

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

Supplementary material

Supplementary Methods

Sample size

The minimum required sample size for this cross-sectional study was determined using a standard precision-based formula for single proportions (1). Assuming a conservative prevalence of 50% and a 95% confidence level ($Z = 1.96$), with a margin of error of $\pm 7\%$ selected to balance precision with feasibility in a resource-limited setting, the minimum sample size was 196 participants. After adjusting for an anticipated 5% rate of incomplete responses, the final enrollment target was established as 206. Using consecutive sampling, collaborating physicians (XXX) identified eligible adults with type 2 diabetes from facility registers, and eligible patients were approached during scheduled visits at three public healthcare facilities in Osh, Kyrgyzstan (XXX). In total, 252 eligible individuals were approached, and 207 consented and completed the survey. Recruitment ended once the target sample size was reached.

Survey instrument

The survey instrument was a structured, self-administered questionnaire developed through a comprehensive literature review of validated diabetic kidney disease (DKD) related Knowledge, Attitudes and Practices (KAP) instruments (2-4) and adapted to the local context through consultations with endocrinologists and nephrologists in Kyrgyzstan. The questionnaire was translated into Kyrgyz and Russian and back-translated by bilingual researchers (XXX) to confirm the accuracy of technical terminology. The survey comprised several sections covering sociodemographic characteristics, socioeconomic indicators, health and well-being, information sources, and the KAP scales (Supplementary Table 1). It was pilot tested in both languages with two patients with diabetes, and knowledge items were rephrased for clarity. The results of the pilot surveys were not included into the main analysis.

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. 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.

Statistical significance was set at $p < 0.05$. Bias minimization strategies included consecutive sampling, validated instruments, standardized training, anonymous data collection, and multivariable adjustment for confounding. We followed the STROBE guidelines for cross-sectional studies (5).

Supplementary Table 1 Survey tool

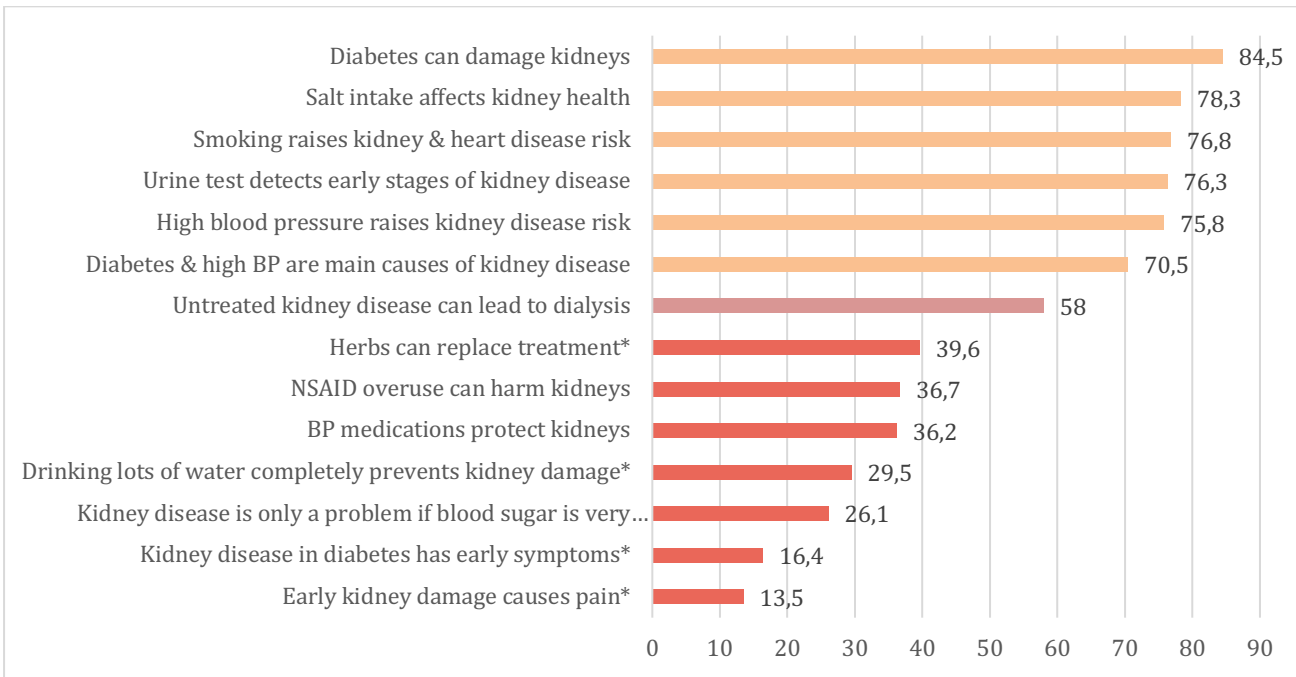
Section	Q #	Question	Response Options
Screening	1	Informed Consent	Yes, I agree / No, I don't agree
	2	Have you ever been diagnosed with diabetes?	Yes / No / Don't know
	3	What type of diabetes do you have?	Type 1 / Type 2 / Gestational / Don't know
	4	Who diagnosed your diabetes?	Doctor / Nurse / Self / Don't remember
A: Socio-demographic	A1	Your age (in years)	Open-ended (numeric)
	A2	Your gender	Male / Female
	A3	Marital status	Single / Married / Widowed / Divorced
	A4	Main language for communication	Kyrgyz / Russian / Uzbek / Tajik / Kazakh / Other
	A5	Living region	Osh / Osh region / Batken region / Jalalabad region / Other
	A6	Type of living place	City / Town / Rural
B: Socioeconomic	B1	Education level	No formal schooling / Primary (1-4) / Basic secondary (5-9) / Full secondary (10-11) / Vocational/technical / Higher education / Graduate/postgraduate
	B2	Current working status	Full-time / Part-time / Self-employed / Unemployed / Housewife / Retired / Student / Unable to work / Other
	B3	Occupation	Agriculture / Worker / Trade/business/services / Public sector / Private sector / Other
	B4	Approximate monthly family income	<10,000 KGS / 10,001-20,000 / 20,001-30,000 / 30,001-50,000 / 50,001-80,000 / >80,000 / Difficult to answer
	B5	Type of housing	Apartment (own) / Apartment (rent) / Private house (own) / Private house (rent) / Other
	B6	How do you get your medications? (multiple)	Buy at own expense / Buy with partial coverage / Free under state program / Family help / Charity assistance / Don't take medications / Other
C: Health & Well-being	C1	Number of family members living together	Open-ended (numeric)
	C2	Family members with diabetes?	No / Yes-parent(s) / Yes-sibling(s) / Yes-child(ren) / Other
	C3	How long have you had diabetes?	<1 year / 1-5 years / 6-10 years / 11-15 years / >15 years / Difficult to answer
	C4	Do you smoke?	Never / Quit / Sometimes (<1/day) / Daily (<10 cigarettes) / Daily (>10 cigarettes)
	C5	Do you drink alcohol?	Never / Quit / Rare (<1/month) / Sometimes (1-3/month) / Regular (1-3/week) / Often (>3/week)
	C6	Do you have other diseases? (multiple)	Hypertension / Heart problems / Stroke / Lung problems / Vision problems / Kidney problems / Numbness / Don't know / None / Other
	C7	Who do you turn to first for health problems?	Doctor / Family / Religious leader / Healer / Home treatment / Other
D: Information Sources	D1	Where do you get diabetes information? (multiple)	Healthcare workers / Relatives with diabetes / Other family / Friends/colleagues / Religious leaders / Healers / Social media / Internet / TV/newspapers / Other
	D2	Who do you trust most for health information? (one option)	Healthcare workers / Relatives with diabetes / Other family / Friends/colleagues / Religious leaders / Healers / Social media / Internet / TV/newspapers / Other

	D3	Have you received kidney protection information from health worker?	Yes / No / Don't remember
E: Knowledge (True/False/Don't know)	E1	Diabetes can damage small blood vessels in kidneys	True* / False / Don't know
	E2	High blood pressure increases kidney disease risk in diabetes	True* / False / Don't know
	E3	Diabetes and high blood pressure are most common causes of kidney disease	True* / False / Don't know
	E4	Excess salt intake can affect kidney health	True* / False / Don't know
	E5	Smoking increases kidney and heart disease risk	True* / False / Don't know
	E6	Early kidney damage usually causes pain	True / False* / Don't know
	E7	Kidney disease only is a problem if blood sugar is very high	True / False* / Don't know
	E8	You will always know if you have kidney disease because it has clear symptoms	True / False* / Don't know
	E9	Urine test can help detect early kidney problems	True* / False / Don't know
	E10	Blood pressure medications can also protect kidneys	True* / False / Don't know
	E11	Folk remedies/herbs can completely replace medical treatment of diabetes	True / False* / Don't know
	E12	If untreated, diabetic kidney disease may require dialysis	True* / False / Don't know
	E13	Overusing pain medications (such as ibuprofen) can harm kidneys	True* / False / Don't know
	E14	Drinking lots of water completely prevents kidney damage	True / False* / Don't know
		Scoring: 0-5 = Low; 6-10 = Moderate; 11-14 = Good	(* = correct answer)
F: Attitudes (5-point Likert)	F1	I sometimes feel worried that I could develop kidney disease	1=Strongly Disagree to 5=Strongly Agree
	F2	Many people with diabetes develop kidney disease	1=Strongly Disagree to 5=Strongly Agree
	F3	Kidney disease is one of most serious complications of diabetes	1=Strongly Disagree to 5=Strongly Agree
	F4	Regular check-ups can protect my kidneys	1=Strongly Disagree to 5=Strongly Agree
	F5	Cost/distance/time make it hard to get regular kidney check-ups (R)	1=Strongly Disagree to 5=Strongly Agree
	F6	I'm worried about kidney disease affecting my family	1=Strongly Disagree to 5=Strongly Agree
	F7	I want to know more about protecting my kidneys	1=Strongly Disagree to 5=Strongly Agree
	F8	I believe I can slow/prevent kidney disease with my actions	1=Strongly Disagree to 5=Strongly Agree
	F9	I trust my doctor's advice on protecting kidneys	1=Strongly Disagree to 5=Strongly Agree
	F10	Little depends on me—everything is decided by fate/God (R)	1=Strongly Disagree to 5=Strongly Agree

		Scoring: 10-25 = Low; 26-37 = Moderate; 38-50 = High	(R) = reverse scored
G: Practices (5-point frequency)	G1	I take my diabetes medications as prescribed	1=Never to 5=Always
	G2	I try to eat less salty foods	1=Never to 5=Always
	G3	I try to eat fewer sweets and sweet drinks	1=Never to 5=Always
	G4	I try to move more every day (walk, light exercise)	1=Never to 5=Always
	G5	I have kidney function checked at least once a year	1=Never to 5=Always
	G6	I don't take painkillers without doctor's prescription	1=Never to 5=Always
	G7	I talk with the doctor about my kidney's health	1=Never to 5=Always
	G8	I remind family members with diabetes to get their kidney function checked	1=Never to 5=Always
		Scoring: 8-18 = Low; 19-29 = Moderate; 30-40 = High	
H: Open-ended	H1	What helps you follow doctor's recommendations?	Open-ended text response
	H2	What information about diabetes/kidney disease would you like to learn?	Open-ended text response
	H3	What do you think about using folk/herbal remedies for diabetes?	Open-ended text response

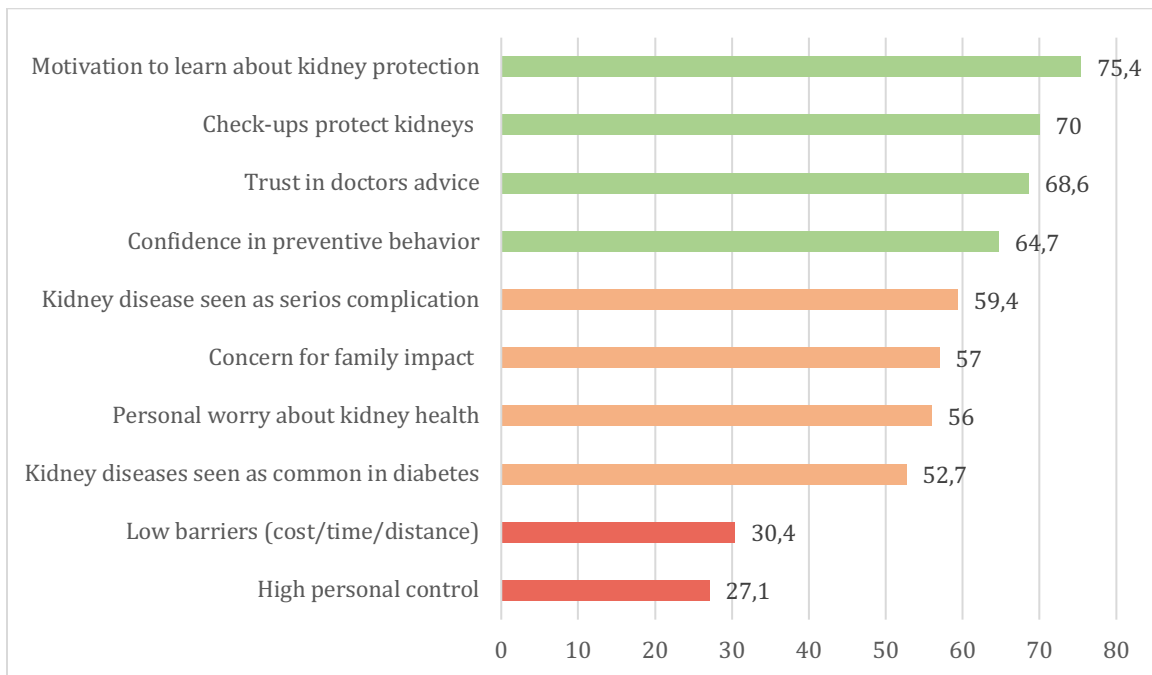
Notes: R – reverse coding

Supplementary Figure 1 Percentage of correct responses to knowledge items (n=207)

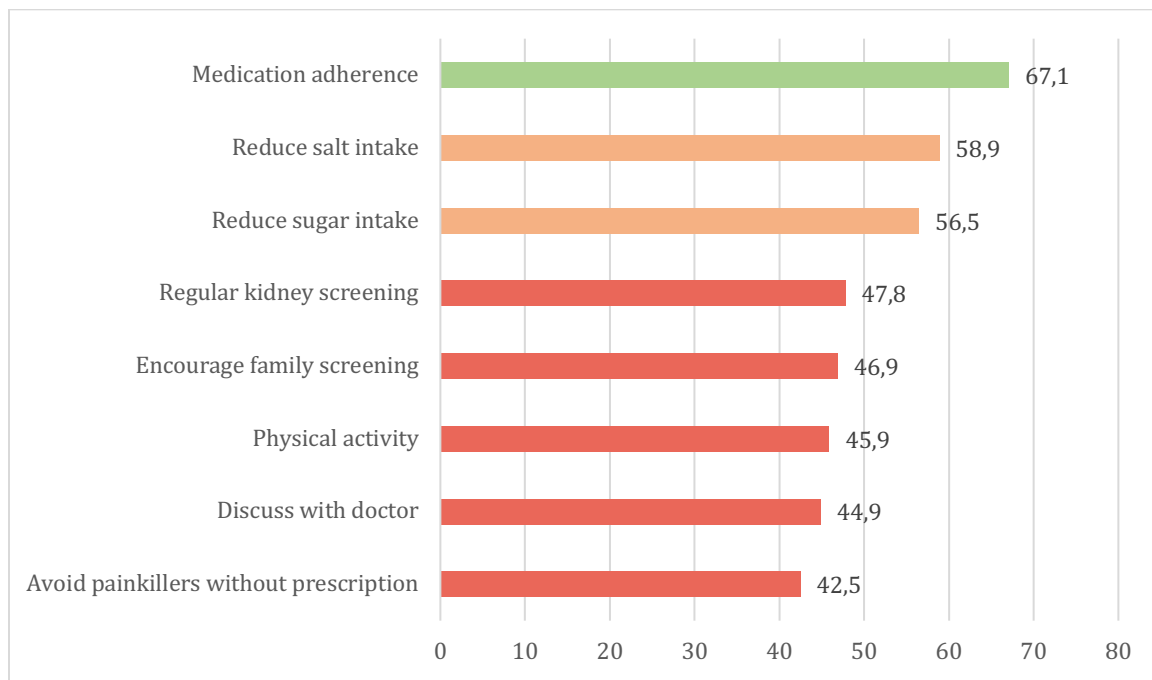


Notes: BP - blood pressure; NSAID - non-steroid anti-inflammatory drug.
 *False statement items (correct response=recognizing statement as false)

Supplementary Figure 2 Percentage of responses to attitude items (n=207)



Supplementary Figure 3 Percentage of responses for practice items (n=207)



Supplementary Table 2 Correlations between knowledge, attitude and practice scores (n=207)

Variable	Knowledge	Attitude	Practice
Knowledge	1.000	-	-
Attitude	0.488***	1.000	-
Practice	0.352***	0.492***	1.000
n	207	207	207

Notes: *** $p < 0.001$

Supplementary References

1. Lwanga SK, Lemeshow S. Sample size determination in health studies: a practical manual. WHO; 1991.
2. Badran A, Bahar A, Tammam M, Bahar S, Khalil A, Koni AA, et al. The relationship between diabetes-related knowledge and kidney disease knowledge, attitudes, and practices: a cross-sectional study. *BMC Public Health*. 2023;23(1):480.
3. Wang D, Liu Z, Liu Y, Zhao L, Xu L, He S, et al. Knowledge, attitudes, and practices among patients with diabetes mellitus and hyperuricemia toward disease self-management. *Front Public Health*. 2024;12:1426259.
4. Dia N, Ferekh S, Jabbour S, Akiki Z, Rahal M, Khoury M, et al. Knowledge, attitude, and practice of patients with diabetes towards diabetic nephropathy, neuropathy and retinopathy. *Pharm Pract (Granada)*. 2022;20(1):2608.
5. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *The Lancet*. 2007;370(9596):1453-7.