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Factors associated with the willingness to become a kidney transplant recipient — the results from a national cross sectional study

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Abstract

Background Kidney transplantation (KT) is considered the best method of renal replacement therapy for patients with end-stage renal disease, providing them with better treatment outcomes and improved quality of life.

Objective The aim of this study was to investigate the impact of sociodemographic/clinical factors upon knowledge and attitude towards KT, and information support on the willingness to undergo KT among Polish dialysis patients.

Methods The cross-sectional study was conducted from August 2023 to December 2024 in 99 dialysis centers in Poland in accordance with ethical approval and international research guidelines. The study included a group of 1,523 adult dialysis patients surveyed with the use of a 5-part self-report questionnaire and standardized tools.

Results In the studied group 834 subjects (55%) were willing to undergo KT, while 689 (45%) were reluctant. The dialysis patients with greater knowledge about KT, those who discussed with medical staff the possibility of organ donation from a living donor and those who considered receiving a kidney from either a living related or non-related donor (if legally permissible), were more likely to express willingness to become kidney transplant recipients. Conversely, those who were older, with longer dialysis treatment timespan and insufficient informational support regarding KT showed negative association with the willingness to consider renal transplantation.

Conclusion Findings suggest that Polish dialysis patients have insufficient knowledge about KT. Higher knowledge and awareness were linked to greater willingness to undergo KT.

Trial registration This study was registered in Clinical Trials.gov (ID: NCT06148116) on 19/11/2023.

Keywords Kidney transplantation, Willingness to transplant, Perceived knowledge, Patient concerns, Educational programs

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Background

Currently, kidney transplantation (KT) is considered to be the best treatment option of renal replacement therapy (RRT) in patients with an end stage renal disease (ESRD), providing them significantly better outcomes and improved quality of life (QOL) [1, 2]. Additionally, the 5 yrs. survival rate comparison of dialyzed vs. transplanted patients showed 45% vs. 82% difference in case of deceased donor (DD) KT and up to 92% in case of living donor (LD) KT, respectively [3]. As the number of patients with chronic kidney disease (CKD) waiting for a KT in many countries is constantly increasing, LDKT has become the most important alternative [4–6]. Living donation (LRD – living related vs. LNRD – living unrelated) is practiced in many countries around the world and regulated by national and international law [7, 8]. In Poland, the “*Act on the harvesting, storage and transplantation of cells, tissues and organs*” of July 1st. 2005 describes detailed rules for organ procurement and transplantation [8].

In Poland, LDKT has been practiced since 1966, but it still remains a small percentage of all kidney transplantations performed in the country [9]. In the year 2023, the total number of 1041 KT's were performed which consisted of 3.4% of all hemodialysis (HD) and 13.4% of all peritoneal dialysis (PD) patients [10]. Of all transplanted kidneys 963, the vast majority, were considered as DD grafts and 78 as LD grafts (92.5% vs. 7.5%, respectively) [11]. The average waiting time for kidney transplantation from a deceased donor in Poland in 2023 was 427 days and for LD 280 days. At the end of 2023, total number of awaiting patients was 1193 [11]. The percentage of LD transplantations in Poland remains low if compared to other European countries, such as the Netherlands or the United Kingdom, where the percentage of LDKT's vs. total number of transplants was 49.5% and 28%, respectively [12]. LDKT is currently accepted by most transplant centers worldwide and accounts for a significant percentage of all kidney transplantations, including the United States, United Kingdom, Australia, the Netherlands and Israel [12, 13].

We have to consider that LD kidney donation is associated with possibility of complications in the donor, primary surgical, associated with relatively low (0.03%) risk of death [14, 15]. Although kidney donation does not seem to affect the overall psychological health or mental status of LD, the results from several studies showed emotional problems and a need for psychological support after organ donation in some of them [16–18]. Moreover, the impact of living donation on psychological well-being of those, who offer their kidney to the closest family member remains still a subject of intense research. In the context of the risk of possible medical and psychological complications for LD, the transplant teams have to

face with unique clinical and ethical dilemmas that must be solved on an ongoing basis [19]. Gellert et al. (2025) published data that had shown approximately 4.7 million people in Poland suffering from CKD [4]. By the end of 2023, a total number of patients on dialysis was 20,536 which 19,770 stayed on HD and 766 on PD. A slight increase in the total number of patients requiring RRT was observed (an annual increase of 1.7% if compared to 2022) [10]. According to the data from “Poltransplant”, the organizational and coordinating center for organ transplantation in Poland, there were 1,193 patients being considered as active on the waiting list for KT on December 31st 2023. The average waiting time for DDKT was 427 days vs. 280 days for LDKT [11].

The results of our preliminary single-center study showed insufficient knowledge and poor attitude of the HD patients towards KT, probably due to inadequate education, lack of educational brochures, medical personnel's time shortage to allow the patients to face the challenges of KT as well as organizational and structural problems that must be solved to increase the number of LD KT's [20]. Results of the Baum study (2017) conducted on 80 patients showed that 68% of patients on dialysis did not believe in the meaning and importance of KT. The vast majority of studied dialysis subjects (81%) were afraid of the risks associated with KT and 92% of them had been convinced to have too little knowledge to recognize kidney transplantation as beneficial [21]. A study conducted by Bojanowska et al. (2015) showed that dialysis patients in the Mazovian voivodship did not have sufficient knowledge about KT to consider it as best ESRD treatment modality [22]. For comparison, Sheu et al. (2012) had also emphasized the insufficient knowledge on transplantation in ESRD patients. The authors had described some of the myths prevailing among patients, for example that “the donor's life may be shortened”, or that “kidney recipient's life may be shortened as well” [23]. Additionally, KT recipients were afraid to talk to their loved ones about the donation [24]. Fear and anxiety are the major problems in dialysis patients regarding risks related to transplantation, organ rejection, health loss, developing CKD or even death of the living donors [25, 26]. In research from the USA, China, Morocco, Norway, Tanzania and Turkey, the authors studied several cohorts of patients with different numbers of subjects and came to similar conclusions: positive attitude towards transplantation and insufficient knowledge about the procedure are the main factors that determine the willingness to undergo a KT [27–35]. American authors used the term “knowledge gap” when Peipert et al. (2019) aimed to investigate the validity and reliability of a newly developed Knowledge Assessment of Renal Transplantation (KART) scale in measuring transplant knowledge among adult ESRD patients. They had found

significant differences resulting from various lengths of transplant education through multiple interventions that patients had received. This was also the first attempt to standardize the questionnaire [33, 36].

Aim of the study

The aim of this study was to assess the willingness of Polish dialysis patients to undergo kidney transplantation and to investigate how this decision had been influenced by sociodemographic and clinical factors as well as by the level of knowledge, attitudes toward transplantation, and the availability of informational support.

The scientific value of this study is worth emphasizing, as no research has yet been conducted in Poland on knowledge and attitudes toward kidney transplantation among dialysis patients across all voivodeships. The study will allow for the identification of dialysis patients' knowledge and attitudes toward transplantation. The results of this study may contribute to the development and implementation of new educational and informational programs that can increase knowledge and influence attitudes toward transplantation, which could significantly contribute to an increase in transplantation among people with chronic kidney disease.

Materials and methods

Study design, setting, ethical considerations

A cross-sectional questionnaire-based study was conducted between August 2023 and December 2024 after obtaining consent of the Bioethics Committee of the Andrzej Frycz Modrzewski University in Krakow (decision no. KBKA /34/O/2023). The guidelines of the Declaration of Helsinki (World Medical Association, 2013) and STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) [37] as well as the General Data Protection Regulation [38] were followed. This study was registered in Clinical Trials.gov (ID: NCT06148116) on 19/11/2023. Surveys were sent to 45 public and 54 non-public (private) dialysis Polish centers all around the country and this number constituted 38% of all dialysis centers in Poland. The centers included into the study gave consent to carry out the project and the dialysis department directors and nursing staff managers had given consent to the study. It is worth mentioning, that currently in Poland there are 260 dialysis centers, either public or private which work on a contract basis with the National Health Fund. Over 65% of ESRD patients are dialyzed in private centers [39].

Participants - the dialysis patients

The inclusion criteria were as follow: patients undergoing RRT (either HD or PD), aged ≥ 18 yrs., having no medical contraindications to KT, patients who were temporarily suspended on National Waiting List (NWL) for KT.

Participation in the study was voluntary. Signed informed consent was mandatory. Communicative knowledge of Polish language was considered a basic condition. Patients who had absolute medical contraindications to KT, i.e. recently diagnosed or disseminated cancer, persistent untreated infection, severe irreversible systemic disease, expected short life span, presenting lack of cooperation (alcohol abuse or drug addiction, mental illness), neither unable to make independent decisions nor to sign an informed consent were excluded from the study.

Measures

The tools

The questionnaire was designed by the study authors, and the first draft was reviewed, then some questions were modified according to notes and comments from three experts involved in direct and personal dialysis patients' care, i.e.: nephrologist, transplant surgeon and clinical psychologist. The final questionnaire was sent out asking for response to 30 patients undergoing dialysis at County Hospital in Chrzanów, to check the correctness of assumptions. Each of these patients had completed a five-part questionnaire. The first part gathered demographic data (age, gender, marital status, having children/ siblings, education level, place of residence, declaring one's faith); the second part referred to clinical variables (cause of ESRD, data on outpatient treatment before dialysis, information support, dialysis timespan, dialysis modality, the presence of side effects/ complications during dialysis therapy); the third part concerned knowledge and attitude towards KT and access to recent information about transplantation as well as availability of learning materials; part four of the questionnaire contained questions addressed to those of dialysis patients who were willing to become KT recipients; part five consisted of questions related to experiencing pain, and will be the subject for a separate study. The knowledge dimension consisted of 9 questions with one or more answers to questions 26, 27, 28, 32, 34, 36, 37, 38, 39 (see Additional file 1). One point was awarded for each correct answer, and 0 points were awarded for an incorrect one. The total score for the knowledge dimension ranged from 0 to 19 points. A Cronbach's α value of 0.82 suggested good internal consistency of the knowledge dimension. All questionnaires were completed anonymously.

Outcomes

The primary outcomes focused on the percentage of dialysis patients who declared willingness to undergo KT. The secondary outcomes included: sociodemographic/ clinical factors, knowledge and attitude toward KT, and information support.

Data analysis and statistics

The data was analyzed using Statistica 13.3 (*1984–2017 TIBCO Software Inc, Stat Soft Poland, Krakow) and Set Plus (Stat Soft Polska Sp. z o. o. 2024, Set Plus version 5.1.0. (www.statsoft.pl)). A p -value < 0.05 was considered as statistically significant.

Categorical variables were expressed as frequencies and corresponding percentages, whereas continuous variables were reported as medians with interquartile ranges and means with standard deviations. Differences between groups were analyzed using the *Chi-square test* for categorical data and the Mann–Whitney U test for continuous variables. To evaluate relationships between two continuous variables, Spearman's rank correlation analysis was conducted. The correlation coefficient (R) was classified as follows: negligible (< 0.1), weak (0.1 – 0.39), moderate (0.4 – 0.69), strong (0.7 – 0.89), and very strong (0.9 – 1.0). The Shapiro–Wilk test was applied to assess the normality of the distribution of variables.

Due to substantial missing data, 385 questionnaires were excluded from the analysis. In the remaining cases, missing values were identified in three continuous variables: *age* (1 case), duration of dialysis treatment (0.1%), and *dialysis access survival time* (0.1%). These were imputed using the sample median. In addition, 16 missing values (1.1%) were identified for the categorical variable *dialysis modality*, and these cases were retained in the statistical analysis.

The logistic regression model was used to assess the relationship between independent variables (sociodemographic factors, clinical factors, knowledge and attitude towards KT) and the willingness to become a kidney transplant recipient (binary outcome: willing/ unwilling). Variables with $p \leq 0.1$ in univariate analysis, as well as clinically relevant factors (e.g., age and gender, considered potential confounders), were included in the multiple logistic regression model. To determine the most significant factors, a backward elimination technique was applied. Adjusted odds ratios (OR) with 95% confidence intervals were calculated to assess the strength and direction of associations. The goodness-of-fit (fit compliance) of the model was evaluated using the Hosmer–Lemeshow test ($p > 0.05$ indicated a good model fit), and multicollinearity was assessed using the variance inflation factor (VIF; all VIF values were < 2 , indicating no evidence of multicollinearity).

Results

Questionnaires, survey response rate

4,000 surveys were sent out and the research team had received back 1,958 questionnaires from the patients. Preliminary survey response rate was 48%. After a preliminary review, 435 questionnaires were excluded from further analysis: 358 due to incomplete data and 77 for

medical reasons, i.e. medical disqualification of the respondent from KT (patients had been asked in the questionnaire if they were disqualified). Finally 1,523 questionnaires were analyzed in the study, which had corresponded to 38% survey response rate.

Socio-demographic characteristics of the participants

The majority of the participants were males (58%) who were married or in a committed relationship (64%), had siblings (88%) and were believers (89%). The cohort of patients who expressed a willingness for kidney transplantation consisted of 834 subjects, the number of those who were unwilling consisted of 689 subjects, respectively. Patients who were willing to become KT recipient were 10 years younger on the average (55 ± 14 vs. 65 ± 12), had more likely completed either high school (39% vs. 33%) or university education (18% vs. 14%), were employed (20% vs. 8%), had assessed their housing conditions rated as very good (38% vs. 30%), and rarely had been having children (78% vs. 85%) as compared to those, who were unwilling (see Table 1 for details).

Clinical characteristics of the participants

The clinical characteristics of the studied subjects is summarized in Table 2. The cause of ESRD in almost every fourth patient was kidney glomerular disease (glomerulonephritis) although this result differs significantly from the national data concerning the entire Polish dialysis population [10]). The most prevalent method of RRT was HD (92%). Participants in the willing group had significantly shorter dialysis timespan (3.9 ± 4.6 vs. 4.9 ± 5.4 yrs.) and vascular access survival time (3.1 ± 4.1 vs. 3.6 ± 4.2 yrs.), lower incidence of cardiovascular complications (11% vs. 18%), and higher incidence of secondary hyperparathyroidism (23% vs. 16%) than those in the unwilling group. In the willing group 15% of patients ($n = 234$) were put on the transplant waiting list for the 1st time, 4% of patients ($n = 61$) for the 2nd and 21 subjects (1%) for the 3rd, respectively. Every fifth subject ($n = 286$; 19%) did not know whether they were on the list. The shortest and the longest time interval to return back to dialysis after loss of graft varied significantly from a few days up to 31 years, respectively.

Knowledge about kidney transplantation

The study participants varied considerably in their knowledge regarding KT as a therapeutic option of RRT (Fig. 1). Patients from the willing group had higher level of knowledge than the those in the unwilling group (median 8 [5; 11] vs. 6 [3; 8]). However, the knowledge level correlated negatively with the age of patients ($R = -0.39$; $t = -16.68$; $p < 0.01$). The difference in the knowledge level between women and men was statistically significant (7 [4; 11] vs. 7 [4; 10; $Z = -2.34$; $p = 0.02$]).

Table 1 Association of socio-demographic data with the willingness to become a kidney transplant recipient in questionnaire based polish nation-wide study performed in 1,523 dialysis subjects

Variables	Willingness to become a kidney transplant recipient				
	Total n = 1523	Willing n = 834	Unwilling n = 689	Statistics values	p-values
Age (years)	62 [50; 70]	56 [47; 66]	67 [58; 74]	Z = 13.51	< 0.01*
Gender					
- Female	648 (42)	348 (42)	298 (43)	$\chi^2 = 0.36$	0.54
- Male	877 (58)	486 (58)	391 (57)		
Place of residence					
- City	885 (58)	504 (60)	381 (55)	$\chi^2 = 3.87$	0.05
- Rural area	638 (42)	330 (40)	308 (5)		
Family status					
- married or in a committed relationship	969 (64)	539 (65)	430 (62)	$\chi^2 = 0.80$	0.37
- having children	1236 (81)	653 (78)	583 (85)	$\chi^2 = 9.85$	0.002*
- having siblings	1341 (88)	735 (88)	606 (88)	$\chi^2 = 0.01$	0.92
Educational level					
- primary school	215 (14)	98 (12)	117 (17)	$\chi^2 = 17.67$	0.0005*
- vocational education	509 (33)	260 (31)	249 (36)		
- high school	554 (36)	328 (39)	226 (33)		
- university	245 (16)	148 (18)	97 (14)		
Employment status					
- employed (full/part time)	218 (14)	165 (20)	53 (8)	$\chi^2 = 53.59$	< 0.0001*
- pensioner/ retired	1215 (80)	608 (73)	607 (88)		
- students	10 (1)	7 (1)	3 (1)		
- unemployed	80 (5)	54 (6)	26 (4)		
Housing conditions					
- very good	527 (35)	316 (38)	211 (31)	$\chi^2 = 11.94$	0.02*
- good	764 (50)	404 (48)	360 (52)		
- average	201 (13)	95 (11)	106 (15)		
- bad	18 (1)	11 (1)	7 (1)		
- very bad	13 (1)	8 (1)	5 (1)		
Declaring confession of faith ¹	1354 (89)	730 (87)	624 (90)	$\chi^2 = 3.52$	0.06

¹Religious self-identity: Roman Catholic (90%). ²Age is presented as median [upper and lower quartile]. Categorical variables are presented as absolute numbers and percentages; * statistically significant

Results of evaluation of patients' knowledge on KT considering a source of kidney graft, some issues on transplantation surgery, risks associated with surgery and risk factors considered either for the LD or for the recipient same as the risks of immunosuppressive treatment after KT are shown in Table 3. A short summary of the above results showed that more than half of the respondents perceived KT as a more beneficial treatment option than dialysis and this form of RRT that may improve the QOL. More than half of the participants were unaware that in Poland, a kidney donor can be an unrelated living donor (57%) or a living donor in a paired exchange program (61%). They also did not consider a LRKT as superior to DDKT (73%). This may be due to the misconception that living kidney donation carries significant risks for the donor (62%) and worsens their QOL (54%). Knowledge about immunosuppressive therapy was also insufficient, especially regarding potential side effects or complications related to the treatment (81%).

Informational support

Data on this issue was obtained from a group of 1,266 patients (83%) who before entering dialysis had been treated. The majority of these patients declared that they had been informed about KT as one of the therapeutic options ($n = 898$, 71%) while the other subjects ($n = 626$, 49%) had only heard about the possibility of LKD (i.e. from family member). However, one quarter of dialysis patients reported insufficient information and support to consider KT, with a higher proportion of those patients belonging to the unwilling group (32% vs. 15%; $\chi^2 = 58.85$; $p < 0.0001$). Patients from this group were less likely to report that healthcare providers had discussed the possibility of organ donation from a LD (21% vs. 42%; $\chi^2 = 81.36$; $p < 0.0001$) or had suggested a joint conversation with the patient's family to inform them about the possibility of a LDKT. (12% vs. 24%; $\chi^2 = 39.64$; $p < 0.0001$). Moreover, they were less willing to express a need for such a conversation (15% vs. 29%; $\chi^2 = 48.31$; $p < 0.0001$).

Table 2 Association of clinical data with the willingness to become a kidney transplant recipient in questionnaire based Polish nation-wide study performed in 1,523 Dialysis subjects

Variables	Willingness to become a kidney transplant recipient				
	Total n=1523	Willing n=834	Unwilling n=689	Statistics values	p-values
Cause of end-stage renal failure					
- diabetic nephropathy	279 (18)	131 (16)	148 (21)	$\chi^2=8.40$	0.08
- hypertensive nephropathy	278 (18)	139 (17)	139 (20)	$\chi^2=3.11$	0.54
- glomerulonephritis	409 (27)	260 (31)	149 (22)	$\chi^2=17.52$	0.001*
- polycystic kidney disease	241 (16)	126 (15)	115 (17)	$\chi^2=0.71$	0.95
- anomalies of kidney and urinary tract	118 (8)	80 (10)	38 (6)	$\chi^2=8.77$	0.07
- unrecognized medical diagnosis	77 (5)	42 (5)	35 (5)	$\chi^2=0.00$	1.00
- diagnosis unknown to the patient	11 (7)	51 (6)	60 (9)	$\chi^2=3.75$	0.44
Duration of dialysis treatment (years)	3 [1; 6]	2.5 [1; 5]	3 [1.5; 6]	Z=4.15	<0.0001*
Dialysis modality					
- HD	1400 (92)	763 (92)	637 (94)	$\chi^2=3.61$	0.61
- HDF	53 (3)	28 (4)	25 (4)		
- CAPD	33 (2)	20 (2)	13 (2)		
- APD	21 (1)	15 (2)	6 (1)		
- lack of data	16 (1)	8 (1)	8 (1)		
Dialysis access					
- arterio-venous fistula	978 (64)	522 (63)	456 (66)	$\chi^2=9.64$	0.47
- arterio-venous graft	27 (2)	18 (2)	9 (1)		
- permanent venous catheter	430 (28)	238 (29)	192 (28)		
- temporary venous catheter	58 (4)	32 (4)	26 (4)		
- Tenckhoff peritoneal catheter	29 (2)	23 (3)	6 (1)		
Dialysis access survival time	2 [1; 4]	2 [1; 4]	2 [1; 5]	Z=3.56	0.0003*
Presence of medical complications during dialysis therapy in the last year					
- HT	578 (38)	333 (40)	245 (36)	$\chi^2=3.05$	0.54
- FO	320 (21)	189 (23)	131 (19)	$\chi^2=3.03$	0.55
- Underdialysis	128 (8)	76 (9)	52 (7)	$\chi^2=1.20$	0.88
- decreased appetite/malnutrition	196 (13)	107 (13)	89 (13)	$\chi^2=0.00$	1.00
- cardio-vascular complications	219 (14)	96 (11)	123 (18)	$\chi^2=12.32$	0.01*
- secondary hyperparathyroidism	301 (20)	192 (23)	109 (16)	$\chi^2=12.34$	0.01*
- others	140 (9)	74(9)	66 (10)	$\chi^2=0.22$	0.99
- none	429 (28)	218 (26)	211 (31)	$\chi^2=5.03$	0.54

Age, dialysis duration, and dialysis access survival time were presented as median [upper and lower quartile]. Categorical variables were presented as absolute numbers and percentages. Statistical analysis included comparison between the two groups: these which were willing and those which were unwilling to become a transplant recipient. APD – automated peritoneal dialysis, CAPD continuous ambulatory peritoneal dialysis, HD – hemodialysis; FO – fluid overload; HDF – hemodiafiltration; HT – hypertension; * statistically significant

The main source of knowledge for dialysis patients about their disease and its treatment were medical staff members (75%), another patients who had already been dialyzed or transplanted (46%), news from portals and websites (33%), respectively. Less frequently patients used medical literature (23%), websites of patient associations and organizations (12%) or websites of scientific societies (9%). Patients reported that some educational opportunities regarding KT were available at their dialysis centers. These included printed brochures (42%), educational talks (43%), educational films for own-watching (4%), educational meetings with family members in the presence of medical staff (4%). Notably, 29% of patients

reported having no access to any form of training or education.

Kidney transplantation attitude

The vast majority of patients in the willing group believed in the need for KT (71% vs. 40%; $\chi^2=149.09$; $p<0.0001$). They were more willing to accept an organ from LRD (29% vs. 10%; $\chi^2=106.79$; $p<0.0001$) and - if possible - from a stranger, LNRD (48% vs. 22%; $\chi^2=127.15$; $p<0.0001$) than subjects in the unwilling group. Twice as many patients in the group that considered a KT instead of dialysis had known someone who expressed willingness to donate them a kidney (36% vs. 18%; $\chi^2=56.12$; $p<0.0001$). Patients in this group were also

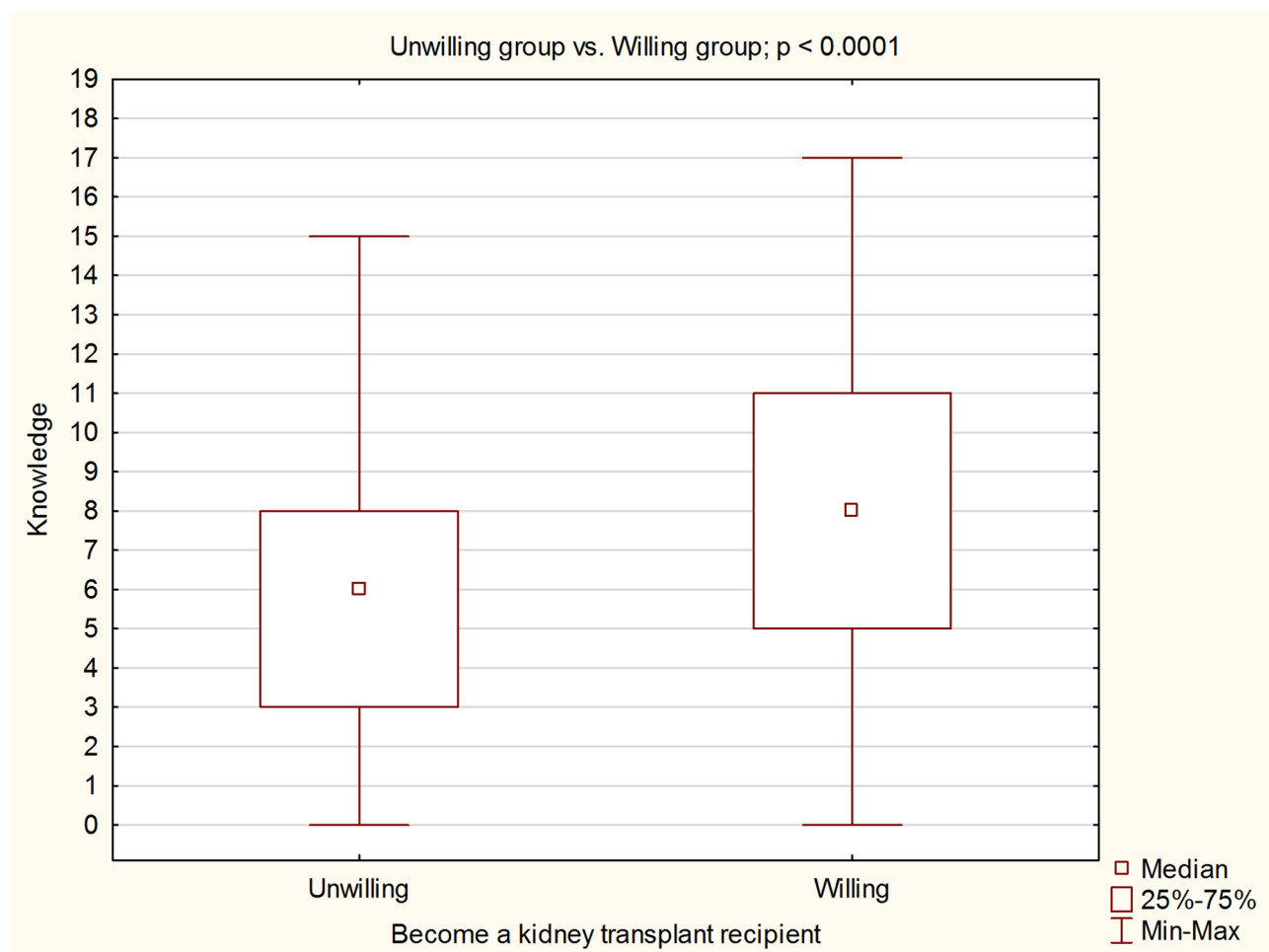


Fig. 1 The level of knowledge on kidney transplantation in accordance to willingness of being transplanted in 1,523 Polish dialysis patients evaluated in nation-wide cross sectional questionnaire based study. Knowledge level expressed as score-points (see text for details)

less concerned about the risks associated with KT (32% vs. 38%; $\chi^2 = 5.30$; $p = 0.02$).

Subjects on dialysis who were willing to undergo a KT had expected that this treatment modality would allow them to be free from dialysis (81%), improve QOL (67%), improve health (64%), allow to abandon fluid and dietary restrictions related to dialysis (46%) and allow to return back to work or other professional activities (27%).

Factors associated with the willingness to become kidney transplant recipient

The dialysis patients with greater knowledge about KT, those who discussed with medical staff the possibility of organ donation from a living donor and those who considered receiving a kidney from either a LRD or LNRD (if legally permissible), were more likely to express willingness to become kidney transplant recipients.

Conversely, those who were older, with longer dialysis treatment timespan and insufficient informational support regarding KT showed negative association with the willingness to consider transplantation. Nagelkerke's

R^2 indicated that the model had explained 27% of the variation in the outcome (see Table 4.).

Discussion

The present study provides important insights into dialysis patients and the determinants influencing their willingness to consider KT. Willingness was expressed by 55% of respondents, while 45% were unwilling, a distribution closely resembling that reported in other studies [40]. Our findings highlight both facilitating and limiting factors in the decision-making process. Positive determinants included greater knowledge about KT, discussions with medical staff regarding LDKT, and openness to transplantation from either related or unrelated living donors. Negative associations were observed with older age, longer dialysis duration, and insufficient informational support. Notably, with the exception of age, most identified factors are potentially modifiable.

In our study, over half of patients believed that KT would improve their QOL (53%) and considered it a superior therapeutic option compared with dialysis

Table 3 The patients' knowledge about kidney transplantation in questionnaire based Polish nation-wide study performed in 1,523 end stage renal disease subjects

Items—the correct answer	Total n = 1523	Willing n = 834	Unwilling n = 689	Statistics Values χ^2	p-values*
In Poland, a kidney donor can be:					
- DD (yes)	1129 (74)	649 (78)	480 (70)	13.07	0.0003
- LRD (yes)	1106 (73)	631 (76)	475 (69)	8.31	0.004
- LNRD (yes)	657 (43)	398 (48)	259 (37)	15.78	0.00007
- LD in a pair exchange program (yes)	602 (39)	382 (46)	220 (32)	30.37	<0.0001
It is only necessary to remove your own kidneys before transplantation in special cases (yes).	214 (14)	142 (17)	72 (10)	13.43	0.0002
The graft is placed in the right / left iliac fossa (yes)	559 (37)	388 (46)	171 (24)	76.17	<0.0001
KT will improve QOL (definitely yes)	807 (53)	547 (65)	260 (38)	116.94	<0.0001
KT is a better treatment for kidney failure than dialysis (definitely yes)	782 (51)	524 (63)	258 (37)	96.82	<0.0001
LRKT is more advantageous for the recipient than transplantation from DD (definitely yes)	414 (27)	265 (32)	149 (22)	19.76	0.0001
LRKT may pose a significant risk to the donor (probably not, definitely not)	586 (38)	344 (41)	242 (35)	6.06	0.01
LRKT will significantly worsen the donor's QOL (probably not, definitely not)	696 (46)	423 (51)	273 (40)	19.09	0.0001
Immunosuppressive therapy:					
- aims to inhibit or reduce the immune response (yes)	578 (38)	366 (44)	212 (31)	27.56	<0.0001
- may promote the occurrence of infections or neoplasms and cause adverse organ effects (yes)	285 (19)	200 (24)	85 (12)	33.63	<0.0001
- requires careful monitoring (yes)	754 (49)	470 (56)	284 (41)	35.48	<0.0001
- is necessary from the moment of organ transplantation until the graft stops functioning (yes)	602 (39)	378 (45)	224 (32)	25.91	<0.0001
- immunosuppressive medications must be taken regularly (yes)	644 (42)	406 (49)	238 (34)	30.90	<0.0001
- cessation of treatment or irregular medications use lead to rejection of the transplanted organ (yes)	568 (37)	373 (45)	195 (28)	44.59	<0.0001

Categorical variables were presented as absolute numbers and percentages. DD – deceased donor; LD – living donor; KT – kidney transplantation; LNRD – living non related donor; LRD – living-related donor; – living related kidney transplantation; QOL – quality of life; * statistically significant

(51%), findings consistent with those of Nizič-Kos et al. (2013) [41]. Similarly, Nwanji et al. (2021) demonstrated that awareness of potential QOL improvement is a key determinant in the decision to pursue transplantation [42]. Overall, 55% of our respondents expressed willingness to undergo KT, closely aligning with results from the United States, where Ilori et al. (2015) reported a rate of 54% [40]. These observations suggest that insufficient knowledge diminishes patients' determination to undergo transplantation and fosters concerns about the procedure. As highlighted in previous reports, the main clinical barriers include fears related to surgical complications, perioperative risks, possible graft rejection, and the adverse effects of lifelong immunosuppressive therapy [43].

Our findings highlight the crucial role of medical education in the decision-making process regarding KT. Patients' awareness of the benefits, effectiveness and safety of transplantation may reduce uncertainties and concerns, which often act as barriers from making a decision to enter the transplant waiting list. This was also confirmed by reports from other countries [24, 33, 36, 44]. Furthermore, a key factor supporting a positive attitude towards transplantation was a discussions with

medical staff about the possibility of LDKT. Patients who had such conversations were likely to receive more detailed information about the procedure, its success rates, and potential risks, which may have contributed to their increased willingness to undergo transplantation. It should be noted that in Poland there are 32 LDKT coordinators currently working in teams preparing living-donor transplants (as of December 2024) [11]. Their professional duties include organizing meetings and training sessions at dialysis centers and hospitals for patients with ESRD and their families, dialysis staff, nephrology clinics, and nephrology department staff. Our many years of observation and experience show that dialysis nurses are also in a privileged position, as they have the best contact with patients and gain their trust. However, they are not officially involved in the preparation process for transplantation. Therefore, to increase patients' willingness to consider KT, action is needed on many levels and it is necessary to tailor information strategies to the individual needs of different patient groups. To meet best practice requirements, transplant education must be (1) individually tailored, (2) understandable to patients with low health literacy, (3) culturally competent, and (4) helpful in showing patients how to navigate the

Table 4 Factors associated with the willingness to become a kidney transplant recipient in the cohort of 834 Polish Dialysis patients in cross-sectional nationwide multicenter study

Variables	B	SE (B)	Wald test	P value	OR (CI 95%)
Simple logistic regression					
Gender	-0.03	0.05	0.36	0.55	0.97 (0.07–1.04)
Age	-0.05	0.004	157.03	0.00	0.95 (0.94–0.95)
Housing conditions	0.18	0.07	7.16	0.00	1.20 (1.05–1.37)
Education level	0.21	0.06	14.30	0.00	1.24 (1.11–1.38)
Having children	-0.20	0.07	8.97	0.00	0.82 (0.72–0.93)
Duration of dialysis treatment (dialysis timespan)	-0.04	0.01	14.95	0.00	0.96 (0.94–0.98)
Dialysis access survival time	-0.03	0.01	5.98	0.01	0.97 (0.95–0.99)
Glomerulonephritis (as primary cause of ESRD)	0.24	0.06	16.42	0.00	1.27 (1.13–1.43)
Secondary hyperparathyroidism	0.22	0.06	11.34	0.00	1.25 (1.09–1.42)
Insufficient informational support regarding KT	-0.47	0.06	56.81	0.00	0.62 (0.55–0.70)
Knowledge about KT	0.15	0.01	115.65	0.00	1.16 (1.13–1.20)
Discussion with medical staff about the possibility of LDKT	0.51	0.06	75.63	0.00	1.66 (1.48–1.86)
Considering donation from a living donor	0.67	0.07	80.86	0.00	1.96 (1.69–2.27)
The doctor's suggestion to hold a joint conversation with the patient and their family about the possibility of a LRD KT	0.42	0.07	35.32	0.00	1.52 (1.32–1.75)
Someone expressed willingness to donate a kidney	0.45	0.06	54.49	0.00	1.57 (1.39–1.77)
Willingness to accept KT from a stranger (LNRD KT) — if legally permissible	0.57	0.06	100.30	0.00	1.77 (1.59–1.99)
Multiple logistic regression model					
Age	-0.04	0.005	64.63	0.00	0.96 (0.95–0.97)
Duration of dialysis treatment	-0.06	0.01	22.89	0.00	0.94 (0.92–0.97)
Insufficient informational support regarding KT	-0.17	0.07	5.24	0.02	0.85 (0.73–0.98)
Knowledge about KT	0.07	0.02	15.27	0.00	1.07 (1.03–1.10)
Discussion with medical staff about the possibility of LDKT	0.21	0.07	10.09	0.00	1.24 (1.09–1.42)
Willingness to accept KT from a stranger (LNRD) — if legally permissible	0.31	0.06	22.97	0.00	1.36 (1.20–1.55)
Considering donation from a living donor	0.39	0.08	23.09	0.00	1.49 (1.26–1.75)

B - regression coefficient; SE - standard error; OR - odds ratio; CI - confidence interval

Multivariable logistic regression model: R^2 Nagelkerke = 0.27; Hosmer Lemeshow = 6.76; $p = 0.56$; VIF ≤ 1.41

ESRD – end stage renal disease; KT – kidney transplantation, LRD – living related donor; LNRD – living non related donor; LD – living donor

complex process of health care [45]. Previous research suggests that a lack of communication between patients and healthcare professionals can lead to misinformation and reluctance to consider this treatment option [21, 22, 24–27, 34, 45–47].

Additionally, the results of our study also indicated that patients who were open to receiving a kidney from living nonrelated donor—if legally permitted—were more inclined to consider KT. This finding suggests that legal reforms allowing LNRKT could potentially increase the number of patients willing to receive a transplant. This aspect requires further evaluation taking into account ethical, legal, and organizational perspectives.

Older age, longer dialysis timespan and insufficient informational support were negatively associated with the willingness to consider KT. Previous studies have indicated that older patients often perceive themselves as less suitable candidates for transplantation, despite evidence showing favorable outcomes in selected elderly recipients. Additionally, healthcare providers may be less likely to discuss transplantation with older patients, further reducing their awareness and motivation. Similar

results were reported in many other studies [20, 25, 26, 48, 49]. The negative impact of older age on KT willingness may be related to concerns about surgical risks, post-transplant complications and overall life expectancy [43].

A particularly concerning finding in our study was, that insufficient informational support had significantly contributed to reluctance toward transplantation. In conclusion, patients who lacked proper education about KT may overestimate the risks, misunderstand eligibility criteria, or be unaware of the benefits compared to long-term dialysis. This highlights the critical role of medical professionals in providing clear, personalized, and continuous education to dialysis patients, ensuring they have the necessary knowledge to make informed decisions. This also aligns with previous studies [24, 50].

Longer dialysis timespan was another factor that had been associated with a lower likelihood of considering KT. Prolonged time spent on dialysis can lead to physical and psychological adaptation to the routine, making patients less open to change. Moreover, long dialysis timespan can cause complications such as, intradialytic

hypotension, secondary hyperparathyroidism, mineral bone disease, lack of appetite or malnutrition. For various reasons dialysis could be inadequate and have negative impact on intradialytic tolerance and recovery time, which may directly translate into lower QOL of the patients. Many of them, especially the elderly, experience frailty syndrome. Depression is also a very common finding. All of the above may discourage both patients and healthcare providers from pursuing transplantation. Results of many studies indicate, that early evaluation for transplantation is crucial, as patients who remain on dialysis for extended periods may develop a perception that transplantation is no longer a viable option [51].

Implications for clinical practice

CKD is currently considered pandemic diseases affecting approximately of 13% of world population [52]. In Poland it is estimated that about 4.7 million people suffer from CKD, most of whom are not aware of it [4]. In Poland by the fall of 2024, 20,500 patients, mainly those on HD, were treated with RRT and upward trend in the scope of organ transplants had been observed with the increasing number of LRKTs which meant that the percentage of LRKT was 7%, showing a 2% annual increase [11]. Nevertheless, LDKT vs. DDKT rate remains still low if compared to many western European countries [12]. The results of our study showed insufficient level of knowledge of dialysis patients concerning KT which had been caused by many factors and which has many causes. All these resulted in the lack of will to be transplanted in 45% of respondents. The study showed an association between socio-demographic and clinical factors and patients' knowledge and attitudes. The most important conclusion is, that with the increase in knowledge and awareness about KT, the willingness to undergo transplantation increases. This conclusion highlights the urgent need for comprehensive educational programs tailored to individual patients. Also due to fact that some patients are making misguided decisions based on inaccurate prior beliefs and misconceptions, there is a need for targeted psychosocial and educational interventions using The Theory of Planned Behavior and the Adaptive Decision Maker Framework [53]. To ensure the effectiveness of these programs, the Polish Transplantation Society should play a key role in developing a framework for such activity.

Strengths and limitations of the study

The strength of our study is the very large cohort of over 1500 patients, which is about four times larger than the calculated minimum sample size and represents 7% of all Polish dialysis patients. This makes our study the first nationwide analysis of this kind in Poland and comparable to similar international studies.

Limitations include the use of a non-validated self-assessment questionnaire and the lack of assessment of psychological factors such as depression, burnout, or social support. Nevertheless, we performed an internal consistency analysis for the “knowledge” dimension, which yielded Cronbach's $\alpha = 0.82$, indicating good reliability (as mentioned in the Measures section). A full validation (including content, construct, and discriminant validity) will be addressed in future research. Another limitation is the 38% response rate, which raises the possibility of selection bias; however, we believe this is mitigated by the size and nationwide scope of the cohort, which strengthens the credibility of our findings. An additional limitation of the study is that the questionnaire did not include questions about whether reluctance to undergo transplantation itself could be the reason for lack of interest and refusal to receive education on this topic.

Conclusions

In summary, our findings suggest that dialysis patients with greater knowledge about KT, those who discussed the possibility of organ donation from a living donor with medical staff, and those who considered receiving a kidney from either a living related or nonrelated donor — if legally permitted — were more likely to express willingness to become transplant recipients. Conversely, older age, longer dialysis duration, and insufficient informational support were negatively associated with the willingness to consider transplantation.

While these results highlight important trends, they should be interpreted with caution given the methodological and statistical limitations of the study, including reliance on a non-validated questionnaire and the potential for selection bias. Nevertheless, our study provides valuable insights and a foundation for future research aimed at identifying modifiable factors that could support the development of tailored educational programs. Such strategies, refined and validated in further studies, may ultimately help address patient concerns, improve decision-making, and increase the number of transplant candidates, particularly from living donors.

Abbreviations

KT	Kid transplantation
RRT	Renal replacement therapy
ESRD	End stage renal disease
QOL	Quality of life
DD	Deceased donor
LD	Living donor
CKD	Chronic kidney disease
LRD	Living related donor
LNRD	Living nonrelated donor
HD	Hemodialysis
PD	Peritoneal dialysis
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
NWL	National Waiting List

APD	Automated peritoneal dialysis
CAPD	Continuous ambulatory peritoneal dialysis
FO	Fluid overload
HDF	Hemodiafiltration
HT	Hypertension
SE	Standard error
OR	Odds ratio
CI	Confidence interval

Supplementary Information

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Supplementary Material 1

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Author contributions

P.K: designed study, collected data, interpreted data, and drafted article; L.T: analyzed statistically, interpreted data, and drafted article; I.M: interpreted data, and drafted article; G.D: interpreted data, and drafted article; E.T: collected data; B.S: collected data; R.D: collected data, critically revised and approved the article; A.D-S: collected data, critically revised and approved the article; J.A.P: interpreted data, drafted article; critically revised and approved the article.

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Data availability

The data is stored by the authors of the study and may be made available at the request of the reader. The corresponding author is eligible to grant access to the raw data analyzed in the study.

Declarations

Ethics approval and consent to participate

Bioethics Committee of the Andrzej Frycz Modrzewski University in Krakow (decision no. KBKA /34/O/2023), maintaining due diligence in protecting personal data in accordance with applicable Polish law, has approved the study on June 15th 2023. All study participants gave their informed consent to participate in the study by signing the below form which was a part of the questionnaire.

Consent for publication

Not applicable.

Consent to participate in the study and personal data processing

To confirm your consent to participate in the study, it is necessary to check all of the following consents: I voluntarily agree to participate in the study and am aware that I may withdraw from it at any time without giving a reason and without any consequences. I agree to the processing of my personal data included in the questionnaire by Andrzej Frycz Modrzewski Krakow University for the purpose of participating in the study entitled "Attitudes and Knowledge of Dialysis Patients Regarding Kidney Transplantation." In accordance with Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data ("General Regulation") and the Polish Personal Data Protection Act of May 10, 2018 (Journal of Laws 2018, item 1000), I acknowledge that this consent may be withdrawn at any time by submitting a statement of intent to Andrzej Frycz Modrzewski Krakow University.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be considered as a potential conflict of interest.

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