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Original Article

Diabetic Kidney Disease Prevention in Type 2 Diabetes: Knowledge, Attitudes and Practices Study from Kyrgyzstan

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Abstract:

Background: To evaluate diabetic kidney disease (DKD) knowledge, attitudes, and practices (KAP) among adults with type 2 diabetes (T2D) in southern Kyrgyzstan.

Methods: A cross-sectional survey assessed DKD KAP among adults with T2D recruited from public healthcare facilities in Osh, Kyrgyzstan. We used a structured questionnaire guided by the Health Belief Model and the Health Locus of Control. We used multiple linear regression models to examine factors associated with KAP scores.

Results: A total of 207 adults participated (mean age 61.0 ± 10.7 years; 61.4% female). Although 91.3% identified healthcare workers as their most trusted information source, only 49.3% reported receiving DKD-related information from a healthcare provider. Only 13.5% recognized that early kidney damage does not cause pain. Despite generally positive attitudes towards kidney protective behaviors, 72.9% of participants reported low personal control over their health outcomes. In adjusted models, prior receipt of provider DKD information was the sole factor consistently associated with higher knowledge (β = 1.25, 95% CI 0.43–2.08, p = 0.003), attitudes (β = 3.11, 95% CI 1.61–4.61, p < 0.001), and practices (β = 3.99, 95% CI 2.26–5.71, p < 0.001).

Conclusion: Adults with T2D in southern Kyrgyzstan experience significant knowledge gaps and misconceptions regarding kidney protection, despite high trust and willingness to learn from healthcare providers. Prior provider-delivered information was associated with better practices, highlighting the need for structured DKD counseling that explicitly addresses misconceptions and aligns health messages with local beliefs to strengthen self-efficacy.

Keywords: Type 2 Diabetes; Diabetic Kidney Disease; Health Communication; Central Asia; Kyrgyzstan

Introduction

Diabetes mellitus is a major global health challenge. In 2024, an estimated 589 million adults aged 20-79 were living with diabetes worldwide (11.1% of this age group) (1). The burden is unevenly distributed, with around four in five adults living with diabetes (81%) residing in low- and middle-income countries (LMICs) (1). In this context, type 2 diabetes (T2D) is the predominant form, comprising around 90% of cases (2).

Diabetes complications affect multiple organ systems, including the kidneys, cardiovascular system, brain, peripheral vasculature, eyes, liver, skeletal muscle, nervous system, and the lower extremities (3). Among these, diabetic kidney disease (DKD), a chronic kidney disease (CKD) attributable to diabetes-related pathology, is a leading cause of end-stage kidney disease (ESKD) globally (4). It develops in up to 40% of people with diabetes (5), increasing cardiovascular diseases risks (6), and substantially raising healthcare costs (7).

Given its high prevalence, clinical and economic consequences, timely identification of DKD is a key priority in diabetes care. Clinical guidelines recommend at least annual assessment of DKD using both spot urine albumin-to-creatinine ratio and estimated glomerular filtration rate (eGFR) from diagnosis of diabetes (8, 9). However, screening remains suboptimal, especially in LMICs, where DKD is frequently detected at advanced stages when therapeutic options are limited (1). This gap between guidelines and practices reflects both provider-level and patient-level barriers (10).

The Kyrgyz Republic, a lower-middle-income country in Central Asia, exemplifies many challenges faced by resource-constrained nations, including constrained health-system capacity and limited patient education infrastructure (11, 12). Although the national registry reported 85,142 registered cases of diabetes as of January 1, 2024, the system operates largely offline and struggles with delayed data entry and limited internet access in remote regions (13). The World Health Organization estimates the true burden of diabetes may be eightfold higher than official figures suggest (14). Additionally, data on DKD-related knowledge, screening perceptions, and kidney-protective practices among adults with T2D in Kyrgyzstan remain limited. This is a critical gap because DKD is common, often asymptomatic in early stages, and prevention depends on timely screening and sustained self-management behaviors (15).

Therefore, this cross-sectional study aims to evaluate the knowledge, attitudes, and practices regarding kidney protection among adults with type 2 diabetes in southern Kyrgyzstan. This study is theoretically grounded in the Health Belief Model (HBM) (16) and Health Locus of Control (HLOC) (17). The HBM posits that behavior change requires a cue to action to activate perceived risk and overcome perceived barriers. In this context, we conceptualize provider-delivered DKD information as a communicative cue. Furthermore, because Central Asian populations frequently exhibit high deference to medical authority (18), HLOC is utilized to understand how patients attribute control over their health (19). By integrating these theories, the findings are intended to strengthen routine clinical counseling to improve kidney health outcomes in resource-limited settings.

Methods

Data collection

This cross-sectional study was conducted between September 10, 2025, and October 10, 2025, at three tertiary public healthcare facilities in Osh, Kyrgyzstan. These facilities serve as the primary referral centers for a population of approximately 3.65 million residents across southern regions of the Kyrgyz Republic, including Osh, Batken, and Jalalabad (20). Participants were recruited using a consecutive sampling strategy, wherein collaborating physicians identified potentially eligible individuals from clinical registers and research assistants approached them during scheduled outpatient visits. In total, 252 eligible individuals were approached, and 207 consented and completed the survey (response rate 82.1%). Recruitment ended once the target sample size was reached (Detailed sampling strategy in Supplementary Methods).

Participants were eligible if they: (1) were aged 18 years or older; (2) had a documented T2D diagnosis (based on medical records from the facility where contacts were obtained, or physician's referral with diagnosis confirmation); and (3) were able to provide informed consent. Individuals were excluded if they: (1) had type 1 diabetes or gestational diabetes; (2) had severe cognitive impairment preventing completion of the questionnaire.

Data collection was facilitated by trained field research assistants (AO, AS, KhZh), who were medical doctors with prior experience in conducting patient-based surveys. Before data collection, they completed a one-week training on research methodologies and study procedures provided by the Public Foundation "Health Policy Analysis Center". The research assistants met eligible participants in person and sent a Google Forms questionnaire link to participants' mobile

devices via WhatsApp. The survey opened with an electronic informed-consent form, and participants who consented completed the questionnaire anonymously and independently on their own devices whenever possible.

For participants without access to a smartphone or with limited digital literacy, research assistants provided practical support, including access to a device when needed, and could administer the questionnaire in an interviewer-assisted format by entering participants' responses into Google Forms. In all cases, research assistants were limited to providing neutral clarification on survey procedures or question wording if requested and did not assist with selecting responses. To minimize social desirability bias and protect confidentiality, participants were instructed to complete the survey privately without assistance from family members or healthcare providers whenever feasible.

The survey instrument was a structured, self-administered questionnaire developed through a literature review of previously used DKD-related KAP instruments (21-23) and adapted to the local context through consultation with endocrinologists and nephrologists in Kyrgyzstan. The questionnaire was translated into Kyrgyz and Russian and back-translated by bilingual researchers to confirm the accuracy of wording and technical terminology. It was pilot tested in both languages with two patients with diabetes to assess clarity and comprehensibility, and several knowledge items were rephrased accordingly. The pilot responses were not included in the main analysis. The full survey instrument is available in the Supplementary Table 1.

Data analysis

Statistical analysis was performed using Stata/MP 16.0 for Mac. Descriptive statistics were generated for all variables, with the distribution of KAP scores assessed for normality via Shapiro–Wilk tests and visual inspection of histograms. Internal consistency of the KAP instruments was evaluated using Cronbach's alpha for the knowledge, attitude, and practice items. Bivariate differences in mean KAP scores were examined using independent-samples t-tests for binary predictors and one-way ANOVA for categorical predictors with three or more groups. Correlations between KAP domains were assessed using Pearson pairwise correlation coefficients, which were interpreted as weak ($r = 0.10–0.29$), moderate ($r = 0.30–0.49$), or strong ($r \geq 0.50$).

To identify factors associated with each KAP score, multivariable linear regression models were fitted. Predictors were prespecified based on prior literature and their conceptual relevance. Model 1 adjusted for basic demographics (sex, age category, and residence), Model 2 additionally adjusted for socioeconomic characteristics (education, marital status, and household size), Model 3 additionally adjusted for clinical history (diabetes duration category and comorbidity category), and Model 4 further included receipt of provider-delivered DKD information. Variance inflation factors (VIFs) were examined to assess multicollinearity. Regression diagnostics included assessment of heteroskedasticity using the Breusch–Pagan/Cook–Weisberg test, and model specification using the link test. Residual distributions were examined visually, and no major violations of regression assumptions were identified. Model fit statistics (R^2 and adjusted R^2) were reported for the final models.

Complete-case analysis was performed, observations with missing data on variables included in each model were excluded. The ratio of observations to estimated parameters was maintained at approximately ≥10 observations per parameter to reduce the risk of overfitting (24).

Statistical significance was set at $p < 0.05$. Bias minimization strategies included consecutive sampling, use of previously published KAP instruments adapted to the local context, standardized training, anonymous data collection, and multivariable adjustment for confounding. We followed the STROBE guidelines for cross-sectional studies (25).

Results

Participants characteristics

A total of 207 adults with T2D were included in the analysis. Participants' age ranged from 30 to 93 years (mean 61.0 ± 10.7 years), and 61.4% were female. Most lived in the Osh region (54.1%) or Osh city (32.9%), while 12.1% were from other regions (Batken and Jalalabad). Education levels were high school or below (44.9%), technical/vocational (24.2%), and undergraduate or higher (30.9%). Over half were retired (52.2%), and 45.4% reported monthly household income of 20,000–50,000 KGS (approx. $229–$572 USD). Hypertension (77.3%), coronary heart disease (57.0%), and kidney disease (28.0%) were the most frequently reported comorbidities, and 37.2% reported three or more comorbid conditions. Healthcare workers were the most trusted source of health information (91.3%), yet only 49.3% reported receiving provider-delivered information on DKD.

KAP scores

The mean knowledge score was 7.2 (SD 3.1) out of 14, the mean attitude score was 36.0 (SD 5.5) out of 50, and the mean practice score was 27.9 (SD 6.2) out of 40 (Table 1).

Table 1 Participant characteristics and Knowledge, Attitude, and Practice (KAP) scores (n=207)

Variable	n(%)	Knowledge		p*	Attitude		p	Practice		p
		Mean	SD		Mean	SD		Mean	SD	
Total		7.2	3.1		36.0	5.5		27.9	6.2	
Gender				0.588			0.845			0.905
Males	80 (38.6%)	7.0	3.0		36.1	5.7		27.8	6.6	
Females	127 (61.4%)	7.3	3.1		35.9	5.7		27.9	5.9	
Age				0.296			0.518			0.287
<50 years	28 (13.5%)	6.4	3.5		36.6	5.3		27.7	6.0	
50-69 years	135 (65.2%)	7.2	3.0		35.7	5.2		28.3	6.1	
≥70 years	44 (21.3%)	7.5	3.0		36.6	6.5		26.6	6.4	
Residence type				**<0.001**			**0.007**			**0.009**
Urban	103 (49.8%)	**8.1**	**2.8**		**37.0**	**5.4**		**29.0**	**6.4**	
Rural	104 (50.2%)	**6.3**	**3.1**		**35.0**	**5.5**		**26.6**	**5.7**	
Region				**0.003**			**<0.001**			0.094
Osh city	68 (33.2%)	**8.2**	**3.0**		**38.0**	**5.0**		29.1	6.7	
Osh region	112 (54.3%)	**6.6**	**2.9**		**35.3**	**5.6**		27.1	5.9	
Other (Batken, Jalalabad regions)	25 (12.2%)	**6.8**	**3.4**		**33.9**	**4.9**		28.4	5.5	
Education				**<0.001**			**0.001**			**0.008**
High school and below	93 (44.9%)	**6.3**	**3.1**		**34.5**	**5.4**		**26.5**	**5.9**	
Technical/vocational school	50 (24.2%)	**7.7**	**2.7**		**37.2**	**5.6**		**28.5**	**5.6**	
Undergraduate and above	64 (30.9%)	**8.2**	**2.9**		**37.3**	**5.3**		**29.4**	**6.6**	
Employment				0.945			0.473			0.242
Employed	78 (37.7%)	7.1	3.4		36.6	5.4		28.3	6.3	
Retired	108 (52.2%)	7.2	2.7		35.7	5.7		28.0	6.1	
Other	21 (10.1%)	7.3	3.4		35.3	5.0		25.8	6.2	
Marital status				**0.005**			**0.040**			0.185
Married	128 (61.8%)	**7.6**	**3.0**		**36.6**	**5.3**		28.3	6.0	
Single/divorced/widowed	79 (38.2%)	**6.4**	**3.0**		**35.0**	**5.8**		27.1	6.4	
Household size				**0.030**			0.110			**0.009**
Small (≤3)	28 (13.5%)	**7.9**	**2.8**		38.0	5.5		**30.5**	**7.1**	
Medium (4-6)	115 (55.6%)	**7.5**	**3.0**		35.8	5.4		**28.1**	**6.4**	
Large (≥7)	64 (30.9%)	**6.4**	**3.1**		35.6	5.7		**26.3**	**4.9**	
Monthly income per household, KGS				**0.045**			**0.003**			0.203
<20000	39 (18.8%)	**6.5**	**3.3**		**34.1**	**5.5**		27.2	6.6	
20000-50000	94 (45.4%)	**7.6**	**2.9**		**36.1**	**5.9**		28.6	6.3	
>50000	34 (16.4%)	**8.2**	**3.5**		**38.6**	**5.2**		29.9	6.3	
Out of pocket expenses				0.257			0.093			0.743
Yes	115 (55.7%)	7.4	3.3		36.6	5.9		28.0	6.4	
No	92 (44.4%)	6.9	2.7		35.3	4.9		27.7	5.9	
Duration of DM				0.521			0.875			0.383
1-5 years	66 (31.9%)	6.9	3.3		36.0	5.3		28.4	5.7	
6-10 years	75 (36.2%)	7.5	2.8		35.9	6.0		27.2	6.5	
>10 years	59 (28.5%)	7.2	3.1		36.4	5.2		28.5	6.1	
Comorbidity (multiple choice) tests compare with vs. without the condition										
Hypertension	160 (77.3%)	**7.5**	**3.1**	**0.015**	**36.6**	**5.4**	**0.002**	27.9	6.4	0.992
Coronary heart disease	118 (57.0%)	7.5	2.9	0.127	36.1	5.4	0.831	27.9	6.7	0.911
Stroke	39 (18.8%)	7.3	2.6	0.780	35.9	5.8	0.868	27.4	6.8	0.591
Eye disease	29 (14.0%)	**8.3**	**2.8**	**0.038**	36.9	6.4	0.333	27.5	7.4	0.745
Neuropathy	45 (21.7%)	7.7	3.2	0.212	**37.4**	**5.6**	**0.049**	27.6	5.4	0.746
Kidney disease	58 (28.0%)	7.8	2.9	0.083	35.4	5.8	0.354	27.7	6.6	0.762
Comorbidity burden				**0.009**			**0.027**			0.986
None	26 (12.6%)	**6.5**	**2.4**		**33.0**	**5.5**		27.5	5.1	
One	49 (23.7%)	**6.2**	**3.5**		**36.1**	**5.3**		28.0	6.1	
Two	55 (26.6%)	**7.2**	**2.9**		**36.5**	**5.2**		27.9	6.8	
Three or more	77 (37.2%)	**8.0**	**2.8**		**36.6**	**5.7**		27.9	6.2	
Alcohol intake				0.802			0.432			0.752
Non-drinker	152 (73.4%)	7.2	3.1		35.8	5.7		27.8	6.0	
Drinker	55 (26.6%)	7.3	2.9		36.5	5.2		28.1	6.7	

Table 1. *Cont.*

Variable	n(%)	Knowledge		p*	Attitude	p		Practice		p
		Mean	SD		Mean	SD		Mean	SD	
Smoking				0.224			0.769			0.808
Never	124 (59.9%)	7.5	3.1		36.2	5.7		28.0	6.3	
Former	44 (20.3%)	6.7	3.4		35.7	5.3		27.3	5.1	
Current	39 (18.8%)	6.8	2.6		35.6	5.3		28.2	7.0	
Most trusted information source										
Healthcare workers	189 (91.3%)									
Social	6 (2.9%)									
Digital media	4 (1.9%)									
Other	8 (3.9%)									
Received information about DKD				**<0.001**			**<0.001**			**<0.001**
Yes	102 (49.3%)	**8.1**	**3.2**		**38.0**	**5.3**		**30.2**	**6.2**	
No	105 (50.7%)	**6.3**	**2.6**		**34.1**	**5.1**		**25.6**	**5.3**	

Values are mean (standard deviation). p from two-sample t tests for binary variables and one-way ANOVA for multi-category variables. For comorbidities (multiple choice), each condition was compared against participants without that condition. Percentages are based on the total sample unless otherwise indicated; some variables had missing values (region, n = 2; monthly income, n = 40; duration of diabetes, n = 7), so totals may not sum to 100%. KGS = Kyrgyzstan som; DM = diabetes mellitus; DKD = diabetic kidney disease. KAP = Knowledge, Attitude, Practice.

Most respondents correctly identified diabetes (84.5%), high salt intake (78.3%), smoking 76.8%), and hypertension (75.8%) as risk factors for kidney disease (Supplementary Figure 1). However, only 13.5% knew that early kidney damage does not cause pain, and 16.4% recognized that kidney disease does not always present with clear symptoms. Additional knowledge gaps included awareness that NSAIDs overuse can harm kidneys (36.7% correct), that blood pressure medications can protect kidneys (36.2% correct), and that kidney disease can develop even when blood sugar is not very high (26.1% correct). Most participants reported wanting to learn how to protect their kidneys (75.4%), believed that regular check-ups are beneficial (70.0%), trusted their healthcare provider's guidance (68.6%), and felt confident they could adopt preventive behaviors (64.7%), whereas only 27.1% reported strong personal control over their health outcomes (Supplementary Figure 2). In the practice domain, medication adherence was relatively high (67.1% often or always taking medications as prescribed), although dietary modifications were more modest (58.9% reducing salt, and 56.5% reducing sugar intake) (Supplementary Figure 3). However, less than half reported regular kidney function monitoring (47.8%), discussing kidney health with providers (44.9%), engaging in physical exercises (45.9%), or avoiding NSAIDs without a prescription (42.5%).

Urban residents had higher scores across all three domains, with better knowledge ($p < 0.001$), attitudes ($p = 0.007$), and practices ($p = 0.009$) (Table 1). Higher education showed similar patter, being associated with higher knowledge ($p < 0.001$), attitudes ($p = 0.001$), and practices ($p = 0.008$). Other variables showed domain specific associations. Living in households with fewer members was associated with higher knowledge ($p = 0.03$) and practices ($p = 0.009$), but not attitudes. Being married was associated with higher knowledge ($p = 0.005$) and attitudes ($p = 0.04$). Higher household income was associated with higher knowledge ($p = 0.045$) and attitudes ($p = 0.003$), and higher comorbidity burden was associated with higher knowledge ($p = 0.009$) and attitudes ($p = 0.027$), but not practices. Prior receipt of DKD information was associated with better knowledge, attitudes and practices (all $p < 0.001$).

In multivariable regression, prior provider-delivered DKD information was associated with higher knowledge ($\beta = 1.25$, 95% CI 0.43–2.08, $p = 0.003$), attitudes ($\beta = 3.11$, 95% CI 1.61–4.61, $p < 0.001$), and practices ($\beta = 3.99$, 95% CI 2.26–5.71, $p < 0.001$) (Table 2).

Knowledge was also significantly associated with older age ($\beta = 1.82$, 95% CI 0.23–3.41, $p = 0.025$), urban residence ($\beta = 1.06$, 95% CI 0.18–1.93, $p = 0.018$), and higher education level (primary or less as the reference category) ($\beta = 1.23$, 95% CI 0.23–2.23, $p = 0.016$ for vocational/technical; $\beta = 1.43$, 95% CI 0.38–2.48, $p = 0.008$ for undergraduate or higher). Attitudes were also associated with higher education (primary or less as the reference category) ($\beta = 2.81$, 95% CI 0.99–4.63, $p = 0.003$ for vocational/technical; $\beta = 2.35$, 95% CI 0.43–4.26, $p = 0.016$ for undergraduate or higher) and comorbidity burden (no comorbidity as the reference category) ($\beta =$ 3.81–4.44 vs none). Knowledge, attitudes, and practices were positively correlated ($p < 0.001$), with the strongest correlation between attitudes and practices ($r = 0.492$) (Supplementary Table 2).

Table 2 Multivariable linear regression analysis of factors associated with DKD KAP scores (n=200)

Variable	Knowledge score			p	Attitude score			p	Practice score			p
	Coef.	95% CI			Coef.	95% CI			Coef.	95% CI		
Gender												
Females	ref											
Males	-0.08	-0.91	0.75	0.852	0.89	-0.62	2.40	0.244	0.19	-1.54	1.93	0.827
Age												
<50 years	ref											
50-69 years	1.07	-0.21	2.36	0.100	-1.12	-3.46	1.22	0.348	1.84	-0.85	4.53	0.179
≥70 years	**1.82**	**0.23**	**3.41**	**0.025**	0.45	-2.44	3.34	0.760	0.50	-2.83	3.83	0.767
Residence type												
Rural	ref											
Urban	**1.06**	**0.18**	**1.93**	**0.018**	0.71	-0.88	2.31	0.380	1.54	-0.30	3.38	0.100
Education												
High school and below	ref											
Vocational/technical school	**1.23**	**0.23**	**2.23**	**0.016**	**2.81**	**0.99**	**4.63**	**0.003**	1.88	-0.21	3.97	0.077
Undergraduate and above	**1.43**	**0.38**	**2.48**	**0.008**	**2.35**	**0.43**	**4.26**	**0.016**	1.18	-1.02	3.38	0.293
Marital status												
Single/divorced/widowed	ref											
Married	0.46	-0.49	1.41	0.337	-0.04	-1.77	1.69	0.965	-0.74	-2.73	1.24	0.461
Household size												
Small (≤3)	ref											
Medium (4-6)	0.36	-0.84	1.57	0.553	-1.60	-3.80	0.60	0.154	-0.44	-2.97	2.09	0.732
Large (≥7)	-0.27	-1.61	1.07	0.691	-0.77	-3.22	1.67	0.534	-1.36	-4.17	1.45	0.342
Duration of DM												
1-5 years	ref											
6-10 years	-0.03	-0.95	1.00	0.958	-0.46	-2.24	1.32	0.610	-1.39	-3.44	0.65	0.181
>10 years	-0.44	-1.54	0.67	0.438	-0.49	-2.50	1.53	0.633	-0.31	-2.63	2.00	0.791
Comorbidity burden												
None	ref											
One	-0.09	-1.52	1.34	0.901	**3.81**	**1.20**	**6.41**	**0.004**	0.24	-2.75	3.23	0.874
Two	0.69	-0.78	2.16	0.354	**4.44**	**1.76**	**7.12**	**0.001**	-0.22	-3.30	2.86	0.889
Three or more	1.40	-0.08	2.89	0.063	**4.10**	**1.40**	**6.80**	**0.003**	-0.41	-3.52	2.69	0.792
Received information about DKD												
No	ref											
Yes	**1.25**	**0.43**	**2.08**	**0.003**	**3.11**	**1.61**	**4.61**	**<0.001**	**3.99**	**2.26**	**5.71**	**<0.001**

Multivariable linear regressions with one outcome per column (Knowledge, Attitude, Practice) based on complete-case analysis (n=200). Models adjust for sex, age group, residence type, education, marital status, household size, diabetes duration, comorbidity burden, and receipt of information about diabetic kidney disease (DKD). Coefficients are shown relative to the reference category specified in the first row of each block. 95% CI = 95% confidence interval. Model fit: Knowledge (R^2 = 0.257, adjusted R^2 = 0.197); Attitude (R^2 = 0.247, adjusted R^2 = 0.185); Practice (R^2 = 0.196, adjusted R^2 = 0.130). KAP = Knowledge/Attitude/Practice; DM = diabetes mellitus; DKD = diabetic kidney disease. Bold indicates p<0.05

Discussion

In this cross-sectional study of adults with T2D in southern Kyrgyzstan, we observed generally positive attitudes toward kidney protection, while DKD-specific knowledge and protective practices were suboptimal. The key finding is that prior receipt of provider-delivered DKD information was associated with higher knowledge, more positive attitudes, and was the only factor that remained associated with better preventive practices after adjustment.

The remarkably strong association between provider-delivered DKD-information and preventive practices suggests that in this setting, clinical encounters may function as the primary external cues to action within the HBM. However, healthcare delivery in Kyrgyzstan has historically reflected a paternalistic, top-down model rather than patient-centered care (18). In such contexts, patients may defer to physicians' expertise and authority rather than developing their own understanding of disease mechanisms and complications (26).

Indeed, we found that medication adherence was notably higher compared to other LMICs (27, 28), but proactive preventive behaviors (e.g., monitoring kidney function, discussing kidney health with providers, engaging in regular physical activity, etc.) showed lower uptake. While medication-taking requires a one-time prescription followed by routine consumption (29), diabetes self-management requires an ongoing education and support that facilitates problem solving and skills acquisition (30).

Effective health communication is also important in addressing widespread misconceptions about DKD (31). In our cohort most participants believed that early kidney damage cause pain or other symptoms. If patients assume they will experience pain when the disease occurs, the absence of symptoms may act as a false indicator of health (32). Recent literature suggests that because early-stage CKD is often clinically silent, inadequate communication of the diagnosis and its risks is an important barrier to CKD awareness among people with diabetes (33). Given that 91.3% of participants identified healthcare workers as their most trusted source of information, clinical encounters offer a unique opportunity for proactive communication to improve awareness and support sustained self-management in people with diabetes.

In crafting such communication, it is important to provide person-centered messages that are culturally tailored to address local beliefs. Although most participants in our study expressed strong motivation to learn about kidney protection practices (75.4%), believed check-ups protect kidneys (70.0%), and felt confident in preventive behaviors (64.7%), a substantial majority (72.9%) simultaneously believed that health outcomes are predetermined by fate or God. This high level of fatalism represents a significant challenge to perceived control, which serves as a psychological mediator for successful self-management. Literature suggests that if individuals approach a situation as largely uncontrollable, they are less likely to sustain healthy behavior (34, 35). Such disconnect between wanting to obtain knowledge and believing one has not the agency to change outcomes can create a barrier to cultivating a positive attitude toward the disease and building the emotional resilience required to navigate its lifelong psychological burdens and daily stresses. Educational strategies must therefore explicitly assess fatalistic health beliefs from the outset, since without the focus on a person's beliefs and desires, ongoing treatment goals can rarely be met (36).

Structural barriers further compounded these psychosocial challenges, with approximately 70% of participants reporting substantial obstacles related to cost, distance, or time. These findings are consistent with evidence from comparable settings, which have documented interconnected barriers including economic hardship, lack of family support, work-related time constraints, transportation difficulties, and limited access to healthcare services (35, 37, 38). In Kyrgyzstan's context, these barriers may be especially pronounced for rural residents who must travel long distances to access specialist care, often requiring substantial transportation costs (12). Health system capacity for diabetes self-management education also appears limited, with specialist services concentrated in regional centers and diabetes education programs largely unavailable at the primary healthcare level (39). Primary care facilities often lack basic diagnostic capacity for kidney function assessment, requiring patients to travel for tests that should be routine (18).

Similarly, dietary modifications (lowering sugar and salt intake) were partial, likely reflecting broader structural constraints. Kyrgyzstan has one of the highest sodium intakes globally, with mean consumption of 5.38 g/day compared to WHO recommendation of less than 2 g/day (40). Furthermore, healthier options appear less accessible in southern regions (41). Overall, effective kidney protective self-management in this setting is not merely a matter of individual willpower but is contingent on structural conditions that enable (or impede) sustained preventive practices, particularly among underserved populations.

Despite reporting high trust in healthcare workers, fewer than half of the participants had received prior information about DKD. This discrepancy reveals a major, yet highly actionable, missed opportunity, as every routine diabetes consultation serves as a potential intervention point for preventive health communication. Bridging this gap requires strengthening provider communication capacity through structured training programs that integrate person-centered DKD education into standard care. Furthermore, because providers themselves operate within constrained environments, future research must investigate the system-level factors that currently restrict the delivery of effective health communication during routine diabetes care, including consultation time limits, competing clinical priorities, and gaps in guideline implementation.

Several limitations warrant consideration when interpreting these findings. Consecutive sampling from three healthcare facilities limits generalizability to healthcare-engaged individuals in southern Kyrgyzstan, potentially excluding those not in regular care who may have poorer KAP. Although practical support was provided for participants without smartphones or with limited digital literacy, including interviewer-assisted administration when needed, individuals with limited access to care, lower digital confidence, or residence in remote rural settings may still have been underrepresented. Therefore, our findings may be biased toward more health-engaged participants and may overestimate KAP levels. Self-reported data may also be subject to social desirability bias, which cannot be fully excluded despite the anonymous, primarily self-administered survey format and the use of neutral clarification by research assistants. Although the questionnaire demonstrated

acceptable internal consistency (Cronbach's α = 0.77–0.81), it has not been fully psychometrically validated in Kyrgyz or Russian populations, and the findings should be interpreted as preliminary. We did not assess specific DKD information content or clinical outcomes, limiting identification of effective educational approaches or examination of clinical relevance. Finally, single-month data collection may reflect seasonal variations.

Supplementary Materials

Supplementary Figure 1. Percentage of correct responses to knowledge items (n=207).
Supplementary Figure 2 Percentage of responses to attitude items (n=207).
Supplementary Figure 3 Percentage of responses for practice items (n=207).
Supplementary Table 1 Survey tool
Supplementary Table 2 Correlations between knowledge, attitude and practice scores (n=207)
Supplementary file available via: https://www.cajn-journal.org/suppfile/745/Supplemetary-material_cajn012.pdf

Conclusion

This study provides the first systematic assessment of DKD knowledge, attitudes, and practices among adults living with T2D in Kyrgyzstan. The findings highlight the critical role of provider-patient communication and support integrating structured DKD counseling into routine care to strengthen patient self-management. Educational programs should prioritize practical, skills-based communication about screening routines and actionable kidney-protective behaviors. Furthermore, these initiatives must explicitly address patient misconceptions and strengthen self-efficacy by aligning health messages with local beliefs. Further research should formally validate the instrument and evaluate scalable provider-focused communication strategies, such as targeted training and standardized counseling protocols, to determine their impact on sustained preventive behaviors and clinical outcomes.

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