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Knowledge, attitude and practice towards multiple myeloma among medical staff in Enshi Region

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A study in the Enshi Region between Sept-Nov 2023 assessed medical staff's knowledge, attitude, and practice regarding multiple myeloma. The disease significantly impacts physical health, quality of life, and mental well-being. Medical professionals play crucial roles in its prevention and treatment. Analysis used Pearson's correlation, logistic regression, and structural equation model (SEM). A total of 229 valid questionnaires were collected, with 68.6% of female participants, and 42.4% aged 31–40 years. The knowledge, attitude, and practice scores were 36.27 ± 4.97 (range: 25–53), 42.40 ± 5.78 (range: 30–56), and 29.71 ± 6.41 (range: 7–35), respectively. Pearson's correlation analysis revealed significantly positive correlation between knowledge and attitude. Moreover, in both univariate and multivariate analysis, knowledge showed positive association with attitude. Several demographic factors independently associated with KAP scores were identified, including education level, age, occupation type, and frequency of academic conferences or medical education activities per year. SEM further indicated direct association between attitude and practice (β = 0.320, 95%CI: 0.189–0.452, *P* < 0.001). In the Enshi Region, medical staff displayed moderate knowledge, neutral attitudes, and proactive practices towards multiple myeloma. Moreover, significant positive association was found between knowledge and attitude. These discoveries provided valuable perspectives to the development of healthcare interventions and educational initiatives for improving medical staff's knowledge, attitudes, and practices.

Keywords Knowledge, Attitude, Practice, Medical staff, Multiple myeloma, Enshi Region

Multiple myeloma refers to the neoplastic proliferation of monoclonal plasma cells in the bone marrow, featured by excessive production and destructive growth of abnormal cells[1]. This disease has considerable health impacts on individuals, manifesting as compromised immune function, bone lesions, anemia, and impaired renal function[2,3]. Reportedly, its global incidence reached an increment of 126% between 1990 and 2016, with age-standardized rate of 1.78% in 2020[4,5]. Elevated incidence and mortality were observed in developed countries, especially in Australia, New Zealand and norther America[4]. In China, the estimated age-standardized incidence and mortality rates reached 0.93 and 0.67 per 100,000 in 2019, respectively[6]. Given the escalating prevalence and healthcare burden associated with multiple myeloma, there is a pressing need for effective prevention and treatment strategies to address this public health challenge.

The impacts of multiple myeloma on patients extend beyond physical health to life quality and mental well-being. To be specific, multiple myeloma often causes pain, fatigue, and impaired physical function, which significantly reduce patients' overall quality of life[7]. Moreover, dealing with chronic and potentially life-threatening illness can lead to mental health challenges[8]. Therefore, early diagnosis, timely intervention, and comprehensive management are crucial to improving the prognosis and enhancing the well-being of multiple myeloma patients. Medical staff, as frontline healthcare providers, play a critical role in preventing, treating, and managing multiple myeloma. By offering accurate information, timely interventions, and personalized care, medical staff can empower patients to make informed decisions and actively participate in their treatment. Additionally, medical staff's mental support and empathy can significantly impact patients' mental health, fostering positive outlook and effective coping mechanisms.

The knowledge, attitude, and practice (KAP) framework provides a comprehensive approach for examining medical staff's understanding, attitudes, and behaviors concerning multiple myeloma. By assessing their knowledge, attitudes towards prevention and treatment, and actual implementation of recommended practices, this framework yields valuable insights that can guide targeted interventions and educational initiatives, and

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ultimately promote the overall well-being of patients. For example, in a mixed methods study conducted in European countries, 34% of hematologists and 69% of nurses had suboptimal knowledge regarding the mechanisms of action of new agents for multiple myeloma[9]. In addition, a study from Australia indicated that hematologists recognized the importance of physical activity for multiple myeloma, but lack confidence in recommending specific exercises and determining the appropriateness for managing specific disease complications[10]. Despite the potential clinical benefits from KAP studies, no research was available to explore the KAP scores among medical staff in China, which hampered the long-term development of multiple myeloma management in healthcare units.

Based on a cross-sectional study in Enshi Region, we aimed to investigate the KAP of medical staff regarding multiple myeloma and the influential factors of KAP. The findings of this study could identify areas for improvement and guide the development of targeted interventions to enhance the role of medical staff in the prevention and treatment of multiple myeloma.

Methods

Study design and participants

This cross-sectional study recruited medical staff at hospitals in Enshi Region between Sept 2023 and Nov 2023. Ethical approval was obtained from The Committee on Biomedical Research Ethics of the Central Hospital of Enshi Tujia and Miao Autonomous Prefecture, and informed consent was obtained from participants.

Inclusion criteria encompassed medical staff employed in medical, nursing, and medical technology professions at hospitals in Enshi Region. Exclusion criteria were as follows: (1) questionnaires with response times below 114 s (with a minimum of 2 s for single-choice questions and 3 s for multiple-choice questions) or exceeding 1800 s; (2) incomplete responses; (3) and participants who were unable to provide informed consent.

Sample size determination

The sample size was determined based on the total population of healthcare professionals in the Enshi region engaged in disciplines directly or indirectly related to multiple myeloma. This region comprises eight counties and cities with 19 hospitals classified as secondary level or higher, including two tertiary hospitals and one private hospital. The number of hematology specialists is fewer than 100. However, when accounting for professionals in nephrology, orthopedics, traumatology, and other related fields, the estimated population of medical staff involved in myeloma-related care is approximately 300.

Questionnaire and quality control

The questionnaire employed in this study was developed following relevant literature[4,11,12] and *The guidelines for the diagnosis and management of multiple myeloma in China (2022 revision)*[13]. Refinements were made based on feedback from 3 senior hematologists. A pilot study involving 50 participants was conducted, and the Cronbach's α coefficient of 0.757 demonstrated acceptable internal consistency[14]. The Kaiser-Meyer-Olkin (KMO) measure was 0.828, indicating strong validity for factor analysis.

The final Chinese version of the questionnaire consisted of four dimensions: demographic characteristics, knowledge, attitude, and practice. The demographic dimension included 10 items, covering gender, age, marital status, education level, profession type, occupation, professional title, type of medical institution, work experience duration, and frequency of academic conferences or medical education activities per year.

The knowledge dimension comprised a total of 13 questions. It consisted of two single-choice questions (K1 and K7), each scoring 1 point for a correct answer and 0 points for an unclear or incorrect answer. Additionally, there were eleven multiple-choice questions (K2-K6, K8-K13), with a perfect score of 5 points for all correct choices, 3 points for partially correct choices, and 0 points for any incorrect choices. The total score ranged from 0 to 57. The attitude dimension consisted of 12 questions, all measured using a five-point Likert scale, ranging from strongly agree (5 points) to strongly disagree (1 point). The 12th question was an open-ended question and was not scored. The total score ranged from 11 to 55. The practice dimension included 7 questions, also measured using a five-point Likert scale, with all items having positive scores ranging from strongly agree (5 points) to strongly disagree (1 point). The total score ranged from 7 to 35.

To assess the difficulty level of questionnaire items, the degree of difficulty was calculated as the percentage of participants who answer the item correctly. The degree of difficulty index ranges from 0 to 1, where higher values indicate easier questions[15]. Items with a difficulty level from 0 to 0.3 are classified as difficult; those from 0.3 to 0.8 are considered desirable; and items exceeding 0.8 are classified as easy[15]. The indicator provides valuable insights into the appropriateness of item difficulty levels within a questionnaire.

To evaluate the levels of knowledge, attitude, and practice (KAP), cut-off values of 60% and 80% of the total score were employed[16]. Participants were categorized into three levels based on their scores in each KAP dimension: good knowledge, positive attitude, and proactive practice (80–100%); moderate knowledge, neutral attitude, and moderate practice (60–79%); and inadequate knowledge, negative attitude, and inappropriate practice (below 60%).

Data collection and quality control

The online questionnaire was developed using Questionnaire Star (http://www.wjx.cn), a professional online survey software platform. Participants accessed the questionnaire via WeChat by scanning a QR code. To ensure data quality, each IP address was restricted to one submission, and all items of questionnaire were mandatory. After data collection, an Excel spreadsheet was exported from the Questionnaire Star platform. The research team carefully reviewed all questionnaires for integrity, internal coherence, and reasonableness.

Statistical analyses

Data analysis was conducted using the SPSS version 26.0 (IBM, Armonk, NY, USA) and Stata version 18.0 for structural equation modeling (SEM). For the descriptive analysis of participants' demographic information and KAP scores, continuous variables were expressed as means ± standard deviations (SDs), while categorical variables were presented as frequencies and percentages. Student's t-test was used for comparisons of KAP scores between two groups with normally distributed data, while the Wilcoxon-Mann-Whitney test was applied for non-normally distributed data between two groups. ANOVA was employed for continuous variables involving three or more groups with normal distribution and equal variances. Kruskal-Wallis analysis was used for categorical variables that did not follow a normal distribution for three or more groups.

Pearson correlation analysis was conducted to explore the inter-correlations between KAP scores. KAP scores were dichotomized as dependent variables based on the mean score of each dimension. Univariate and multivariate logistic regression analysis were performed to analyze associations between demographic factors and KAP scores. In the multivariate regression analysis, only variables with P value < 0.05 in the univariate analysis were included. SEM was employed to test the following hypotheses: (1) knowledge directly influences attitude, (2) attitude directly influences practice, and (3) knowledge directly influences practice. Model fit indices were assessed based on the following criteria: root mean square error of approximation (RMSEA) < 0.08, standardized root mean residual (SRMR) < 0.08, comparative fit index (CFI) > 0.80, and Tucker Lewis index (TLI) > 0.80[17]. P values was recorded with three decimals, and two-tailed P value less than 0.05 was considered statistically significant.

Results

Demographic characteristics

A total of 252 questionnaires were collected, and after removing 23 (9.13%) questionnaires due to incomplete contents or repetitive choices, 229 (90.87%) questionnaires were considered valid for formal analysis. Among the participants, 42.4% were aged between 31 and 40 years. The majority were female (68.6%), held bachelor's degrees (77.7%), were married (75.1%), and worked as doctors and nurses (98.7%). Additionally, 41.9% had intermediate professional titles, and 90.8% belonged to general hospitals, with 46.3% being in public level 3 hospitals. Moreover, nearly half of the participants had more than 10 years of work experience (46.7%) and attended academic conferences or medical education activities 2–5 times per year (45.0%) (Table 1).

Knowledge

Participants obtained an average knowledge score of 36.27 ± 4.97 with range from 25.00 to 53.00, and 47.3% of participants scored above the mean knowledge score (Table 2). Higher knowledge scores were observed among participants who identified as male ($P = 0.019$), worked as technicians ($P = 0.019$), and attended academic conferences or medical education activities 6–10 times per year ($P = 0.038$) (Table 1). As shown in Table 3, **81**.2% correctly identified the definition of multiple myeloma (**K1**), while only 29.7% were familiar with the different stages of multiple myeloma (**K7**). The degree of difficulty ranged from 0.297 to 0.883, with the median of 0.761.

Attitude

The participants exhibited an attitude score of 42.40 ± 5.78 with range from 30 to 56, and 54.1% of participants scored above the mean attitude score (Table 2). Male participants ($P = 0.041$), those with a master's degree or higher ($P < 0.001$), doctors ($P = 0.002$), individuals with a senior professional title ($P = 0.013$), those affiliated with public level 1 hospitals ($P = 0.004$), and those attending academic conferences or medical education activities 10 times or more per year ($P = 0.002$) exhibited higher attitude scores (Table 1). In the attitude section, response rates of "Strongly agree" to "Agree" spanned from 26.2 to 85.1%. Notably, a significant proportion of participants (85.1%) expressed positive attitude towards the importance of support and cooperation from patients and their families during multiple myeloma treatment (**A10**). Conversely, only 26.2% of participants agreed that after completing multiple myeloma treatment, there was no need for follow-up examinations, and patients could monitor their condition on their own (**A8**). Similarly, merely 26.2% agreed that after completing multiple myeloma treatment, patients could choose not to follow the doctor's follow-up plan (**A11**). The degree of difficulty varied from 0.574 to 0.889, with the median of 0.756 (Table 4).

Practice

The practice score of medical staff showed mean value of 29.71 ± 6.41 ranging from 7 to 35, and 38.0% scored above the mean practice score (Table 2). Higher practice scores were observed among participants who attended academic conferences or medical education activities 10 times or more per year ($P = 0.031$) (Table 1). Notably, participants demonstrated varying levels of adherence to recommended practices, with proportions ranging from 82.1 to 89.1%. The highest proportion of participants (89.1%) actively conducted regular follow-up examinations and visits during the treatment of multiple myeloma patients (**P7**). Additionally, the second highest proportion (88.2%) educated multiple myeloma patients about the importance of exercise and dietary management (**P6**). Moreover, 82.1% regularly observed and recorded the vital signs of multiple myeloma patients (**P1**). The degree of difficulty varied from 0.819 to 0.877, and the median value was 0.856 (Table 5).

Correlation and logistic analysis

Pearson's correlation analysis indicated significantly positive correlation between knowledge and attitude (Pearson's rho = 0.184, $P = 0.005$) (Table S1). In the univariate analysis, participants with master's degree or higher education level had significantly higher knowledge scores compared to those with junior college or below (OR = 3.636, 95% CI: 1.054–12.546, $P = 0.041$). Additionally, nurses exhibited lower knowledge scores compared to doctors (OR = 0.585, 95% CI: 0.346–0.991, $P = 0.046$). Moreover, participants attending academic conferences

		Knowledge		Attitude		Practice	
	N(%)	Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*
Total	244	36.27 ± 4.97		42.40 ± 5.78		29.71 ± 6.41	
Gender			0.019		0.041		0.646
Male	72(31.4)	37.40 ± 5.10		43.56 ± 6.13		30.00 ± 6.50	
Female	157(68.6)	35.75 ± 4.84		41.87 ± 5.56		29.58 ± 6.39	
Age			0.146		0.058		0.558
30 years and below	64(27.9)	36.72 ± 4.84		41.22 ± 5.96		28.98 ± 7.67	
31–40 years	97(42.4)	36.71 ± 5.11		42.15 ± 5.80		29.76 ± 6.17	
41–50 years	49(21.4)	34.84 ± 4.53		43.67 ± 5.42		29.94 ± 5.93	
Above 50 years	19(8.3)	36.21 ± 5.40		44.37 ± 5.21		31.32 ± 3.62	
Marital status			0.458		0.717		0.655
Married	172(75.1)	36.11 ± 5.09		42.58 ± 5.89		29.94 ± 5.97	
Unmarried	52(22.7)	36.94 ± 4.68		41.85 ± 5.41		29.06 ± 7.68	
Divorced	5(2.2)	34.80 ± 3.42		42.00 ± 6.56		28.80 ± 7.43	
Education level			0.249		< 0.001		0.066
Junior college or below	35(15.3)	35.14 ± 4.17		39.97 ± 4.46		29.40 ± 7.40	
Bachelor's degree	178(77.7)	36.39 ± 5.02		42.24 ± 5.42		29.45 ± 6.38	
Master's degree and above	16(7.0)	37.44 ± 5.76		49.56 ± 6.85		33.31 ± 2.27	
Occupation type			0.019		0.002		0.446
Doctor	113(49.3)	37.15 ± 5.12		43.72 ± 5.90		29.38 ± 6.53	
Technician	3(1.3)	38.00 ± 7.21		43.67 ± 6.81		26.33 ± 7.02	
Nurse	113(49.3)	35.35 ± 4.62		41.05 ± 5.36		30.13 ± 6.29	
Professional title			0.900		0.013		0.752
No professional title	5(2.2)	36.60 ± 4.93		37.00 ± 3.61		30.80 ± 7.19	
Junior	80(34.9)	36.26 ± 4.93		41.51 ± 5.88		28.97 ± 7.25	
Intermediate	96(41.9)	36.45 ± 5.09		42.53 ± 5.59		29.98 ± 5.80	
Associate Senior	43(18.8)	35.70 ± 5.05		43.84 ± 5.74		30.16 ± 6.35	
Senior	5(2.2)	37.60 ± 3.44		47.20 ± 4.09		31.40 ± 3.05	
Type of medical institution			0.092		0.640		0.357
General Hospital	208(90.8)	36.25 ± 5.09		42.44 ± 5.86		29.86 ± 6.18	
Specialized Hospital	1(0.4)	26.00		37.00		34.00	
Traditional Chinese Medicine Hospital	20(8.7)	37.05 ± 2.80		42.25 ± 5.04		27.95 ± 8.55	
Type of hospital			0.969		0.004		0.052
Public Level 1 Hospital	4(1.7)	36.00 ± 2.58		44.00 ± 6.68		28.75 ± 5.50	
Public Level 2 Hospital	103(45.0)	36.31 ± 5.35		40.88 ± 5.27		28.84 ± 6.87	
Public Level 3 Hospital	106(46.3)	36.33 ± 4.84		43.60 ± 6.06		30.92 ± 5.57	
Private Hospital	16(7.0)	35.69 ± 3.81		43.81 ± 4.92		27.50 ± 7.69	
Duration of work experience			0.228		0.059		0.236
Less than 1 year	11(4.8)	37.64 ± 4.11		42.45 ± 5.77		31.91 ± 3.11	
1–3 years	24(10.5)	36.67 ± 4.38		41.25 ± 6.70		27.25 ± 9.09	
4–6 years	32(14.0)	37.56 ± 5.03		43.53 ± 6.10		30.09 ± 6.63	
7–10 years	55(24.0)	36.51 ± 5.72		40.69 ± 5.81		29.35 ± 6.87	
More than 10 years	107(46.7)	35.53 ± 4.68		43.20 ± 5.30		30.11 ± 5.52	
Frequency of academic conferences or medical education activities per year			0.038		0.002		0.031
Less than 2 times	84(36.7)	35.39 ± 4.88		40.73 ± 5.24		28.80 ± 6.90	
2–5 times	103(45.0)	36.28 ± 4.71		42.83 ± 5.81		29.46 ± 6.72	
6–10 times	23(10.0)	38.57 ± 5.38		44.17 ± 6.72		31.39 ± 4.04	
10 times or more	19(8.3)	37.32 ± 5.48		45.32 ± 4.78		33.11 ± 2.16	

Table 1. Participants' demographic information and KAP scores.

	Max	Min	Mean ± SD	Proportion of participants greater than mean score (%)	Proportion of participants lower than mean score (%)
Knowledge	53.00	25.00	36.27 ± 4.97	47.3	52.7
Attitude	56.00	30.00	42.40 ± 5.78	54.1	45.9
Practice	35.00	7.00	29.71 ± 6.41	38.0	62.0

Table 2. Distribution of knowledge, attitude and practice scores.

	A	B	C	D	E	Degree of difficulty			
1. What do you think multiple myeloma is?	186 (81.2)	13 (5.7)	8 (3.5)	9 (3.9)	13 (5.7)	0.812			
2. The etiology of multiple myeloma is not fully understood, but which of the following factors may be associated with its development? (Multiple choices allowed)	114 (62.9)	192 (83.8)	167 (72.9)	221 (96.5)	139 (60.7)	0.775			
5. Regarding the prevention and screening of multiple myeloma, which of the following statements do you believe to be correct? (Multiple choices allowed)	132 (57.6)	181 (79.0)	85 (37.1)	194 (84.7)	178 (77.7)	0.308			
6. Which of the following methods can be used for the diagnosis of hematological diseases? (Multiple choices allowed)	209 (91.3)	179 (78.2)	190 (83.0)	199 (86.9)	117 (51.1)	0.374			
7. Are you familiar with the different stages of multiple myeloma?	68 (29.7)	53 (23.1)	108 (47.2)			0.297			
8. Multiple myeloma is a disease involving multiple systems, and patients experiencing related symptoms may seek medical attention from which of the following departments? (Multiple choices allowed)	222 (96.9)	194 (84.7)	137 (59.8)	79 (34.5)	64 (27.9)	0.462			
10. Regarding adverse reactions during the treatment of multiple myeloma, which of the following statements do you believe to be correct? (Multiple choices allowed)	214 (94.8)	217 (94.8)	202 (88.2)	104 (45.4)	193 (84.3)	0.459			
11. Regarding the role of hematopoietic stem cell transplantation in the treatment of multiple myeloma, which of the following statements do you believe to be correct? (Multiple choices allowed)	208 (90.8)	194 (84.7)	203 (88.6)	198 (86.5)		0.883			
12. Regarding hematopoietic stem cell transplantation, which of the following statements do you believe to be correct? (Multiple choices allowed)	219 (95.6)	206 (90.0)	197 (86.0)	185 (80.8)	187 (81.7)	0.883			
13. During the maintenance treatment of multiple myeloma patients, which of the following drugs is commonly used for maintenance therapy? (Multiple choices allowed)	164 (71.6)	166 (72.5)	118 (51.5)	167 (72.9)	138 (60.3)	0.314			
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**Degree of difficulty**
3. Which of the following are clinical manifestations of multiple myeloma? (Multiple choices allowed)	224 (97.8)	210 (91.7)	202 (88.2)	146 (63.8)	168 (73.4)	158 (69.0)	158 (69.0)	118 (51.5)	0.761
4. What are the common laboratory abnormalities observed in multiple myeloma? (Multiple choices allowed)	213 (93.0)	186 (81.2)	179 (78.2)	156 (68.1)	169 (73.8)	187 (81.7)			0.810
9. Are you aware of the common treatment modalities for multiple myeloma? (Multiple choices allowed)	223 (97.4)	164 (71.6)	117 (51.1)	192 (83.8)	194 (84.7)	191 (83.4)			0.762

Table 3. Distribution of knowledge dimension responses.

or medical education activities 6–10 times per year achieved higher knowledge scores, as evidenced in both univariate (OR = 3.200, 95% CI: 1.191–8.599, $P = 0.021$) and multivariate analysis (OR = 2.898, 95% CI: 1.022–8.217, $P = 0.045$) (Table S2).

In the attitude dimension, consistently positive associations between knowledge and attitude scores were observed in both univariate (OR = 1.102, 95% CI: 1.042–1.167, $P = 0.001$) and multivariate analysis (OR = 1.112, 95% CI: 1.043–1.186, $P = 0.001$). In the univariate analysis, male participants scored higher in the attitude dimension than female participants (OR = 1.769, 95% CI: 1.008–3.107, $P = 0.047$). Participants within the age range of 41–50 years (OR = 2.768, 95% CI: 1.284–5.970, $P = 0.009$) and above 50 years (OR = 3.273, 95% CI: 1.128–9.497, $P = 0.029$) achieved higher attitude scores. Moreover, participants with bachelor's degree scored higher in attitude compared to those with junior college or below in the univariate analysis (OR = 2.524, 95% CI: 1.119–5.692, $P = 0.026$). Additionally, participants with master's degree or above achieved higher attitude scores in both univariate (OR = 12.519, 95% CI: 2.888–54.255, $P = 0.001$) and multivariate analysis (OR = 10.199, 95% CI: 1.785–58.265, $P = 0.009$). In contrast, nurses had lower attitude scores than doctors in the univariate analysis (OR = 0.347, 95% CI: 0.202–0.596, $P < 0.001$). Furthermore, participants attending academic conferences or medical education activities 10 times or more per year achieved higher attitude scores compared to those with attendances < 2 times (OR = 3.086, 95% CI: 1.098–8.673, $P = 0.033$) (Table S3).

Regarding the practice dimension, participants attending academic conferences or medical education activities 10 times or more per year achieved higher practice scores (OR = 7.022, 95% CI: 1.525–32.326, $P = 0.012$) compared to those with attendances < 2 times (Table S4).

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Degree of difficulty
1. Do you believe that there has been significant progress in the diagnosis and treatment of multiple myeloma?	70 (30.6)	95 (41.5)	55 (24.0)	6 (2.6)	3 (1.3)	0.795
2. Do you consider multiple myeloma to be similar to leukemia?	21 (9.2)	71 (31.0)	64 (27.9)	61 (26.6)	12 (5.2)	0.576
3. Do you perceive an increasing incidence and a trend towards younger age of onset for multiple myeloma?	46 (20.1)	132 (57.6)	47 (20.5)	3 (1.3)	1 (0.4)	0.791
4. Do you believe that hematopoietic stem cell transplantation is the only choice for treating multiple myeloma, without any other effective treatment options?	24 (10.5)	64 (27.9)	75 (32.8)	50 (21.8)	16 (7.0)	0.574
5. Do you consider maintenance therapy to be crucial for the management of multiple myeloma?	57 (24.9)	126 (55.0)	44 (19.2)	2 (0.9)	0	0.808
6. Do you think that multiple myeloma patients after hematopoietic stem cell transplantation can discontinue maintenance therapy?	20 (8.7)	47 (20.5)	50 (21.8)	67 (29.3)	45 (19.7)	0.661
7. Do you believe that post-transplant patients require regular bone marrow aspiration to promptly detect relapse or metastasis of multiple myeloma?	46 (20.1)	137 (59.8)	40 (17.5)	2 (0.9)	4 (1.7)	0.791
8. Do you think that after the completion of multiple myeloma treatment, there is no need for follow-up examinations, and patients can monitor their condition on their own?	19 (8.3)	41 (17.9)	32 (14.0)	43 (18.8)	94 (41.0)	0.733
9. Do you believe that the occurrence of multiple myeloma is significantly influenced by emotional factors, and stable emotions can to some extent improve the condition?	33 (14.4)	106 (46.3)	67 (29.3)	18 (7.9)	5 (2.2)	0.726
10. Do you consider the support and cooperation of patients and their families to be crucial during multiple myeloma treatment?	142 (62.0)	53 (23.1)	29 (12.7)	4 (1.7)	1 (0.4)	0.889
11. Do you believe that after completing multiple myeloma treatment, patients can choose not to follow the doctor's follow-up plan?	26 (11.4)	34 (14.8)	26 (11.4)	21 (9.2)	122 (53.3)	0.756
12. Do you think it is necessary to keep PICC or PORT in place during the treatment of multiple myeloma?	78 (34.1)	106 (46.3)	36 (15.7)	7 (3.1)	2 (0.9)	0.795

Table 4. Distribution of attitude dimension responses.

	Always	Frequently	Sometimes	Occasionally	Never	Degree of difficulty
1. Do you regularly observe and record the vital signs of multiple myeloma patients?	112 (48.9)	76 (33.2)	17 (7.4)	6 (2.6)	18 (7.9)	0.825
2. During patient safety assessments, are you able to comprehensively and meticulously evaluate the physical condition of multiple myeloma patients and develop appropriate treatment or care plans?	98 (42.8)	91 (39.7)	15 (6.6)	14 (6.1)	11 (4.8)	0.819
3. Do you frequently assess and promptly address pain in multiple myeloma patients?	131 (57.2)	66 (28.8)	10 (4.4)	9 (3.9)	13 (5.7)	0.856
4. Are you aware of the potential complications that may arise during chemotherapy for multiple myeloma patients and able to implement proper nursing measures?	120 (52.4)	74 (32.3)	13 (5.7)	8 (3.5)	14 (6.1)	0.843
5. Do you provide psychological support to multiple myeloma patients?	125 (54.6)	76 (33.2)	10 (4.4)	6 (2.6)	12 (5.2)	0.859
6. Do you educate multiple myeloma patients about the importance of exercise and dietary management?	128 (55.9)	74 (32.3)	10 (4.4)	6 (2.6)	11 (4.8)	0.864
7. Do you conduct regular follow-up examinations and visits during the treatment of multiple myeloma patients?	137 (59.8)	67 (29.3)	10 (4.4)	6 (2.6)	9 (3.9)	0.877

Table 5. Distribution of practice dimension responses.

	Total effects		Direct effects		Indirect effect	
Model paths	β (95%CI)	*P*	β (95%CI)	*P*	β (95%CI)	*P*
Knowledge→attitude	0.022 (− 0.138,0.182)	0.787	0.022 (− 0.138,0.182)	0.787		
Attitude→practice	0.320 (0.189,0.452)	< 0.001	0.320 (0.189,0.452)	< 0.001		
Knowledge→practice	− 0.083 (− 0.231,0.066)	0.275	− 0.090 (− 0.231,0.052)	0.215	0.007 (− 0.044,0.059)	0.788

Table 6. The total, direct and indirect effects of structural equation models (SEMs).

SEM

SEM demonstrated a good model fit (RMSEA = 0.064, SRMR = 0.091, TLI = 0.875, CFI = 0.887) (Table S5). Besides, positive association was observed between attitude and practice (β = 4.76, $P < 0.001$) (Table S6). SEM findings further indicated direct association between attitude and practice (β = 0.320, 95%CI: 0.189–0.452, $P < 0.001$) (Table 6; Fig. 1). However, no total and direct effects were observed between knowledge and attitude, and between knowledge and practice.

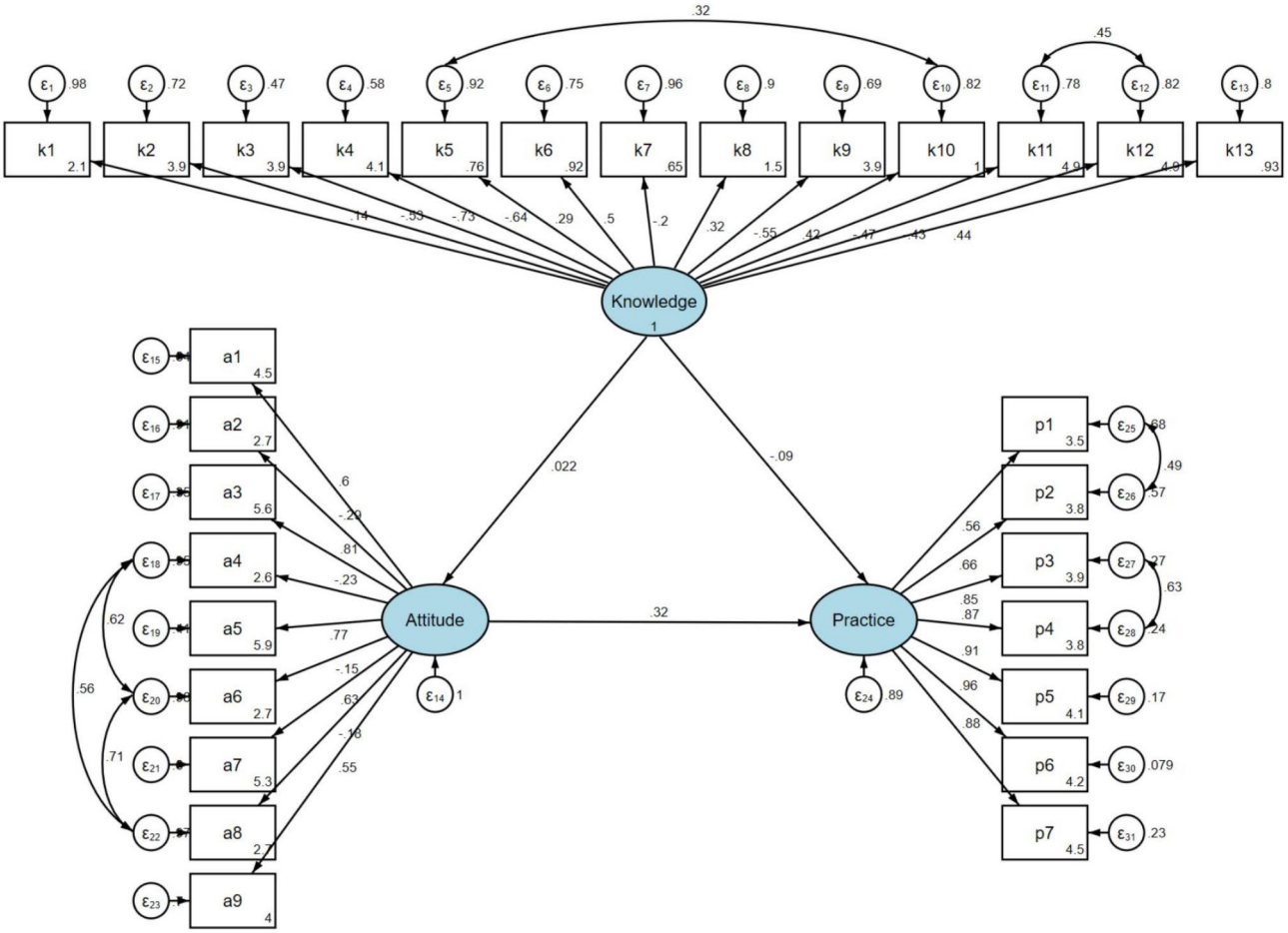

Fig. 1. The structural equation model (SEM) showing the associations between KAP scores. Rectangles show observed variables, ellipses indicate potential variables, and circles represent residual terms.

Discussion

The study findings indicated that medical staff had moderate knowledge, neutral attitudes, and proactive practices towards multiple myeloma. Additionally, significantly positive association were observed between knowledge and attitude. Demographic factors, including education level, age, occupation type, and frequency of academic conferences or medical education activities per year, were found to be associated with KAP scores. These results provided valuable insights that can inform the development of healthcare interventions and educational programs targeted at improving KAP among medical staff.

KAP studies offer a scientific foundation for designing targeted interventions that address knowledge gaps, reshape attitudes, and improve practices[18]. Gaps in KAP were identified in the survey, informing educational programs and policy support to enhance healthcare delivery of multiple myeloma. The moderate knowledge among medical staff in Enshi reflected a common trend in less-resourced settings, where professional training in hematology is limited. Our findings were consistent with previous research from European countries, which revealed significant knowledge gaps among hematologists and nurses regarding multiple myeloma and its treatment agents[9]. Similarly, a study from the USA showed that clinicians lacked knowledge and confidence in providing patient-specific treatment for multiple myeloma, especially for high-risk cases[19]. Despite moderate knowledge, medical staff in Enshi exhibited proactive practices. This finding contrasted with the study from USA, where practice gaps persisted among clinicians despite high awareness of screening testing[20]. Besides, Belarusian physicians exhibited good understanding of the role of autologous stem-cell transplantation (ASCT) as first-line treatment for multiple myeloma, and the majority practiced first-line treatment for more than 4 months[21]. The KAP gaps herein can inform the essentiality of building local capacity in Enshi region, such as practical workshops tailored to regional needs.

The knowledge dimension revealed both positive and concerning aspects of medical staff's knowledge of multiple myeloma. A significant proportion (81.2%) correctly identified the definition of multiple myeloma, indicating good level of awareness. This understanding was essential as it formed the basis for accurate diagnosis and appropriate management. However, only 29.7% exhibited familiarity with the stages of multiple myeloma. The slow development and uneven advancement of hematology in the Enshi region emerge as key contributing factors. Considering the critical importance of understanding disease stages for implementing precise treatment strategies, it is essential to organize targeted educational programs and training sessions for medical staff in

this area[22]. These initiatives would play a significant role in fostering the continuous enhancement of their professional expertise.

The attitude section yielded valuable insights into medical staff's perspectives and beliefs regarding multiple myeloma treatment. A significant proportion (85.1%) exhibited positive attitude towards the importance of patient and family support during treatment, highlighting their recognition of its crucial role in managing multiple myeloma. Since emotional and psychological support from loved ones could greatly impact the well-being and treatment outcomes of patients, understanding the significance of such support could enable medical staff to adopt holistic approach to patient care and address their overall well-being. However, a low agreement rate (26.2%) was observed regarding the necessity of follow-up examinations and patients' ability to self-monitor their condition after completing treatment. Similarly, more than a quarter (26.2%) agreed that patients could choose not to follow the doctor's follow-up plan after treatment, indicating negative attitude towards adhering to medical advice and treatment plans. Regular follow-up examinations are essential for assessing treatment efficacy, monitoring potential relapses, and managing treatment-related side effects[23]. Due to the significance of compliance in ensuring timely intervention[24,25], grassroots myeloma training courses should be expanded to include post-treatment monitoring and patient education. To ensure sustainability and scalability, submitting proposals is recommended to the State Health Commission to prioritize hematology education, including organizing academic seminars and offering training opportunities for local medical staff.

The results of practice dimension shed light on medical staff's adherence to recommended practices for treating multiple myeloma patients. One noteworthy discovery was that 89.1% consistently conducted follow-up examinations and visits during treatment. Another significant observation was that 88.2% proactively educated multiple myeloma patients about exercise and dietary management. By informing patients about exercise and dietary considerations, medical staff could empower them to play an active role in their treatment journey, potentially leading to improved lifestyle choices, treatment efficacy, and quality of life[26,27]. Furthermore, 82.1% regularly observed and recorded vital signs of multiple myeloma patients. This vigilant monitoring was crucial for promptly identifying changes in the patient's health status and addressing potential complications[28]. Although overall adherence to recommended practices was relatively high, it was essential to acknowledge room for improvement. Some medical staff did not fully adhere to certain practices, highlighting the need for targeted interventions and educational programs to address these areas of concern.

No significant correlations of knowledge and attitude with practice were observed, indicating that possessing knowledge and positive attitude towards multiple myeloma might not necessarily lead to better adherence to recommended practices among medical staff. Several explanations could account for this lack of correlation. Firstly, unexamined factors like institutional policies, resource availability, time constraints, and workload might influence medical staff's practices towards multiple myeloma patients[29,30]. Secondly, the complexity of the disease and patient diversity could also contribute to the absence of correlation[31,32]. Additionally, the research unveiled the positive association between knowledge and attitude towards multiple myeloma, which aligned with the theory of planned behavior that attitude was shaped by beliefs about behavioral outcomes[33]. The non-significant associations of knowledge with attitudes and practices were reported in SEM, suggesting the gaps in knowledge translation. Also, SEM analysis reveal a direct association between attitudes and practices. In resource-limited settings like Enshi, where medical staff may face additional challenges such as limited access to continuing education, fostering positive attitudes toward multiple myeloma care may be a more pragmatic approach than focusing solely on knowledge dissemination. Taken these results together, educational programs that enhance knowledge and foster attitudinal shifts towards multiple myeloma can be pivotal for better management. Further, since this study was regional, replicating this research in different settings could validate the universality of these findings and potentially lead to broader policy changes in cancer care.

This study had some limitations. Firstly, it was carried out in solitary region with relatively limited sample size, potentially constraining the generalizability of the outcomes. Nevertheless, these findings could serve as fundamental reference for evaluating the impacts of forthcoming educational interventions on medical staff in terms of preventing and treating multiple myeloma. Besides, the cross-sectional design limited the ability of causal inference. Intervention-based designs are needed to better understand how educational initiatives or policy implementations may influence behavior and attitudes over time. Moreover, the KAP findings might have been swayed by social desirability bias, potentially resulting in inflation of scores, since participants might have given socially desirable answers rather than reflecting their actual behaviors[34] .

Conclusions

In conclusion, medical staff exhibited moderate knowledge, neutral attitudes, and proactive practices towards multiple myeloma. Moreover, a significant positive correlation was observed between knowledge and attitude scores. Targeted educational interventions were recommended to enhance knowledge and attitudes, especially among specific groups, such as female individuals, those with bachelor's degrees or lower education, nurses, and individuals with lower professional titles.

Data availability

All data generated or analysed during this study are included in this published article and its supplementary information files.

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Author contributions

Luping Zou and Jinhua Li carried out the studies, participated in collecting data, and drafted the manuscript. Luping Zou, Jinhua Li and Hang Xiang performed the statistical analysis and participated in its design. Jun Tan and Yan Zeng participated in acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript.

Declarations

Ethics approval and consent to participate

This work has been carried out in accordance with the Declaration of Helsinki (2000) of the World Medical Association. The work was approved by the Ethics Committee of the Central Hospital of Enshi Tujia and Miao Autonomous Prefecture (2023-075-001). Informed consent was obtained from participants.

Competing interests
The authors declare no competing interests.

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