^2 \times p \times (1-p)$. In the formula, "n" represents the sample size for each group, "α" represents the type I error, which is typically set at 0.05, $Z_{1-\alpha/2}$=1.96, δ represents the allowable error, typically set at 0.05, and "p" is set at 0.5 (as setting it at 0.5 maximizes the value and ensures a sufficiently large sample size). The calculated sample size "n" is 384. Considering an estimated questionnaire response rate of 80%, the final plan is to collect 480 valid questionnaires.

Statistical analysis

Stata 17.0 (Stata Corporation, College Station, TX, USA) was used for statistical analysis. A confirmatory factor analysis was performed to determine the questionnaire's reliability. Continuous variables were expressed as means and standard deviations (SD), an independent *t*-test was used for comparisons between two groups, and ANOVA was used for comparisons between multiple groups. Categorical variables were expressed as n (%). Pathway analysis was conducted to test the hypothesis that (H1) knowledge directly affects attitude; (H2) knowledge directly affects practice; and (H3) knowledge indirectly affects practice through attitude. A two-sided $P < 0.05$ was considered statistically significant.

Patient and public involvement

No patient involved

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Results

A total of 610 questionnaires were collected, of which 88 were excluded due to obvious logical errors in the quality control item (K11) or patterns of answering by choosing the same option, resulting in 522 valid questionnaires (85.57%). The majority of participants were male (55.56%), aged 46-60 years old (43.10%), and married (83.14%). More than half of the participants (55.36%) received HD for over 3 years, and 81.42% still used their first AVF **(Table S1)**.

The knowledge, attitude, and practice scores were 16.24 ± 3.88 (possible range: 0-20), 33.31 ± 3.32 (possible range: 8-40), and 28.69 ± 2.74 (possible range: 6-30), respectively. The knowledge item with the highest rate of "know well" answers (91.95%) was (K6) stating that the arm on the side of the fistulas should not be used for blood pressure measurement, intravenous infusion, intravenous blood collection, heavy lifting, and bearing pressure. The item with the lowest rate of "know well" answers (54.60%) was "(K3) stating that if anticoagulation medication is not taken on time as prescribed by the doctor, it will affect the lifespan of the fistulas" **(Table 1)**. Patients participated in relevant education in fistulas care or management ($P < 0.001$), and those with other family members on HD had higher knowledge scores.

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Table 1. Responses to the questions in the knowledge dimension

Items	Correct, n (%)	Wrong, n (%)	Unclear, n (%)
1. For the first hemodialysis, a central venous catheter should be chosen instead of fistulas.	302 (57.85)	96 (18.39)	124 (23.75)
	Know well, n (%)	Partially know, n (%)	Don't know, n (%)
2. A correct range of blood pressure and hemoglobin control in blood will help prolong the fistulas' lifespan.	313 (59.96)	140 (26.82)	69 (13.22)
3. If anticoagulation medication is not taken on time as prescribed by the doctor, it will affect the lifespan of the fistulas to some extent.	285 (54.6)	124 (23.75)	113 (21.65)
4. Excessive compression of the fistulas at the end of hemodialysis can reduce the lifespan of the fistulas to some extent.	407 (77.97)	80 (15.33)	35 (6.7)
5. The weight gain of more than 5% of dry weight during the hemodialysis interval will affect the fistulas' lifespan.	331 (63.41)	108 (20.69)	83 (15.9)
6. The arm on the side of the fistula should not be used for blood pressure measurement, intravenous infusion and blood collection, heavy lifting, or bearing pressure.	480 (91.95)	38 (7.28)	4 (0.77)
7. The vessels of the fistulas should not be used for anything other than hemodialysis and emergency rescue.	455 (87.16)	56 (10.73)	11 (2.11)
8. Daily inspection of the arteriovenous fistulas by the patient/families and at least one palpation or auscultation is an effective measure to detect the possible problems in fistulas promptly.	432 (82.76)	72 (13.79)	18 (3.45)
9. Keeping the skin on the side of the fistula intact and clean, especially by effectively washing the skin before puncture, helps to prevent local skin infections in the fistulas.	456 (87.36)	53 (10.15)	13 (2.49)
10. In case of a fear of or intolerance for punctures, you will inform the healthcare provider to choose another puncture option that suits you.	398 (76.25)	87 (16.67)	37 (7.09)

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For the attitude items, the majority of participants (84.87%) strongly agreed that "it is important to wash the skin around the fistula before each puncture to prevent local infection" (A5), while the item with the highest rate of disagreement was that "as long as the place is right, the different ways of puncture have no direct impact on the lifespan of the fistulas" (A8), with 28.16% of participants strongly disagreeing with this notion. Items on the subject of the attitude towards nurses, such as "There is no need to insist on a nurse with many years of work experience to perform the puncture" (A7), and "Level of pain during puncture is one of the most important criteria for evaluating the puncture skills of nurses" (A9) had an almost equal number of participants strongly agreeing and strongly disagreeing (40.04% vs. 22.8% for A7; 34.87% vs. 25.1% for A9) **(Table 2)**.

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Table 2. Responses to the questions in the attitude dimension

Items	Strongly agree, n (%)	Agree, n (%)	Neutral, n (%)	Disagree, n (%)	Strongly disagree, n (%)
1. The lifespan of the arteriovenous fistulas is mainly determined by the material used, and there is little influence by how it is cared for.	142 (27.2)	49 (9.39)	60 (11.49)	79 (15.13)	192 (36.78)
2. For the care of arteriovenous fistulas, keeping your blood pressure within the range recommended for your age is important.	407 (77.97)	87 (16.67)	21 (4.02)	1 (0.19)	6 (1.15)
3. It is important to use anticoagulants as prescribed by your doctor to keep the fistulas flowing.	375 (71.84)	95 (18.2)	50 (9.58)	1 (0.19)	1 (0.19)
4. It is necessary to check your fistulas at least once every day.	416 (79.69)	65 (12.45)	21 (4.02)	12 (2.3)	8 (1.53)
5. Is it important to wash the skin around the fistula before each puncture to prevent local infection at the site?	443 (84.87)	58 (11.11)	19 (3.64)	1 (0.19)	1 (0.19)
6. It is the patient's responsibility to decide on the puncture site with the nurse for each puncture.	389 (74.52)	83 (15.9)	39 (7.47)	7 (1.34)	4 (0.77)
7. As long as it is a one-time success and has no effect on the lifespan of the fistulas, there is no matter how many years of work experience the nurses have, and there is no need to insist on a nurse with many years of work experience to perform the puncture.	209 (40.04)	104 (19.92)	55 (10.54)	35 (6.7)	119 (22.8)
8. As long as the place is right, the different ways of puncture (rope ladder cannulation, buttonhole cannulation, area cannulation) have no direct impact on the lifespan of the fistulas.	186 (35.63)	68 (13.03)	70 (13.41)	51 (9.77)	147 (28.16)
9. The level of pain experienced by the patient during a puncture is one of the most important criteria for evaluating the puncture skills of nurses.	182 (34.87)	98 (18.77)	69 (13.22)	42 (8.05)	131 (25.1)

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The highest compliance rate of 88.12% for the practice items was linked with avoiding pressure or strain on the fistula side (P5). The lowest compliance rate of 76.44% was found for the following item: “If you find bleeding at the puncture site of fistulas on your way home or at home, you can handle it without fear or panic” **(Table 3)**. The practice score was higher in patients older than 60 years ($P = 0.004$) and those who had participated in relevant education in fistulas care or management ($P < 0.015$). The pathway analysis was performed to test the hypothesis regarding the effect of knowledge on practice and attitude **(Figure 1)**. Patients' knowledge directly affected their attitude ($\beta = 0.29$, 95%CI: 0.22-0.35, $P < 0.001$) and practice ($\beta = 0.20$, 95%CI: 0.14-0.26, $P < 0.001$) towards AVF. Patients' attitudes toward AVF had a direct and positive effect on practice ($\beta = 0.25$, 95%CI: 0.19-0.32, $P < 0.001$). Knowledge also indirectly affected practice through attitude ($\beta = 0.07$, 95%CI: 0.05-0.10, $P < 0.001$) **(Table 4)**.

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Table 3. Responses to the questions in the practice dimension

Items	Completely obedient, n (%)	Relatively obedient, n (%)	Moderately, n (%)	Relatively not obedient, n (%)	Never obedient, n (%)
1. You will contact and inform your healthcare provider if there is redness, warmth, pain, swelling or purulent discharge on the skin around the fistula.	454 (86.97)	45 (8.62)	21 (4.02)	0 (0)	2 (0.38)
2. You will contact and inform your healthcare provider if there are any abnormalities during hemodialysis, such as weakness or loss of pulsation in the blood vessels near your fistula.	452 (86.59)	50 (9.58)	18 (3.45)	0 (0)	2 (0.38)
3. You would not use the arm on the fistula's side to draw blood or intravenous infusions.	458 (87.74)	41 (7.85)	16 (3.07)	2 (0.38)	5 (0.96)
4. You would not use the arm on the fistula's side to lift heavy objects.	452 (86.59)	47 (9)	17 (3.26)	2 (0.38)	4 (0.77)
5. You would not use the arm on the fistula's side to be under pressure; for example, do not use it to measure blood pressure and sleep on it.	460 (88.12)	32 (6.13)	23 (4.41)	3 (0.57)	4 (0.77)
6. After hemodialysis, if you find bleeding at the puncture site of your fistulas on your way home or at home, you can handle it without fear or panic.	399 (76.44)	72 (13.79)	39 (7.47)	8 (1.53)	4 (0.77)

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Table 4. The model paths of SEM

Model paths	Direct Effect		Indirect effect	
	β (95% CI)	P	β (95% CI)	P
K → A	0.29 (0.22, 0.35)	< 0.001	-	-
A → P	0.25 (0.19, 0.32)	< 0.001	-	-
K → P	0.20 (0.14, 0.26)	< 0.001	0.07 (0.05, 0.10)	< 0.001

Discussion

The present study demonstrated that patients on HD had sufficient knowledge, positive attitude, and proactive practice regarding AVF. Knowledge directly and positively affected attitude and practice, while attitude also indirectly affected knowledge and practice.

Previous KAP studies conducted among HD patients with AVF reported mixed results that seem region-specific, indicating that educational programs might result in better practice; however, in some cases, attitude influenced practice to the same or even higher degree [9, 18]. The population in the present study was characterized by sufficient knowledge, positive attitude, and proactive practice, which seems promising compared to other studies conducted in China [11, 12]. Knowledge and practice scores were significantly higher in those who participated in relevant education programs, especially knowledge. According to pathway analysis, knowledge had only a weak direct effect on attitude and practice, suggesting an influence of other factors.

Previously discussed major factors associated with KAP in HD patients include educational status, gender, age, time of hemodialysis start, and guidance of healthcare personnel [9, 10, 12]. Present study found that the most noticeable difference was among the different types of medical insurance. Although participants with commercial insurance demonstrated higher knowledge and practice scores compared to those with social medical insurance, the score in the practice dimension was significantly higher in participants with social, medical insurance compared to

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commercial. This might be partly explained by the fact that many participants with social medical insurance were retired, thus having more free time to practice self-care. In addition, the population covered by this study included some categories with higher risk of AVF failure, in need of regular surveillance and improved self-care to minimize this risk [19]. Almost one third of participants (32.95%) were older than 60 and 44.44% of participants were women which are significantly associated with the occurrence of AVF failure in previous reports [20, 21]. Diabetes mellitus, another risk factor for poor adaptive remodeling and AVF dysfunction [22, 23] was diagnosed in 28.35% of participants in the present study, which might contribute to the better attention of HD patients to educational interventions and guidance and eventually to higher KAP scores.

With generally high scores, all knowledge, attitude, and practice questions related to the usage of the arm on the side of the fistula (washing skin, avoiding blood pressure measuring and drawing blood, avoiding unnecessary strain, etc.) were answered with high correctness, which is consistent with the previous study reported by Ozen *et al.* [16]. This confirms that patients can remember instructions repeated continuously by doctors and nurses. However, among the most important findings of this study is the negative attitude and lack of trust in the nurse-patient relationship. Those participants who received guidance from doctors had significantly higher levels of knowledge, better attitude, and acceptable practice than those who received guidance from nurses. At the same time, more than half of the participants insisted that only very experienced nurses should perform the puncture (question A7), and the pain level during puncture is one of the most important criteria for evaluating the puncture skills of nurses (question A9). Cannulation of AVF is technically challenging and demands special education from nurses [5, 24]. The process might be painful for patients,

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affecting their relationship with the nurse [25]. Conversely, it) might influence the acceptance of guidance, making patients trust doctors more than nurses. Structured training of clinical personnel could solve part of these issues, but it is impossible to make cannulation painless in 100%. Consequently, expecting nurses to be fully responsible for building trust only puts more strain on them. Instead, discussing the expectations for the cannulation process with patients in more detail might be beneficial.

Questioning different ways of puncture (rope-ladder cannulation, buttonhole cannulation, area cannulation) was also challenging, as 35.63% of participants strongly agreed that it had no direct impact, while 28.16% strongly disagreed with that and other results. Although buttonhole cannulation has some benefits compared to other options, it increases infection risk, while rope-ladder cannulation is challenging to implement, resulting in the limited choice of cannulator in daily practice [26]. This question is still under discussion, which might influence the attitude of patients. Yet, the absence of a strong opinion might also result from the lack of specific knowledge, suggesting that additional education guidance is needed for this point. Another discussed issue is the regular usage of anticoagulants, 28.16% participants remain unclear about the regular usage of Anticoagulants. Anticoagulation therapy was previously reported to be associated with lower complication and mortality rates in patients with AVF and AVG[27, 28]; however, this protective effect was not confirmed by other studies [2, 20]. This discrepancy may be the source of confusion among patients and healthcare providers, who obtain information from different sources.

The present study has several limitations. First, this was a single-center study, with a sample size that was not sufficiently large, higher KAP scores might result from

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specific regional educational programs, and those results could not be directly compared to other areas. Second, it was possible to overlook other barriers to treatment compliance due to initially high KAP scores and the inability to account for issues other than those covered by the questionnaire. Accordingly, more new questions should be introduced to further analyze identified factors, especially in practice. Finally, possible social expectation bias should be taken into account, as results of the questionnaire were self-reported possibly leading to bias into analysis.

In conclusion, the study population was characterized by sufficient knowledge, positive attitude, and proactive practice, which revealed that knowledge has a direct and positive effect on attitude and practice, while attitude also has an indirect effect on knowledge and practice. In addition to financial factors, new barriers (such as the negative attitude and lack of trust in the nurse-patient relationship) were identified in the attitude dimension related to the trust in the ability of puncture nurses.

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Declarations

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Author's Contributions

Dongmei Liu carried out the studies, participantsed in collecting data, and drafted the manuscript. Sifeng Huang and Yuhong Liu performed the statistical analysis and participated in its design. Xianli Liu participated in acquisition, analysis and draft the manuscript. All authors read and approved the final manuscript.

Data availability statement

All data generated or analysed during this study are included in this published article.

Ethics approval and consent to participate

The Ethical committee of the First Affiliated Hospital of Chongqing Medical University (K2023-103) approved the study, and written informed consent was obtained from all the study participants. I confirm that all methods were performed in accordance with the relevant guidelines. All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figure Legend

Figure 1. Results of the structural equation modeling (SEM).

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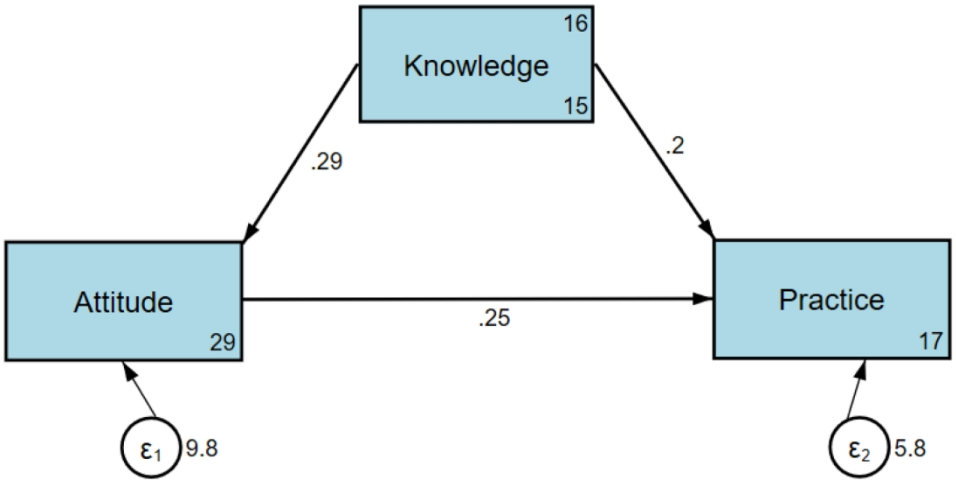

Figure 1. Results of the structural equation modeling (SEM).

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Table S1. Demographic characteristics of study participants and their Knowledge, Attitude, and Practice scores

Variables	N (%)	Knowledge score		Attitudes score		Practice score	
		Mean ± SD	P	Mean ± SD		Mean ± SD	P
Total	522	16.24 ± 3.88		33.31 ± 3.32		28.69 ± 2.74	
Age, years			0.385		0.799		0.004
18-45	125 (23.95)	15.90 ± 3.73		33.48 ± 3.76		28.29 ± 3.58	
46-60	225 (43.10)	16.20 ± 4.13		33.24 ± 3.32		28.48 ± 2.78	
> 60	172 (32.95)	16.53 ± 3.65		33.28 ± 2.98		29.25 ± 1.76	
Gender			0.753		0.396		0.276
Male	290 (55.56)	16.19 ± 3.80		33.24 ± 3.12		28.81 ± 2.59	
Female	232 (44.44)	16.30 ± 3.99		33.40 ± 3.57		28.54 ± 2.92	
Marital status			0.112		0.328		0.090
Married	434 (83.14)	16.38 ± 3.90		33.35 ± 3.31		28.76 ± 2.64	
Unmarried	49 (9.39)	15.92 ± 3.36		33.14 ± 3.08		27.88 ± 3.69	
Divorced/Widowed	39 (7.47)	15.08 ± 4.13		33.08 ± 3.75		28.90 ± 2.36	
Residence			0.615		0.843		0.014
Urban	381 (72.99)	16.26 ± 3.86		33.30 ± 3.24		28.90 ± 2.60	
Rural	110 (21.07)	16.34 ± 4.00		33.26 ± 3.64		28.05 ± 3.13	
Suburban	31 (5.94)	15.58 ± 3.82		33.65 ± 3.22		28.39 ± 2.69	
Education			0.766		0.968		0.267
Primary school and below	109 (20.88)	15.97 ± 4.25		33.28 ± 3.42		28.72 ± 2.65	
Middle school	161 (30.84)	16.22 ± 3.83		33.35 ± 3.46		28.52 ± 3.12	
High school/Technical secondary school	134 (25.67)	16.36 ± 3.85		32.90 ± 3.28		28.94 ± 2.54	
Junior college/Undergraduate	113 (21.65)	16.44 ± 3.65		33.81 ± 2.94		28.71 ± 2.37	
Postgraduate and above	5 (0.96)	14.60 ± 4.34		32.20 ± 5.26		26.40 ± 4.39	
Work status			0.336		0.336		0.002
Unemployed/Layoff	147 (28.16)	16.46 ± 3.73		33.54 ± 3.23		28.61 ± 2.58	
Employed	60 (11.49)	16.38 ± 3.66		33.43 ± 3.40		28.12 ± 3.28	

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Retired	242 (46.36)	16.27 ± 3.82		33.20 ± 3.13	29.01 ± 2.17	
Self-employed/Freelance	48 (9.20)	16.00 ± 4.41		33.02 ± 3.56	28.94 ± 2.34	
Full-time househusband/housewife	25 (4.79)	14.72 ± 4.70		33.28 ± 4.88	26.96 ± 5.81	
Monthly per capita income, CNY			0.300		0.214	0.996
<2000	182 (34.87)	15.92 ± 4.03		33.30 ± 3.55	28.73 ± 2.87	
2000-4999	219 (41.95)	16.47 ± 3.78		33.21 ± 3.06	28.67 ± 2.68	
5000-9999	89 (17.05)	16.57 ± 3.79		33.42 ± 3.54	28.66 ± 2.72	
≥10000	32 (6.13)	15.53 ± 3.98		33.78 ± 3.13	28.69 ± 2.71	
Medical insurance type			<0.001		<0.001	<0.001
Social medical insurance only	491 (94.06)	16.35 ± 3.69		33.43 ± 3.16	28.75 ± 2.52	
Commercial medical insurance only	2 (0.38)	17.50 ± 0.71		36.00 ± 0.00	24.00 ± 8.49	
Both social and commercial medical insurance	22 (4.21)	16.18 ± 3.96		31.73 ± 3.33	29.50 ± 1.57	
No medical insurance	7 (1.34)	8.14 ± 7.97		28.86 ± 8.40	23.57 ± 8.66	
Duration of the HD, years			<0.001		0.344	0.014
< 1	109 (20.88)	15.10 ± 4.57		33.16 ± 3.59	28.16 ± 2.85	
[1, 2)	70 (13.41)	15.77 ± 4.15		33.03 ± 3.71	28.17 ± 4.08	
[2, 3)	54 (10.34)	15.81 ± 4.54		32.80 ± 3.64	28.74 ± 2.65	
≥3	289 (55.36)	16.86 ± 3.25		33.53 ± 3.04	29.01 ± 2.25	
Participation in relevant education in fistulas care or management			<0.001		0.066	0.015
Yes	493 (94.44)	16.43 ± 3.72		33.38 ± 3.28	28.76 ± 2.66	
No	29 (5.56)	12.97 ± 5.04		32.20 ± 3.84	27.48 ± 3.75	
Guidance on fistula care received from			<0.001		0.214	0.002
Doctor	55 (10.54)	16.27 ± 3.52		33.42 ± 3.29	29.51 ± 1.87	

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Nurse	57 (10.92)	14.05 ± 5.31		32.04 ± 4.80	27.82 ± 4.00	
Doctor and nurse	396 (75.86)	16.63 ± 3.52		33.51 ± 3.00	28.75 ± 2.48	
Not received in hospital	14 (2.68)	13.79 ± 4.71		32.57 ± 3.90	27.21 ± 4.77	
Arteriovenous fistulas currently used			0.028		0.397	0.348
The first one	425 (81.42)	16.06 ± 3.86		33.40 ± 3.30	28.74 ± 2.66	
The second or more	97 (18.58)	17.02 ± 3.92		32.92 ± 3.40	28.45 ± 3.08	
Lifespan of the current arteriovenous fistula, years			0.008		0.060	0.215
< 1	127 (24.33)	15.49 ± 4.39		33.20 ± 3.50	28.39 ± 2.63	
[1, 2)	76 (14.56)	16.00 ± 3.51		33.33 ± 2.75	28.68 ± 2.90	
[2, 3)	57 (10.92)	15.65 ± 5.03		32.28 ± 3.46	28.30 ± 3.31	
≥3	262 (50.19)	16.80 ± 3.33		33.58 ± 3.33	28.92 ± 2.61	
Other family members on HD			0.039		0.348	0.195
Yes	65 (12.45)	17.17 ± 3.11		33.38 ± 3.25	28.28 ± 3.07	
No	457 (87.55)	16.11 ± 3.97		33.30 ± 3.34	28.75 ± 2.69	

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Questionnaire

Knowledge, attitude, and practice toward arteriovenous fistulas among uremic patients on hemodialysis

Demographic information	
1. Age, years	_____
2.Gender	a. Male b. Female
3. Marital status	a. Unmarried b. Married c. Divorced/Widowed
4. Residence	a. Rural b. Urban c. Suburban
5. Education	a. Primary school and below b. Middle school c. High school/Technical secondary school d. Junior college/Undergraduate e. Postgraduate and above
6. Work status	a. Employed b. Unemployed/Layoff c. Retired d. Self-employed/Freelance e. Full-time househusband/housewife
7. Monthly per capita income, CNY	a.<2000 b.2000-4999 c.5000-9999 d.≥10000

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8. Medical insurance type	a. Social medical insurance only b. Commercial medical insurance only c. Both social and commercial medical insurance d. No medical insurance
9. Duration of the HD, years	a. < 1 b. [1, 2) c. [2, 3) d. ≥3
10. Participation in relevant education in fistulas care or management	a. Yes b. No
11. Guidance on fistula care received from	a. Doctor b. Nurse c. Doctor and nurse d. Not received in hospital
12. Arteriovenous fistulas currently used	a. The first one b. The second or more
13. Lifespan of the current arteriovenous fistula, years	a. < 1 b. [1, 2) c. [2, 3) d. ≥3
14. Other family members on HD	a. Yes b. No

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Knowledge			
1. For the first hemodialysis, a central venous catheter should be chosen instead of fistulas.	a. Correct	b. Wrong	c. Unclear
2. A correct range of blood pressure and hemoglobin control in blood will help prolong the fistulas' lifespan.	a. Know well	b. Partially know	c. Don't know
3. If anticoagulation medication is not taken on time as prescribed by the doctor, it will affect the lifespan of the fistulas to some extent.	a. Know well	b. Partially know	c. Don't know
4. Excessive compression of the fistulas at the end of hemodialysis can reduce the lifespan of the fistulas to some extent.	a. Know well	b. Partially know	c. Don't know
5. The weight gain of more than 5% of dry weight during the hemodialysis interval will affect the fistulas' lifespan.	a. Know well	b. Partially know	c. Don't know
6. The arm on the side of the fistula should not be used for blood pressure measurement, intravenous infusion and blood collection, heavy lifting, or bearing pressure.	a. Know well	b. Partially know	c. Don't know
7. The vessels of the fistulas should not be used for anything other than hemodialysis and emergency rescue.	a. Know well	b. Partially know	c. Don't know
8. Daily inspection of the arteriovenous fistulas by the patient/families and at least one palpation or auscultation is an effective measure to detect the possible problems in fistulas promptly.	a. Know well	b. Partially know	c. Don't know
9. Keeping the skin on the side of the fistula intact and clean, especially by effectively washing the skin before puncture, helps to prevent local skin infections in the fistulas.	a. Know well	b. Partially know	c. Don't know
10. In case of a fear of or intolerance for punctures, you will inform the healthcare provider to choose another puncture option that suits you.	a. Know well	b. Partially know	c. Don't know
11. For the first hemodialysis, fistulas should be chosen instead of a central venous catheter.	a. Correct	b. Wrong	c. Unclear
Attitude			
1. The lifespan of the arteriovenous fistulas is mainly	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly

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determined by the material used, and there is little influence by how it is cared for.					disagree
2. For the care of arteriovenous fistulas, keeping your blood pressure within the range recommended for your age is important.	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly disagree
3. It is important to use anticoagulants as prescribed by your doctor to keep the fistulas flowing.	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly disagree
4. It is necessary to check your fistulas at least once every day.	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly disagree
5. Is it important to wash the skin around the fistula before each puncture to prevent local infection at the site?	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly disagree
6. It is the patient's responsibility to decide on the puncture site with the nurse for each puncture.	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly disagree
7. As long as it is a one-time success and has no effect on the lifespan of the fistulas, there is no matter how many years of work experience the nurses have, and there is no need to insist on a nurse with many years of work experience to perform the puncture.	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly disagree
8. As long as the place is right, the different ways of puncture (rope ladder cannulation, buttonhole cannulation, area cannulation) have no direct impact on the lifespan of the fistulas.	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly disagree
9. The level of pain experienced by the patient during a puncture is one of the most important criteria for evaluating the puncture skills of nurses.	a. Strongly agree	b. Agree	c. Neutra	d. Disagree	e. Strongly disagree
Practice					

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1. You will contact and inform your healthcare provider if there is redness, warmth, pain, swelling or purulent discharge on the skin around the fistula.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
2. You will contact and inform your healthcare provider if there are any abnormalities during hemodialysis, such as weakness or loss of pulsation in the blood vessels near your fistula.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
3. You would not use the arm on the fistula's side to draw blood or intravenous infusions.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
4. You would not use the arm on the fistula's side to lift heavy objects.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
5. You would not use the arm on the fistula's side to be under pressure; for example, do not use it to measure blood pressure and sleep on it.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
6. After hemodialysis, if you find bleeding at the puncture site of your fistulas on your way home or at home, you can handle it without fear or panic.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient

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Knowledge, Attitudes, and Practices Regarding Arteriovenous Fistulas Among Uremic Patients Undergoing Hemodialysis in China: A Cross-Sectional Study

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Knowledge, Attitudes, and Practices Regarding Arteriovenous Fistulas Among Uremic Patients Undergoing Hemodialysis in China: A Cross-Sectional Study

Running title: KAP toward AVF

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Abstract

Objectives: This study aimed to investigate the relationship between knowledge, attitude, and practice (KAP) regarding arteriovenous fistula (AVF) care in uremic patients undergoing hemodialysis.

Design: A web-based cross-sectional study was conducted among uremic patients receiving hemodialysis at the First Affiliated Hospital of Chongqing Medical University between April 2023 and June 2023.

Setting: The study took place at the First Affiliated Hospital of Chongqing Medical University.

Participants: A total of 522 valid questionnaires were collected from patients undergoing hemodialysis, representing 85.57% of the 610 patients eligible for the study.

Interventions: Pathway analysis was used to assess the interplay among knowledge, attitude, and practice scores related to AVF care in the participants.

Primary and Secondary Outcome Measures: The study evaluated KAP scores (ranging from 0-20, 8-40, and 6-30, respectively) to gauge patients' knowledge, attitude, and practice regarding AVF care.

Results: The findings indicated that patients exhibited adequate knowledge, positive attitudes, and proactive practices toward AVF care. Patients' knowledge directly influenced their attitudes and practices, with attitudes also positively impacting practices. Additionally, knowledge indirectly affected practices through attitudes.

Conclusions: Uremic patients undergoing hemodialysis demonstrated satisfactory understanding, favorable attitudes, and proactive behaviors concerning AVF care. The pathway analysis provided insights into the relationships between knowledge,

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attitude, and practice, illustrating the direct and indirect effects of these factors on each other in the context of AVF care among patients.

Keywords: Knowledge, attitude, practice; uremic; arteriovenous fistula; structural equation modeling; cross-sectional study

Strengths and limitations of this study

1. The study achieved a response rate of 85.57%, with 522 valid questionnaires collected, indicating strong engagement and participation from uremic patients undergoing hemodialysis at the hospital.
2. The utilization of pathway analysis allowed for a detailed assessment of the intricate relationships among knowledge, attitude, and practice scores related to AVF care, providing a comprehensive understanding of how these factors interact in the patient population.
3. The study's findings of patients exhibiting sufficient knowledge, positive attitude, and proactive practice towards AVF care offer actionable insights for healthcare providers to optimize patient education and interventions in hemodialysis settings, potentially improving outcomes and care quality.
4. This was a single-center study, with a sample size that was not sufficiently large, higher KAP scores might result from specific regional educational programs, and those results could not be directly compared to other areas.

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5. It was possible to overlook other barriers to treatment compliance due to initially high KAP scores and the inability to account for issues other than those covered by the questionnaire

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Introduction

The number of patients with end-stage renal disease (ESRD) has been steadily increasing worldwide, resulting in a growing demand for hemodialysis (HD) as a renal replacement therapy [1]. The two main modalities of permanent vascular access for HD are central venous catheters and arteriovenous access, such as grafts and arteriovenous fistula (AVF)[2, 3]. Recently, AVF has been discussed as the gold standard for maintenance HD due to its superior patency and long-term durability[4, 5]. Moreover, it has been associated with lower complication rates, including thrombosis and infection [6], directly affecting the life quality of patients on HD [6]. Although lower complication rates and durability are important factors, better knowledge and practice of self-care methods for fistulas among maintenance HD patients can further improve the lifespan of vascular access [2, 7]. In addition, behavior modification should be based on the pragmatic, patient-centered approach; for shared decision-making, patients need access to relevant information about treatment options and reasonable alternatives to fully comply with their HD plan [1, 3]. Thus, sufficient knowledge and active participation are crucial for effective management.

A KAP study is based on the notion that knowledge positively influences attitude, which in turn influences practice[8]. A few previous studies accessed KAP in different countries, reporting low or inadequate knowledge among HD patients [9, 10]. Liu *et al*. [11] suggested that the knowledge-attitude-behavior model is a valuable tool for the health education of HD patients. A recent meta-analysis revealed that adequate practice of AVF self-care ranged from 59% to 99% in southern Asian countries [10], while AVF self-care behavior was at a low or moderate level in about 69.9% of HD patients in China [12]. Identifying gaps in KAP might help reveal

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barriers to treatment compliance and behavior changes relevant to maintenance HD patients [13]. However, there are only few comprehensive studies with large samples focusing on Chinese patients, and KAP towards AVF is rarely discussed. Therefore, this study aimed to investigate KAP regarding AVF among uremic patients on hemodialysis.

Methods

Patient and public involvement statement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Study design and patients

Uremic patients receiving hemodialysis in the First Affiliated Hospital of Chongqing Medical University between April 2023 and June 2023 were enrolled in this web-based cross-sectional study. Inclusion criteria were the following: 1) age 17-90 years old; 2) diagnosed as uremia according to the GFR <15ml/min 3) regular outpatient HD for more than 1 month. Exclusion criteria were: 1) concurrent peritoneal dialysis; 2) consciousness impairment, cognitive impairment, or severe complications, such as infection, thrombogenesis, stenosis.

The Ethical committee of the First Affiliated Hospital of Chongqing Medical University (K2023-103) approved the study, and informed consent was obtained from all the study participants.

Questionnaires and quality control

The questionnaire was designed based on the previously published studies on KAP in hemodialysis [14-16], expert consensus on the establishment and maintenance of AVF published by China Medical Education Association[13], and Vascular access

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guidelines by Kidney Disease Outcomes Quality Initiative (KDOQI) released in 2019[7]. A small pilot test (n=84) was conducted, and Cronbach's alpha was 0.776, indicating good reliability of the questionnaire. The results of the confirmatory factor analysis (n=522) indicated that the questionnaire has good reliability ((CFI=0.897 (>0.800 is good); RMSEA=0.066 (<0.08 is good); TLI=0.877 (>0.080 is good)).

The final questionnaire comprised 41 items, divided into four sections: demographic information (15 items), knowledge (11 items), attitude (9 items), and practice (6 items). For the knowledge section, scoring varied by item type. Item K1 awarded 2 points for a correct answer and 0 points for incorrect or unclear responses. Items K2–K10 were scored as follows: “know well” = 2 points, “partially know” = 1 point, and “don’t know” = 0 points. Item K11 served as a quality control measure to identify and exclude logically inconsistent responses. The total possible knowledge score ranged from 0 to 20. Item A9 assessed patients’ attitudes toward the correlation between puncture pain and nurses’ skills, a neutral topic without a clear positive or negative tendency, and was therefore not scored. Items A2–A8 were rated on a five-point Likert scale: “strongly agree” = 5 points, “agree” = 4 points, “neutral” = 3 points, “disagree” = 2 points, and “strongly disagree” = 1 point. Item A1 was reverse scored. The total attitude score ranged from 8 to 40. For the practice section, responses were rated from “completely obedient” (5 points) to “never obedient” (1 point), yielding a total practice score ranging from 6 to 30. A score of 70% or more of the maximum score for knowledge, attitude, and practice was considered an indicator of “sufficient knowledge”, “positive attitude,” and “proactive practice”[17].

Participants were recruited through ads posted on social media such as WeChat Messenger. Data were collected through the paper questionnaires given on-site by the nurses in the HD unit when the patient was undergoing HD.

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All data were collected anonymously. If difficulties were encountered during the process of answering, the nurse on duty timely addressed the issue. After data collection was completed, the questionnaires were checked for quality by team members. Obvious logical errors, such as mutually exclusive answers to the quality control items or a pattern of choosing exactly the same answer options, was considered invalid.

Sample size

According to the formula for calculating the sample size in cross-sectional surveys $n = \left(\frac{Z_{1-\alpha/2}}{\delta}\right)^2 \times p \times (1-p)$. In the formula, "n" represents the sample size for each group, "α" represents the type I error, which is typically set at 0.05, $Z_{1-\alpha/2}$=1.96, δ represents the allowable error, typically set at 0.05, and "p" is set at 0.5 (as setting it at 0.5 maximizes the value and ensures a sufficiently large sample size). The calculated sample size "n" is 384. Considering an estimated questionnaire response rate of 80%, the final plan is to collect 480 valid questionnaires.

Statistical analysis

Stata 17.0 (Stata Corporation, College Station, TX, USA) was used for statistical analysis. A confirmatory factor analysis was performed to determine the questionnaire's reliability. Continuous variables were expressed as means and standard deviations (SD), an independent *t*-test was used for comparisons between two groups, and one-way ANOVA was used for comparisons between multiple groups. Categorical variables were expressed as n (%). Pathway analysis was conducted to test the hypothesis that (H1) knowledge directly affects attitude; (H2) knowledge directly affects practice; and (H3) knowledge indirectly affects practice

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through attitude. Multivariate logistic regression analysis was used to determine the factors influencing "sufficient knowledge", "positive attitude," and "proactive practice", classified as achieving the highest possible score of 70%. The selection method for variables is stepwise forward. A two-sided $P < 0.05$ was considered statistically significant.

Patient and public involvement

No patient involved

Results

A total of 610 questionnaires were collected, of which 88 were excluded due to obvious logical errors in the quality control item (K11) or patterns of answering by choosing the same option, resulting in 522 valid questionnaires (85.57%). The majority of participants were male (55.56%), aged 46-60 years old (43.10%), and married (83.14%). More than half of the participants (55.36%) received HD for over 3 years, and 81.42% still used their first AVF **(Table S1)**.

The knowledge, attitude, and practice scores were 16.24 ± 3.88 (possible range: 0-20), 33.31 ± 3.32 (possible range: 8-40), and 28.69 ± 2.74 (possible range: 6-30), respectively. The knowledge item with the highest rate of "know well" answers (91.95%) was (K6) stating that the arm on the side of the fistulas should not be used for blood pressure measurement, intravenous infusion, intravenous blood collection, heavy lifting, and bearing pressure. The item with the lowest rate of "know well" answers (54.60%) was "(K3) stating that if anticoagulation medication is not taken on time as prescribed by the doctor, it will affect the lifespan of the fistulas" **(Table 1)**. Patients participated in relevant education in fistulas care or management ($P < 0.001$), and those with other family members on HD had higher knowledge scores.

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Table 1. Responses to the questions in the knowledge dimension

Items	Correct, n (%)	Wrong, n (%)	Unclear, n (%)
1. For the first hemodialysis, a central venous catheter should be chosen instead of fistulas.	302 (57.85)	96 (18.39)	124 (23.75)
	Know well, n (%)	Partially know, n (%)	Don't know, n (%)
2. A correct range of blood pressure and hemoglobin control in blood will help prolong the fistulas' lifespan.	313 (59.96)	140 (26.82)	69 (13.22)
3. If anticoagulation medication is not taken on time as prescribed by the doctor, it will affect the lifespan of the fistulas to some extent.	285 (54.6)	124 (23.75)	113 (21.65)
4. Excessive compression of the fistulas at the end of hemodialysis can reduce the lifespan of the fistulas to some extent.	407 (77.97)	80 (15.33)	35 (6.7)
5. The weight gain of more than 5% of dry weight during the hemodialysis interval will affect the fistulas' lifespan.	331 (63.41)	108 (20.69)	83 (15.9)
6. The arm on the side of the fistula should not be used for blood pressure measurement, intravenous infusion and blood collection, heavy lifting, or bearing pressure.	480 (91.95)	38 (7.28)	4 (0.77)
7. The vessels of the fistulas should not be used for anything other than hemodialysis and emergency rescue.	455 (87.16)	56 (10.73)	11 (2.11)
8. Daily inspection of the arteriovenous fistulas by the patient/families and at least one palpation or auscultation is an effective measure to detect the possible problems in fistulas promptly.	432 (82.76)	72 (13.79)	18 (3.45)
9. Keeping the skin on the side of the fistula intact and clean, especially by effectively washing the skin before puncture, helps to prevent local skin infections in the fistulas.	456 (87.36)	53 (10.15)	13 (2.49)
10. In case of a fear of or intolerance for punctures, you will inform the healthcare provider to choose another puncture option that suits you.	398 (76.25)	87 (16.67)	37 (7.09)

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For the attitude items, the majority of participants (84.87%) strongly agreed that "it is important to wash the skin around the fistula before each puncture to prevent local infection" (A5), while the item with the highest rate of disagreement was that "as long as the place is right, the different ways of puncture have no direct impact on the lifespan of the fistulas" (A8), with 28.16% of participants strongly disagreeing with this notion. Items on the subject of the attitude towards nurses, such as "There is no need to insist on a nurse with many years of work experience to perform the puncture" (A7), and "Level of pain during puncture is one of the most important criteria for evaluating the puncture skills of nurses" (A9) had an almost equal number of participants strongly agreeing and strongly disagreeing (40.04% vs. 22.8% for A7; 34.87% vs. 25.1% for A9) **(Table 2)**.

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Table 2. Responses to the questions in the attitude dimension

Items	Strongly agree, n (%)	Agree, n (%)	Neutral, n (%)	Disagree, n (%)	Strongly disagree, n (%)
1. The lifespan of the arteriovenous fistulas is mainly determined by the material used, and there is little influence by how it is cared for.	142 (27.2)	49 (9.39)	60 (11.49)	79 (15.13)	192 (36.78)
2. For the care of arteriovenous fistulas, keeping your blood pressure within the range recommended for your age is important.	407 (77.97)	87 (16.67)	21 (4.02)	1 (0.19)	6 (1.15)
3. It is important to use anticoagulants as prescribed by your doctor to keep the fistulas flowing.	375 (71.84)	95 (18.2)	50 (9.58)	1 (0.19)	1 (0.19)
4. It is necessary to check your fistulas at least once every day.	416 (79.69)	65 (12.45)	21 (4.02)	12 (2.3)	8 (1.53)
5. Is it important to wash the skin around the fistula before each puncture to prevent local infection at the site?	443 (84.87)	58 (11.11)	19 (3.64)	1 (0.19)	1 (0.19)
6. It is the patient's responsibility to decide on the puncture site with the nurse for each puncture.	389 (74.52)	83 (15.9)	39 (7.47)	7 (1.34)	4 (0.77)
7. As long as it is a one-time success and has no effect on the lifespan of the fistulas, there is no matter how many years of work experience the nurses have, and there is no need to insist on a nurse with many years of work experience to perform the puncture.	209 (40.04)	104 (19.92)	55 (10.54)	35 (6.7)	119 (22.8)
8. As long as the place is right, the different ways of puncture (rope ladder cannulation, buttonhole cannulation, area cannulation) have no direct impact on the lifespan of the fistulas.	186 (35.63)	68 (13.03)	70 (13.41)	51 (9.77)	147 (28.16)
9. The level of pain experienced by the patient during a puncture is one of the most important criteria for evaluating the puncture skills of nurses.	182 (34.87)	98 (18.77)	69 (13.22)	42 (8.05)	131 (25.1)

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The highest compliance rate of 88.12% for the practice items was linked with avoiding pressure or strain on the fistula side (P5). The lowest compliance rate of 76.44% was found for the following item: “If you find bleeding at the puncture site of fistulas on your way home or at home, you can handle it without fear or panic” **(Table 3)**. The practice score was higher in patients older than 60 years ($P = 0.004$) and those who had participated in relevant education in fistulas care or management ($P < 0.015$). The pathway analysis was performed to test the hypothesis regarding the effect of knowledge on practice and attitude **(Figure 1)**. Patients' knowledge directly affected their attitude ($\beta = 0.29$, 95%CI: 0.22-0.35, $P < 0.001$) and practice ($\beta = 0.20$, 95%CI: 0.14-0.26, $P < 0.001$) towards AVF. Patients' attitudes toward AVF had a direct and positive effect on practice ($\beta = 0.25$, 95%CI: 0.19-0.32, $P < 0.001$). Knowledge also indirectly affected practice through attitude ($\beta = 0.07$, 95%CI: 0.05-0.10, $P < 0.001$) **(Table 4)**.

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Table 3. Responses to the questions in the practice dimension

Items	Completely obedient, n (%)	Relatively obedient, n (%)	Moderately, n (%)	Relatively not obedient, n (%)	Never obedient, n (%)
1. You will contact and inform your healthcare provider if there is redness, warmth, pain, swelling or purulent discharge on the skin around the fistula.	454 (86.97)	45 (8.62)	21 (4.02)	0 (0)	2 (0.38)
2. You will contact and inform your healthcare provider if there are any abnormalities during hemodialysis, such as weakness or loss of pulsation in the blood vessels near your fistula.	452 (86.59)	50 (9.58)	18 (3.45)	0 (0)	2 (0.38)
3. You would not use the arm on the fistula's side to draw blood or intravenous infusions.	458 (87.74)	41 (7.85)	16 (3.07)	2 (0.38)	5 (0.96)
4. You would not use the arm on the fistula's side to lift heavy objects.	452 (86.59)	47 (9)	17 (3.26)	2 (0.38)	4 (0.77)
5. You would not use the arm on the fistula's side to be under pressure; for example, do not use it to measure blood pressure and sleep on it.	460 (88.12)	32 (6.13)	23 (4.41)	3 (0.57)	4 (0.77)
6. After hemodialysis, if you find bleeding at the puncture site of your fistulas on your way home or at home, you can handle it without fear or panic.	399 (76.44)	72 (13.79)	39 (7.47)	8 (1.53)	4 (0.77)

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Table 4. The model paths of SEM

Model paths	Direct Effect		Indirect effect	
	β (95% CI)	P	β (95% CI)	P
K → A	0.29 (0.22, 0.35)	< 0.001	-	-
A → P	0.25 (0.19, 0.32)	< 0.001	-	-
K → P	0.20 (0.14, 0.26)	< 0.001	0.07 (0.05, 0.10)	< 0.001

Multivariate logistic regression analysis showed that longer duration of HD was associated with good knowledge ([1,2] years OR=2.245, 95%CI: 1.08-4.64, P=0.029; [2,3] years OR=2.188, 95%CI: 1.00-4.77, P=0.049; >3 years OR=3.639, 95%CI: 2.13-6.20, P<0.001), while absence of medical insurance (OR=0.163, 95%CI: 0.02-0.98, P=0.048), not participating in educational interventions (OR=0.235, 95%CI: 0.10-0.54, P=0.001) and receiving guidance from nurse as compared to the doctor (OR=0.328, 95%CI: 0.17-0.61, P=0.001) were associated with insufficient knowledge (**Table 5**).

As demonstrated in **Table 6**, only higher knowledge scores were associated with positive attitude (OR=1.254, 95%CI: 1.16±1.34, P<0.001).

Higher knowledge scores were also associated with proactive practice (OR=1.226, 95%CI: 1.11-1.35, P<0.001), along with older age (OR=8.617, 95%CI: 1.07-69.2, P=0.043), while not receiving guidance on fistula care was associated with inactive practice (OR=0.124, 95%CI: 0.02-0.58, P=0.009) (**Table 7**).

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Table 5 Factors influencing good knowledge

	OR	95%CI	P
Medical insurance type			
Social medical insurance only	REF		
Commercial medical insurance only	-	-	-
Both social and commercial medical insurance	-	-	-
No medical insurance	0.163	0.02-0.98	0.048
Duration of the HD, years			
< 1			
[1, 2)	2.245	1.08-4.64	0.029
[2, 3)	2.188	1.00-4.77	0.049
≥3	3.639	2.13-6.20	<0.001
Participation in relevant education in fistulas care or management			
Yes			
No	0.235	0.10-0.54	0.001
Guidance on fistula care received from			
Doctor			
Nurse	0.328	0.17-0.61	0.001
Doctor and nurse	-	-	-
Not received in hospital	-	-	-

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Table 6 Factors influencing positive attitude

	OR	95%CI	P
Knowledge	1.254	1.16-1.34	<0.001

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Table 7 Factors influencing proactive practice

	OR	95%CI	P
Knowledge	1.226	1.11-1.35	<0.001
Age, years			
18-45	REF		
46-60	-	-	-
> 60	8.617	1.07-69.2	0.043
Guidance on fistula care received from			
Doctor	REF		
Nurse	-	-	-
Doctor and nurse	-	-	-
Not received in hospital	0.124	0.02-0.58	0.009

Discussion

The present study demonstrated that patients on HD had sufficient knowledge, positive attitude, and proactive practice regarding AVF. Knowledge directly and positively affected attitude and practice, while attitude also indirectly affected knowledge and practice.

Previous KAP studies conducted among HD patients with AVF reported mixed results that seem region-specific, indicating that educational programs might result in better practice; however, in some cases, attitude influenced practice to the same or even higher degree [9, 18]. The population in the present study was characterized by sufficient knowledge, positive attitude, and proactive practice, which seems promising compared to other studies conducted in China [11, 12]. Knowledge and practice scores were significantly higher in those who participated in relevant education programs, especially knowledge. The logistic regression analysis confirmed that longer duration of HD correlated with better knowledge, whereas the absence of medical insurance, lack of participation in educational interventions, and receiving guidance from nurses rather than doctors were linked to lower knowledge levels.

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Importantly, higher knowledge scores were associated with improved attitudes, emphasizing the role of education in shaping perceptions. Furthermore, better practice scores were tied to higher knowledge and older age, while a lack of guidance on fistula care emerged as a significant barrier to optimal practice. These findings underscore the importance of targeted education and comprehensive care strategies to enhance patient outcomes. However, according to pathway analysis, knowledge had only a weak direct effect on attitude and practice, suggesting an influence of other factors. Previously discussed major factors associated with KAP in HD patients include educational status, gender, age, time of hemodialysis start, and guidance of healthcare personnel [9, 10, 12].

Present study found that the most noticeable difference was among the different types of medical insurance. Although participants with commercial insurance demonstrated higher knowledge and practice scores compared to those with social medical insurance, the score in the practice dimension was significantly higher in participants with social, medical insurance compared to commercial. This might be partly explained by the fact that many participants with social medical insurance were retired, thus having more free time to practice self-care. In addition, the population covered by this study included some categories with higher risk of AVF failure, in need of regular surveillance and improved self-care to minimize this risk [19]. Almost one third of participants (32.95%) were older than 60 and 44.44% of participants were women which are significantly associated with the occurrence of AVF failure in previous reports [20, 21]. Diabetes mellitus, another risk factor for poor adaptive remodeling and AVF dysfunction [22, 23] was diagnosed in 28.35% of participants in the present study, which might contribute to the better attention of HD patients to educational interventions and guidance and eventually to higher KAP scores.

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With generally high scores, all knowledge, attitude, and practice questions related to the usage of the arm on the side of the fistula (washing skin, avoiding blood pressure measuring and drawing blood, avoiding unnecessary strain, etc.) were answered with high correctness, which is consistent with the previous study reported by Ozen *et al.* [16]. This confirms that patients can remember instructions repeated continuously by doctors and nurses. However, among the most important findings of this study is the negative attitude and lack of trust in the nurse-patient relationship. Those participants who received guidance from doctors had significantly higher levels of knowledge, better attitude, and acceptable practice than those who received guidance from nurses. At the same time, more than half of the participants insisted that only very experienced nurses should perform the puncture (question A7), and the pain level during puncture is one of the most important criteria for evaluating the puncture skills of nurses (question A9). Cannulation of AVF is technically challenging and demands special education from nurses [5, 24]. The process might be painful for patients, affecting their relationship with the nurse [25]. Conversely, it) might influence the acceptance of guidance, making patients trust doctors more than nurses. Structured training of clinical personnel could solve part of these issues, but it is impossible to make cannulation painless in 100%. Consequently, expecting nurses to be fully responsible for building trust only puts more strain on them. Instead, discussing the expectations for the cannulation process with patients in more detail might be beneficial.

Questioning different methods of puncture (rope-ladder cannulation, buttonhole cannulation, area cannulation) was also challenging, as 35.63% of participants strongly agreed that it had no direct impact, while 28.16% strongly disagreed with that and other results. Although buttonhole cannulation has some benefits compared to

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other options, it increases the risk of infection, while rope-ladder cannulation is challenging to implement, resulting in the limited choice of cannulator in daily practice [26]. This question is still under discussion, which might influence the attitude of patients. However, the absence of a strong opinion might also result from the lack of specific knowledge, suggesting that additional education guidance is needed for this point. Another issue discussed is the regular use of anticoagulants, 28.16% participants remain unclear about the regular usage of Anticoagulants. Anticoagulation therapy was previously reported to be associated with lower complication and mortality rates in patients with AVF and AVG[27, 28]; however, this protective effect was not confirmed by other studies [2, 20]. This discrepancy may be the source of confusion among patients and healthcare providers, who obtain information from different sources.

The present study has several limitations. First, this was a single-center study with a sample size that was not sufficiently large; higher KAP scores might result from specific regional educational programs, and those results could not be directly compared to other areas. Second, it is possible that other barriers to treatment compliance were overlooked due to initially high KAP scores and the inability to account for issues beyond those covered by the questionnaire. Accordingly, new questions should be introduced to further analyze the identified factors, especially in practice. Finally, potential social expectation bias should be considered, as the results of the questionnaire were self-reported, which may have led to bias in the analysis. In addition, while the questionnaire was developed based on prior studies and expert experience, a comprehensive evaluation of its validity, such as content validity, construct validity, or criterion validity, was not conducted. Future studies should incorporate formal validity testing to enhance the robustness of the questionnaire. In

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conclusion, the study population exhibited sufficient knowledge, a positive attitude, and proactive practices. The findings revealed that knowledge has a direct and positive effect on both attitude and practice, while attitude also has an indirect effect on knowledge and practice. Additionally, beyond financial factors, new barriers were identified in the attitude dimension, specifically the negative attitudes and lack of trust in the nurse-patient relationship concerning the abilities of puncture nurses.

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Declarations

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Author's Contributions

Dongmei Liu carried out the studies, participantsed in collecting data, and drafted the manuscript. Sifeng Huang and Yuhong Liu performed the statistical analysis and participated in its design. Xianli Liu participated in acquisition, analysis and draft the manuscript. All authors read and approved the final manuscript. Dongmei Liu is the guarantor.

Data availability statement

All data generated or analysed during this study are included in this published article.

Ethics approval and consent to participate

The Ethical committee of the First Affiliated Hospital of Chongqing Medical University (K2023-103) approved the study, and informed consent was obtained from all the study participants. I confirm that all methods were performed in accordance with the relevant guidelines. All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

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Figure Legend

Figure 1. Results of the structural equation modeling (SEM).

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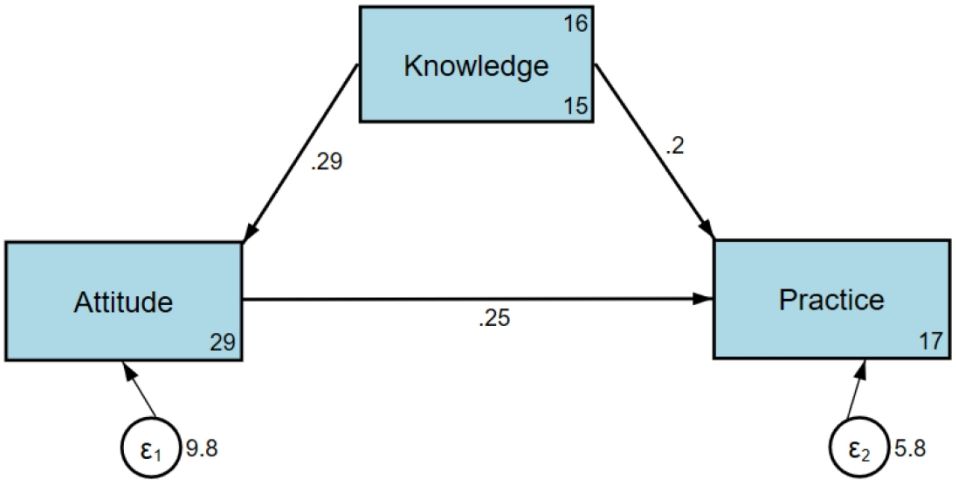

Figure 1. Results of the structural equation modeling (SEM).

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Table S1. Demographic characteristics of study participants and their Knowledge, Attitude, and Practice scores

Variables	N (%)	Knowledge score		Attitudes score		Practice score	
		Mean ± SD	P*	Mean ± SD	P	Mean ± SD	P
Total	522	16.24 ± 3.88		33.31 ± 3.32		28.69 ± 2.74	
Age, years			0.385		0.329		0.004
18-45	125 (23.95)	15.90 ± 3.73		33.48 ± 3.76		28.29 ± 3.58	
46-60	225 (43.10)	16.20 ± 4.13		33.24 ± 3.32		28.48 ± 2.78	
> 60	172 (32.95)	16.53 ± 3.65		33.28 ± 2.98		29.25 ± 1.76	
Gender			0.753		0.196		0.276
Male	290 (55.56)	16.19 ± 3.80		33.24 ± 3.12		28.81 ± 2.59	
Female	232 (44.44)	16.30 ± 3.99		33.40 ± 3.57		28.54 ± 2.92	
Marital status			0.112		0.038		0.090
Married	434 (83.14)	16.38 ± 3.90		33.35 ± 3.31		28.76 ± 2.64	
Unmarried	49 (9.39)	15.92 ± 3.36		33.14 ± 3.08		27.88 ± 3.69	
Divorced/Widowed	39 (7.47)	15.08 ± 4.13		33.08 ± 3.75		28.90 ± 2.36	
Residence			0.615		0.843		0.014
Urban	381 (72.99)	16.26 ± 3.86		33.30 ± 3.24		28.90 ± 2.60	
Rural	110 (21.07)	16.34 ± 4.00		33.26 ± 3.64		28.05 ± 3.13	

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Suburban	31 (5.94)	15.58 ± 3.82		33.65 ± 3.22		28.39 ± 2.69	
Education			0.766		0.288		0.267
Primary school and below	109 (20.88)	15.97 ± 4.25		33.28 ± 3.42		28.72 ± 2.65	
Middle school	161 (30.84)	16.22 ± 3.83		33.35 ± 3.46		28.52 ± 3.12	
High school/Technical secondary school	134 (25.67)	16.36 ± 3.85		32.90 ± 3.28		28.94 ± 2.54	
Junior college/Undergraduate	113 (21.65)	16.44 ± 3.65		33.81 ± 2.94		28.71 ± 2.37	
Postgraduate and above	5 (0.96)	14.60 ± 4.34		32.20 ± 5.26		26.40 ± 4.39	
Work status			0.336		0.186		0.002
Unemployed/Layoff	147 (28.16)	16.46 ± 3.73		33.54 ± 3.23		28.61 ± 2.58	
Employed	60 (11.49)	16.38 ± 3.66		33.43 ± 3.40		28.12 ± 3.28	
Retired	242 (46.36)	16.27 ± 3.82		33.20 ± 3.13		29.01 ± 2.17	
Self-employed/Freelance	48 (9.20)	16.00 ± 4.41		33.02 ± 3.56		28.94 ± 2.34	
Full-time househusband/housewife	25 (4.79)	14.72 ± 4.70		33.28 ± 4.88		26.96 ± 5.81	
Monthly per capita income, CNY			0.300		0.814		0.996
<2000	182 (34.87)	15.92 ± 4.03		33.30 ± 3.55		28.73 ± 2.87	
2000-4999	219 (41.95)	16.47 ± 3.78		33.21 ± 3.06		28.67 ± 2.68	

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5000-9999	89 (17.05)	16.57 ± 3.79		33.42 ± 3.54	28.66 ± 2.72	
≥10000	32 (6.13)	15.53 ± 3.98		33.78 ± 3.13	28.69 ± 2.71	
Medical insurance type			<0.001		<0.001	<0.001
Social medical insurance only	491 (94.06)	16.35 ± 3.69		33.43 ± 3.16	28.75 ± 2.52	
Commercial medical insurance only	2 (0.38)	17.50 ± 0.71		36.00 ± 0.00	24.00 ± 8.49	
Both social and commercial medical insurance	22 (4.21)	16.18 ± 3.96		31.73 ± 3.33	29.50 ± 1.57	
No medical insurance	7 (1.34)	8.14 ± 7.97		28.86 ± 8.40	23.57 ± 8.66	
Duration of the HD, years			<0.001		0.044	0.014
< 1	109 (20.88)	15.10 ± 4.57		33.16 ± 3.59	28.16 ± 2.85	
[1, 2)	70 (13.41)	15.77 ± 4.15		33.03 ± 3.71	28.17 ± 4.08	
[2, 3)	54 (10.34)	15.81 ± 4.54		32.80 ± 3.64	28.74 ± 2.65	
≥3	289 (55.36)	16.86 ± 3.25		33.53 ± 3.04	29.01 ± 2.25	
Participation in relevant education in fistulas care or management			<0.001		0.006	0.015
Yes	493 (94.44)	16.43 ± 3.72		33.38 ± 3.28	28.76 ± 2.66	
No	29 (5.56)	12.97 ± 5.04		32.20 ± 3.84	27.48 ± 3.75	

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Guidance on fistula care received from			<0.001	0.024		0.002
Doctor	55 (10.54)	16.27 ± 3.52		33.42 ± 3.29	29.51 ± 1.87	
Nurse	57 (10.92)	14.05 ± 5.31		32.04 ± 4.80	27.82 ± 4.00	
Doctor and nurse	396 (75.86)	16.63 ± 3.52		33.51 ± 3.00	28.75 ± 2.48	
Not received in hospital	14 (2.68)	13.79 ± 4.71		32.57 ± 3.90	27.21 ± 4.77	
Arteriovenous fistulas currently used			0.028	0.127		0.348
The first one	425 (81.42)	16.06 ± 3.86		33.40 ± 3.30	28.74 ± 2.66	
The second or more	97 (18.58)	17.02 ± 3.92		32.92 ± 3.40	28.45 ± 3.08	
Lifespan of the current arteriovenous fistula, years			0.008	0.050		0.215
< 1	127 (24.33)	15.49 ± 4.39		33.20 ± 3.50	28.39 ± 2.63	
[1, 2)	76 (14.56)	16.00 ± 3.51		33.33 ± 2.75	28.68 ± 2.90	
[2, 3)	57 (10.92)	15.65 ± 5.03		32.28 ± 3.46	28.30 ± 3.31	
≥3	262 (50.19)	16.80 ± 3.33		33.58 ± 3.33	28.92 ± 2.61	
Other family members on HD			0.039	0.838		0.195
Yes	65 (12.45)	17.17 ± 3.11		33.38 ± 3.25	28.28 ± 3.07	
No	457 (87.55)	16.11 ±		33.30 ± 3.34	28.75 ± 2.69	

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	3.97

*Independent t-test was used for comparisons between two groups, and one-way ANOVA was used for comparisons between multiple groups

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Questionnaire

Knowledge, attitude, and practice toward arteriovenous fistulas among uremic patients on hemodialysis

Demographic information	
1. Age, years	_____
2.Gender	a. Male b. Female
3. Marital status	a. Unmarried b. Married c. Divorced/Widowed
4. Residence	a. Rural b. Urban c. Suburban
5. Education	a. Primary school and below b. Middle school c. High school/Technical secondary school d. Junior college/Undergraduate e. Postgraduate and above
6. Work status	a. Employed b. Unemployed/Layoff c. Retired d. Self-employed/Freelance e. Full-time househusband/housewife
7. Monthly per capita income, CNY	a.<2000 b.2000-4999 c.5000-9999 d.≥10000

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8. Medical insurance type	a. Social medical insurance only b. Commercial medical insurance only c. Both social and commercial medical insurance d. No medical insurance
9. Duration of the HD, years	a. < 1 b. [1, 2) c. [2, 3) d. ≥3
10. Participation in relevant education in fistulas care or management	a. Yes b. No
11. Guidance on fistula care received from	a. Doctor b. Nurse c. Doctor and nurse d. Not received in hospital
12. Arteriovenous fistulas currently used	a. The first one b. The second or more
13. Lifespan of the current arteriovenous fistula, years	a. < 1 b. [1, 2) c. [2, 3) d. ≥3
14. Other family members on HD	a. Yes b. No

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Knowledge			
1. For the first hemodialysis, a central venous catheter should be chosen instead of fistulas.	a. Correct	b. Wrong	c. Unclear
2. A correct range of blood pressure and hemoglobin control in blood will help prolong the fistulas' lifespan.	a. Know well	b. Partially know	c. Don't know
3. If anticoagulation medication is not taken on time as prescribed by the doctor, it will affect the lifespan of the fistulas to some extent.	a. Know well	b. Partially know	c. Don't know
4. Excessive compression of the fistulas at the end of hemodialysis can reduce the lifespan of the fistulas to some extent.	a. Know well	b. Partially know	c. Don't know
5. The weight gain of more than 5% of dry weight during the hemodialysis interval will affect the fistulas' lifespan.	a. Know well	b. Partially know	c. Don't know
6. The arm on the side of the fistula should not be used for blood pressure measurement, intravenous infusion and blood collection, heavy lifting, or bearing pressure.	a. Know well	b. Partially know	c. Don't know
7. The vessels of the fistulas should not be used for anything other than hemodialysis and emergency rescue.	a. Know well	b. Partially know	c. Don't know
8. Daily inspection of the arteriovenous fistulas by the patient/families and at least one palpation or auscultation is an effective measure to detect the possible problems in fistulas promptly.	a. Know well	b. Partially know	c. Don't know
9. Keeping the skin on the side of the fistula intact and clean, especially by effectively washing the skin before puncture, helps to prevent local skin infections in the fistulas.	a. Know well	b. Partially know	c. Don't know
10. In case of a fear of or intolerance for punctures, you will inform the healthcare provider to choose another puncture option that suits you.	a. Know well	b. Partially know	c. Don't know
11. For the first hemodialysis, fistulas should be chosen instead of a central venous catheter.	a. Correct	b. Wrong	c. Unclear

Attitude					
1. The lifespan of the arteriovenous fistulas is mainly	a. Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly

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determined by the material used, and there is little influence by how it is cared for.	agree					disagree
2. For the care of arteriovenous fistulas, keeping your blood pressure within the range recommended for your age is important.	a. agree	Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly disagree
3. It is important to use anticoagulants as prescribed by your doctor to keep the fistulas flowing.	a. agree	Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly disagree
4. It is necessary to check your fistulas at least once every day.	a. agree	Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly disagree
5. Is it important to wash the skin around the fistula before each puncture to prevent local infection at the site?	a. agree	Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly disagree
6. It is the patient's responsibility to decide on the puncture site with the nurse for each puncture.	a. agree	Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly disagree
7. As long as it is a one-time success and has no effect on the lifespan of the fistulas, there is no matter how many years of work experience the nurses have, and there is no need to insist on a nurse with many years of work experience to perform the puncture.	a. agree	Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly disagree
8. As long as the place is right, the different ways of puncture (rope ladder cannulation, buttonhole cannulation, area cannulation) have no direct impact on the lifespan of the fistulas.	a. agree	Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly disagree
9. The level of pain experienced by the patient during a puncture is one of the most important criteria for evaluating the puncture skills of nurses.	a. agree	Strongly	b. Agree	c. Neutral	d. Disagree	e. Strongly disagree
Practice						

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1. You will contact and inform your healthcare provider if there is redness, warmth, pain, swelling or purulent discharge on the skin around the fistula.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
2. You will contact and inform your healthcare provider if there are any abnormalities during hemodialysis, such as weakness or loss of pulsation in the blood vessels near your fistula.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
3. You would not use the arm on the fistula's side to draw blood or intravenous infusions.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
4. You would not use the arm on the fistula's side to lift heavy objects.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
5. You would not use the arm on the fistula's side to be under pressure; for example, do not use it to measure blood pressure and sleep on it.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient
6. After hemodialysis, if you find bleeding at the puncture site of your fistulas on your way home or at home, you can handle it without fear or panic.	a. Completely obedient	b. Relatively obedient	c. Moderately	d. Relatively not obedient	e. Never obedient

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