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Kidney health knowledge level and affecting factors in adolescents: A cross-sectional study

Ergenlerde böbrek sağlığı bilgi düzeyi ve etkileyen faktörler: Kesitsel bir çalışma

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ABSTRACT

Aim: This study aimed to evaluate the knowledge of kidney health among high school students and examine how demographic and behavioural factors, including attitudes towards the conscious use of technology (CTU), influence this knowledge.

Methods: A cross-sectional study was conducted between January and May 2024, involving 320 students aged 14–18 from six schools in north-eastern Türkiye. Schools were selected using multistage stratified cluster sampling. Data were collected using the Kidney Health Information Questionnaire and the Attitudes Towards Digital Technology Scale.

Results: The mean age of the students was 15.62 ± 1.11 years, with 57.8% being male. 56.5% of students answered more than half of the kidney health questions correctly. Multiple regression analysis revealed that school type (β=0.36), prior knowledge of kidney disease (β=0.18), and CTU (β=0.12) were significant predictors of knowledge about kidney health (F=17.50; p<0.001), with the model explaining 22.2% of the total variance.

Conclusions: Adolescents' knowledge of kidney health is inadequate, but CTU appears to enhance it. School-based programmes using digital resources may help to close this knowledge gap.

Keywords: Adolescents; conscious technology use; kidney health; level of knowledge

ÖZ

Amaç: Bu çalışma, lise öğrencilerinin böbrek sağlığı hakkındaki bilgilerini değerlendirmeyi ve bilinçli teknoloji kullanımına (BTK) yönelik tutumlar da dahil olmak üzere demografik ve davranışsal faktörlerin bu bilgiyi nasıl etkilediğini incelemeyi amaçlamıştır.

Yöntem: Ocak-Mayıs 2024 tarihleri arasında Türkiye'nin kuzeydoğusundaki altı okuldan 14- 18 yaş arası 320 öğrenci ile kesitsel bir çalışma yapılmıştır. Okullar, çok aşamalı tabakalı küme örnekleme yöntemi kullanılarak seçilmiştir. Veriler, Böbrek Sağlığı Bilgi Anketi ve Dijital Teknolojiye Yönelik Tutum Ölçeği kullanılarak toplanmıştır.

Bulgular: Öğrencilerin ortalama yaşı 15.62±1.11 yıl olup %57.8'i erkekti. Öğrencilerin %56.5'i böbrek sağlığı ile ilgili soruların yarısından fazlasını doğru yanıtlamıştır. Çoklu regresyon analizi sonucunda, okul türü (β=0,36), daha önce böbrek hastalığı hakkında bilgi sahibi olma (β=0.18) ve BTK (β=0.12), böbrek sağlığı hakkındaki bilgi düzeyini anlamlı şekilde tahmin etmiştir (F=17.50; p<0.001) ve model toplam varyansın %22.2'sini açıklamıştır.

Sonuç: Ergenlerin böbrek sağlığı bilgisi yetersizdir, ancak BTK bunu artırıyor gibi görünmektedir. Dijital kaynakları kullanan okul tabanlı programlar bu bilgi açığını kapatabilir.

Anahtar Kelimeler: Ergenler; bilinçli teknoloji kullanımı; böbrek sağlığı; bilgi düzeyi

Introduction

Chronic kidney disease (CKD) is a progressive condition affecting over 800 million individuals worldwide, representing more than 10% of the global population. It is one of the leading causes of death worldwide (Kovesdy, 2022). The Global Burden of Disease (GBD) study revealed that CKD prevalence has increased by 33% in recent years (GBD Chronic Kidney Disease Collaboration, 2020). Furthermore, GBD-2019 data indicates a substantial increase in early-onset CKD among individuals aged 10–24 years (Sun et al., 2024). Specific adolescent risk factors play a critical role in this increase, as adolescence is a sensitive developmental period involving profound physical, cognitive, emotional and social changes, during which lifelong health habits begin to form (Best & Ban, 2021; Daly & Kearney, 2022).

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At this stage, which is generally considered to be the healthiest period in society, adolescents may struggle to access the right information and resources, making them vulnerable to risky behaviours (Moore, Heslin & McNulty, 2023; Patton et al., 2016). Adopting unhealthy habits during this period significantly increases the prevalence of non-communicable diseases and associated risk factors (Sawyer et al., 2012). Most of these diseases are associated with modifiable factors such as nutrition, obesity, rational drug use, smoking, and water consumption. For instance, being overweight or obese has been shown to significantly increase the risk of end-stage renal disease, both diabetic and non-diabetic, in adolescents (Vivante et al., 2012). A study of obese adolescents found that 17% of participants had protein in their urine and 3% had an estimated glomerular filtration rate below 60 ml/min/1.73 m² (Nehus & Mitsnefes, 2019). Furthermore, the risk of acute kidney injury increased by 23% in children prescribed high-dose ibuprofen (Luyckx, Cherney & Bello, 2019; Su et al., 2021), whereas smoking was shown to increase the risk of proteinuria by over twofold (Ito et al., 2020). Conversely, adolescents with low water intake have been reported to be at a higher risk of both chronic kidney disease and proteinuria than those with high water intake (Wang & Jiang, 2021). In summary, behavioural factors during adolescence can impair kidney function and negatively affect kidney health (Korkmaz & Topbaş, 2023).

Globally and in Türkiye, adolescents constitute a substantial proportion of the population, underscoring the importance of promoting healthy lifestyle behaviours in this age group. Adolescents represent approximately 16% of the global population (UNICEF, 2022). In Türkiye, 15.1% of people are aged 10–24, with 30.3% of this group being 15–17 years old (Turkish Statistical Institute, 2024). These demographic characteristics highlight the need to improve adolescents' knowledge of kidney health. While a few studies have examined adolescents' knowledge of kidney function and chronic kidney disease (CKD) (Loo et al., 2022; Sowtali, Mohd Rasani & Mohd Shah, 2019; Ngendahayo et al., 2019; Vassilikopoulos, Kalokairinou, Kourlaba & Grapsa, 2021), these studies have not sufficiently explored the broader determinants that may influence adolescents' knowledge levels. Evidence suggests that variables such as gender and health awareness experiences may influence adolescents' health knowledge and behaviours (Achak et al., 2024; Mazur, Kleszczewska, Malksowska-Szkutnik & Dzielska, 2024; Nakamura, Kaseda, Takeuchi, Kitabayashi & Narita, 2025). Therefore, it is essential to examine how similar factors may specifically influence adolescents' knowledge about kidney health.

In today's digital age, young people often use technology and spend a significant amount of time on digital platforms (Pew Research Center, 2024). This intensive digital engagement significantly influences health habits (Van Sluijs et al., 2021). Adolescents are increasingly turning to online resources, including websites and social media, to find information about sexual health, mental health, chronic and infectious diseases, and nutrition (Taba et al., 2022). Similarly, Park and Kwon (2018) reported that young people actively seek information online regarding topics central to their well-being. However, unconsciously using online environments may expose adolescents to biased, inaccurate or low-quality information, which could lead to negative health outcomes (Taba et al., 2022). In this context, Conscious Technology Use (CTU) (Camalan & Demirbaş, 2024) — the controlled and purposeful use of technology only when needed — may help adolescents access accurate, reliable health information and reduce technology-related risks (e.g. inactivity, obesity, sleep problems) (Patton et al., 2016; Reid Chassiakos et al., 2016).

Studies have shown that the correct and controlled use of social media and digital platforms increases young people's health awareness and positively changes their health behaviours (de Sousa, Fogel, Azevedo & Padrão, 2022). Reliable content shared by health professionals can reinforce young people's health knowledge and support them in making healthy life choices (Kruzan et al., 2022; Saboor, Medina & Marciano, 2024; Kulandaivelu et al., 2023). Therefore, CTU has great potential to raise and create awareness and encourage behavioural change by providing young people with access to accurate information on complex health issues, such as kidney health. This study will investigate the effect of CTU on kidney health knowledge levels, bringing a new perspective to the subject.

Given these considerations, the study aims to address the existing gap in the literature by evaluating adolescents' knowledge of kidney health and identifying the factors that influence it. Accordingly, the following research questions were formulated:

- What is the level of kidney health knowledge among adolescents?
- Do sociodemographic characteristics and CTU significantly predict adolescents' kidney health knowledge levels?

Methods

Study Design and Participants

This cross-sectional study was conducted with high school students in a provincial centre in north-eastern Türkiye (Rize, Türkiye) between January and May 2024. Participants were young people aged 14–18 who had no chronic diseases, were fluent in Turkish, were enrolled in formal education and had signed the written consent form. Students who reported having kidney disease were excluded. However, during data collection, one student stated that they had previously been diagnosed with kidney disease and were receiving peritoneal dialysis treatment, so they were excluded from the study.

Sampling and Sample Size

The study population consisted of 7,113 students enrolled in 19 public high schools during the 2024–25 academic year. Only general public high schools were included in the study. Vocational and technical high schools providing health-related education were excluded because their intensive health-focused curricula could influence students' knowledge levels systematically and limit the generalisability of the findings to the general high school population.

The sample was selected using multi-stage stratified cluster sampling. In the first stage, six schools were selected from the 19 public high schools with a probability proportional to their student numbers. In the second stage, two classes were randomly selected in each school and all students in these classes were included in the sample. The required sample size was calculated using G Power 3.1.9.4 to be 232 at a significance level of 5%, with 99% power and a medium effect size of 0.15, based on 11-variable multiple regression analysis. Questionnaires were distributed to a total of 320 students, all of whom completed them.

Data Collection Tools

Data were collected using the Kidney Health Information Questionnaire and the Attitudes towards Digital Technology Scale.

Kidney Health Information Questionnaire

The Kidney Health Knowledge Questionnaire (KHKL) consisted of two parts. The first part assessed students' characteristics and medical history.

The second part included the KHKL, which was developed specifically for this study based on a comprehensive review of the literature rather than being adapted from an existing scale. The KHKL consisted of 10 items assessing adolescents' knowledge of kidney health. Each correct answer received 1 point, while participants who answered incorrectly or selected 'don't know' received 0 points. Thus, total scores ranged from 0 to 10, with higher scores (≥5) indicating greater knowledge.

The KHKL for adolescents was developed following a systematic, multi-step process. Firstly, an extensive review of relevant literature on kidney health and disease in adolescents was conducted, resulting in the creation of an initial 11-item question pool (Chow et al., 2012; Vassilikopoulos et al., 2021; Loo et al., 2022). To establish content validity, the draft questionnaire was evaluated using the Lawshe content validity method. A panel of eight subject-matter experts, including specialists in paediatric nursing, nephrology and public

health, independently assessed each item for essentiality. Items were rated as essential, useful but not essential, or not necessary. The Content Validity Ratio (CVR) was then calculated for each item based on the experts' judgements. One item yielded a negative CVR value and was excluded. According to Lawshe's method, the minimum acceptable critical CVR value for eight experts at $\alpha = 0.05$ is 0.75 (Almanasreh, Moles & Chen, 2019; Ayre & Scally, 2014). The remaining ten items demonstrated CVR values that exceeded the minimum acceptable threshold. The overall Content Validity Index (CVI) was 0.97, indicating excellent content validity.

After the content validity of the KHKL questionnaire had been established, it was pilot-tested with 30 students to assess its clarity, comprehensibility and face validity. The data obtained during this phase were not included in the main study, but minor revisions were made based on feedback from participants.

Attitude Towards Digital Technology Scale

Attitude towards digital technology scale was developed by Cabi (Cabi, 2016). Each sub-dimension of the scale is calculated separately, with a positive attitude being indicated by higher scores in that sub-dimension. The scale does not have a total score. The conscious use sub-dimension of the scale was used in this study. While the original reliability coefficient of the 'conscious use' sub-dimension, consisting of three questions, was 0.61, this study found it to be 0.82.

Data Collection

The purpose of the study was explained to school principals and they were invited to participate. After approval was given, a consent form was given to students in the sample group, and their parents were informed about the study's purpose and the data collection process. Parents were also informed that participation was voluntary and that the data collected would be kept anonymous and confidential in accordance with the research principles defined in the Declaration of Helsinki. Only students who provided signed consent forms took part in the study. Students were invited to participate in the survey between January and May 2024. The researcher then distributed the questionnaire directly to the students. Participants were given sufficient time to complete the questionnaire.

Ethical Approval

Ethical approval for the study was obtained from the Recep Tayyip Erdoğan University Non-Interventional Clinical Research Ethics Committee (Number: E-40465587-050.01.04-903).

Data Analysis

The data were analysed using SPSS Statistics 26.0 (IBM Corp., Armonk, NY, USA). Missing data were excluded (n = 7,320/313). The normal distribution of the data was analysed by calculating the kurtosis and skewness coefficients, with the results falling between +1 and -1.

Categorical data were defined as frequency (n) and percentage (%), while continuous data were defined as mean and standard deviation (SD). A multiple linear regression model was used to analyse the variables affecting the level of kidney health knowledge among adolescents. Multicollinearity and the independence of residuals were tested in the regression model. The Durbin–Watson test statistic showed no autocorrelation. The normality and homoskedasticity conditions of the error terms were met. An acceptable significance level was determined as $p < 0.05$.

Strengths and Limitations of the Study

While most kidney health research has focused on older age groups, this study focused specifically on adolescents, revealing knowledge and awareness gaps in younger age groups. This emphasises the importance of starting preventive and protective practices earlier. Additionally, the study offers a unique and up-to-date approach to understanding the health behaviours of young people in the digital age by focusing on the positive

and negative potentials of conscious technology use in health education, an area that has been less studied in the literature.

However, the study has some limitations. As the study was limited to secondary education institutions in a provincial centre, the results may not be generalisable. The lack of valid and reliable psychometric measurement tools for kidney health meant that the study had to be conducted using questionnaires created by reviewing the literature. This limitation was mitigated by providing content validity, face validity, and internal consistency coefficients, which are critical parameters for measurement validity. Since the data were collected through self-reporting, there is a risk of social desirability bias.

Results

Of the students, 57.8% were male, and 50.5% of these knew about kidney disease. The mean age was 15.62 years (Table 1).

Table 1. Sociodemographic and medical history characteristics of the adolescents

Variables	**n**	**%**
School		
Science high schools	159	50.8
Social sciences high schools	74	23.6
Anatolian high schools	80	25.6
Gender		
Famale	132	42.2
Male	181	57.8
Kidney Disease Hearing Status		
Yes	158	50.5
No	155	49.5
Presence of Kidney Disease in Relatives		
Yes	8	2.6
No	305	97.4
Presence of Diabetes		
Yes	4	1.3
No	309	98.7
Presence of Diabetes in Relatives		
Yes	70	22.4
No	243	77.6
Presence of High Blood Pressure		
Yes	5	1.6
No	308	98.4
Presence of High Blood Pressure in Relatives		
Yes	65	20.8
No	248	79.2
	X±SD	**Min-Max**
Age	15.62±1.11	14-18
Total	313	100

N: Number, %: Percentage; X: Mean, SD: Standard deviation, Min: Minimum, Max: Maximum

The students were asked ten questions on renal functions and symptoms, the answers to which are shown in Table 2. Most students (83.1%) gave the incorrect answer to the question, 'Do symptoms of kidney disease, such as back pain and decreased urination, become apparent immediately after the disease develops?', and most students (84.7%) gave the correct answer to the question, 'What is the role of the kidney in the human body?'. Seven students could not answer any of the questions correctly, and none could answer all of them correctly. 56.5% of students answered five or more questions correctly. 43.5% of students had below-average knowledge of renal health (Table 2).

Table 2. Students' level of knowledge about kidney health

Questions		N	%
How many healthy kidneys does a person need to lead a normal life?	NIR	223	71.2
	NCR	90	28.8
What is the role of the kidney in the human body?	NIR	48	15.3
	NCR	265	84.7
What can cause kidney disease?	NIR	132	42.2
	NCR	181	57.8
What is the best treatment for end-stage renal failure (kidney failure)?	NIR	126	40.3
	NCR	187	59.7
The nephrons, which are the smallest building blocks of the kidney and are responsible for cleansing the blood of waste products, are not self-renewing.	NIR	227	72.5
	NCR	86	27.5
Urine is formed as a result of the kidneys filtering (cleaning) waste products from our blood	NIR	239	76.4
	NCR	74	23.6
The presence of protein, glucose, erythrocytes, or leukocytes in the urine indicates that the kidney is functioning properly	NIR	239	76.4
	NCR	74	23.6
Symptoms of kidney disease, such as back pain and decreased urination, become apparent immediately after the disease develops	NIR	260	83.1
	NCR	53	16.9
Kidney disease is known to be caused by unchangeable factors such as age and genetics as well as changeable factors such as blood pressure and weight.	NIR	85	27.2
	NCR	228	72.8
Where can dialysis treatment be performed?	NIR	194	62.0
	NCR	119	38.0

N: Number, %: Percentage, NIR: Number of incorrect responses NCR: Number of correct responses

Multiple linear regression analysis was used to test the prediction of variables on the KHKL score. Sociodemographic characteristics and CTU were found to be statistically significant predictors of the renal health knowledge score ($F = 17.50$, $p < .00$). All the variables together explained 22.2% of the variance in the KHKL score (adjusted $R^2 = 0.22$). The most important predictors of the KHKL score were school type (β=0.36; p=0.00), having heard about kidney disease before (β=0.18; p=0.00), and CTU (β=0.12; p=0.03) (Table 3).

Table 3. The level of prediction of sociodemographic and CTU variables on students' KHKL scores

	Unstandardized Coefficients		Standardized Coefficients	t	p	95.0% CI		Collinearity Statistics	
Independent variables	**B**	**SE**	**β**			**Lower**	**Upper**	**Tolerance**	**VIF**
(Constant)	2.82	0.53		5.28	0.00	1.75	3.88		
Gender (R= Male)									
Female	-0.17	0.20	-0.04	-0.82	0.41	-0.58	0.23	0.96	1.04
Hearing of Kidney Disease (R= No)									
Yes	0.73	0.20	0.18	358	**0.00	0.33	1.14	0.96	1.03
School type (R= Social Sciences High School)									
Science High Schools	1.46	0.26	0.36	5.66	**0.00	0.95	1.97	0.61	1.63
Anatolian High Schools	0.05	0.31	0.01	0.17	0.86	-0.56	0.67	0.54	1.84
CTU	0.08	0.04	0.12	2.15	*0.03	0.00	0.17	0.72	1.37

Notes: Dependent variables: KHKL, Durbin-Watson = 1.60; $F = 17.50$, $p < .000$; $R = 0.47$; $R^2 = 0.22$; Adjusted $R^2 = 22.2\%$. Abbreviations: CI, confidence interval; SE, standard error; β, standardized regression coefficient.

Notes: KHKL: Kidney Health Knowledge Level, CTU: Conscious Technology Use.

* Significance level was accepted as $p < .050$.

**Significance level was accepted as $p < .001$

Discussion

Chronic kidney disease is a serious public health problem that develops rapidly and insidiously. In order to prevent the development and progression of this disease, it is crucial that society has sufficient knowledge. According to our study, approximately half of students lack sufficient knowledge about kidney health. This

finding is consistent with the 43.5% rate reported by Sowtali et al. (2019) among Malaysian undergraduates. Similarly, Loo et al. (2022) found that 32.6% of students at a public university in Klang Valley, Malaysia, had low levels of knowledge. Meanwhile, Ngendahayo et al. (2019) reported that 44% of university students in Rwanda (East Africa) demonstrated low knowledge regarding chronic kidney disease. Taken together, these findings suggest that insufficient knowledge about kidney health is a widespread public health concern across different geographic regions and educational contexts.

The main results of this study show that, although adolescent participants are relatively aware of certain issues, some critical aspects of kidney health remain poorly understood. While the majority of participants (84.7%) knew that the main function of the kidneys is to filter waste products from the blood, only 16.9% recognised that kidney diseases can progress without symptoms. Similar findings have been reported in previous research. For example, in a study by Chow et al., 82.4% of participants correctly identified the main function of the kidney, but only 4.5% recognised that kidney disease can progress without symptoms (Chow et al., 2012). These results suggest that, although adolescents have a relatively adequate understanding of basic anatomy and physiology, their awareness of kidney disease risk factors and asymptomatic progression remains limited. Rather than reflecting differences in academic achievement, this pattern indicates potential gaps in health literacy education. Given the well-established role of school health education in fostering an informed and healthy population (Birch, 2017), these findings emphasise the importance of reinforcing kidney health–related content in school health education programmes and public health initiatives.

This study found that the kidney health knowledge levels of adolescents were affected by variables such as school type, prior knowledge of kidney disease, and conscious technology use. Students from numeracy-oriented schools, in particular, had higher levels of kidney health knowledge. This may be because subjects related to kidney anatomy and function are covered in more depth in these programmes, and because these students prioritise these fields in high school in line with their health-oriented career goals, such as medicine and engineering. Therefore, the importance of the information and awareness provided in the school environment is clear (Birch, 2017).

In this study, adolescents with prior knowledge of kidney disease demonstrated higher levels of health-related knowledge. This finding is consistent with previous evidence suggesting that emotional and cognitive factors, such as perceived health threat and health anxiety, are associated with more active and selective health information-seeking behaviour, particularly in online environments (Svestkova, Kvardova & Smahel, 2024; Wedderhoff, Chasiotis & Rosman, 2022). Meanwhile, the rapid development of digital infrastructure and social media platforms has created new opportunities to access health information, playing a critical role in the widespread and rapid dissemination of such content (Langham et al., 2022). In this context, prior exposure to disease-related information and the conscious use of digital technologies can encourage adolescents to engage with reliable health information and make them more aware of health-related issues. These findings therefore underscore the importance of supporting adolescents' health literacy and critical digital competencies. They also suggest that school-based health education and public health initiatives should incorporate structured guidance on kidney health, as well as promoting the conscious and informed use of digital health resources.

Conclusions

Chronic kidney disease (CKD) is a growing global health concern that places a significant burden on health systems (Foreman et al., 2018). Despite its global impact, the scale and long-term consequences of CKD are frequently overlooked. Effective control of CKD requires a multifaceted and comprehensive approach that emphasises early detection, prevention, accurate diagnosis and appropriate treatment across all age groups.

This study examined the level of knowledge about kidney health among high school students and the factors associated with it. The findings suggest that, while adolescents generally have a basic understanding of the primary function of the kidney, their awareness of disease progression and preventive measures is limited.

These results suggest that educational and awareness-raising efforts could be instrumental in preventing kidney disease among younger generations. It is important to address kidney health within the broader context of holistic human health, recognising that organ functions are interrelated and the body operates as an integrated system. Therefore, educational programmes that adopt a comprehensive view of human physiology and health literacy may be more effective than organ-specific approaches alone. Consequently, the fight against kidney disease must extend beyond medical interventions to encompass community-based education and school health programmes that promote healthy lifestyles and an integrated understanding of bodily systems. Health education is one of the most effective and cost-efficient strategies for preventing and managing CKD (Luyckx, Tonelli & Stanifer, 2018). The findings of this study can guide health professionals and educators in developing targeted, age-appropriate and holistic health education strategies to enhance students' health knowledge and awareness.

Implications for Practice

School nurses can play a pivotal role in translating these findings into practice by designing and systematically implementing kidney health education modules for adolescents. Through comprehensive risk assessments, they can identify individuals with limited awareness of kidney disease or who use technology inadequately, and tailor preventive interventions accordingly. Furthermore, integrating kidney health education into paediatric and adolescent outpatient services alongside enhanced screening and awareness initiatives in these clinical settings can facilitate early diagnosis and encourage healthier lifestyle behaviours. Fostering awareness and the internalisation of health knowledge through data-driven educational and counselling programmes could lead to more effective and sustainable health promotion strategies. These findings can also inform policy development by emphasising the long-term benefits of early prevention and health education. Consequently, they provide a strong foundation for national and international guidelines aimed at improving adolescent health outcomes through strategic investment in early-life health interventions.

Ethics Committee Approval: Ethical approval for the study was obtained from the Recep Tayyip Erdoğan University Non-Interventional Clinical Research Ethics Committee (Number: E-40465587-050.01.04-903).

Informed Consent: Consent was obtained from the students and their legal guardians.

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