THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (PHD)

The role of disease specific knowledge in kidney transplantation

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Introduction

Chronic renal failure, with its impact on public health and economy, is a major challenge for today's health systems and societies in both developed and developing countries. Due to advances in pharmaceutical research, including the development of effective immunosuppressive therapy and surgical techniques, kidney transplantation is the preferred treatment choice for suitable patients. However, the number of patients who reject this treatment option is still high.

Based on the rejection behaviour experienced in a significant proportion of patients, the following question arises: *What are the factors that influence patients' decisions on renal replacement therapy?* The patient's medical suitability for a kidney transplant itself does not seem to be the only factor, as the final decision on whether to accept a kidney transplant is made by the patient. Several other factors play a role in decision making, of which, proper knowledge plays a key role in this process. Nonetheless, disseminating teaching material and information is not equivalent to transferring knowledge, since processing and understanding the information, then evaluating and applying it, or even the appearance of questions, are secondary processes, which require the individual's motivation and ability, in other words adequate health literacy. Regarding therapeutic options, several studies revealed lack of knowledge among chronic renal patients. In addition, international literature found correlation between incomplete or incorrect information about renal replacement therapies and health decision-making. Adequate knowledge is important not only in the decision-making phase before kidney transplantation, but afterwards, as well, for instance to maintain proper renal function after kidney transplantation. Several causes may lead to lack of knowledge, incorrect information, or misbeliefs. Some of them are related to the patients and their individual characteristics, while others are related to the institution or the health professionals providing health care service.

Despite the indisputable necessity for educating end-stage renal disease patients, few measurement tools are available especially when measuring patients' disease-specific knowledge of renal replacement therapy. Over the past decade, several transplant education programmes have been developed in order to provide chronic renal patients requesting transplantation with reliable and appropriate sources of information about the benefits and potential disadvantages of the intervention. Although significant progress has been made,

most kidney transplant centres still do not have a well designed, specific, and uniform educational programme for the undergoing kidney transplantations, in addition, inequalities in access to transplantation remains. In Hungary, despite the importance of the topic, relatively few studies have aimed to investigate the disease-specific knowledge of renal patients in connection with renal replacement therapies. However, active participation of the patient in decision-making and transplantation processes seems to be a prerequisite for successful therapy. Establishing appropriate therapeutic collaboration between the renal patient and the transplant team, as well as achieving patient adherence, are the key to this multi-step and complex process, for which patient education is one of the most important tools.

In our study, we examined the knowledge level of the chronic renal failure patients, especially the knowledge on kidney transplantation, and its influencing factors. On the one hand, the identification of all these shortcomings and factors helped to explore the causes influencing decision-making; on the other hand, it helped to develop a targeted patient education programme. Within the framework of our research, we implemented an educational programme, especially for chronic renal disease patients, which aimed at transferring knowledge, dispelling beliefs and misconceptions about transplantation. In addition to transferring knowledge during patient education, we also measured the effectiveness of this programme. The planning of our research faced unexpected difficulties and challenges due to the emergence of the SARS-CoV-2 pandemic. In connection with the pandemic, telemedicine innovations were also brought to the forefront of attention, which we used to create the pilot version of our patient education programme that was adapted to a virtual environment. Thus, the challenge became an opportunity, an opportunity to implement patient education from a new perspective.

1. Objective of the study

The main aim of the dissertation is knowledge transfer regarding kidney transplantation, and to measure the most important factors influencing knowledge transfer in order to identify the potential barriers.

Objectives of the study on which the dissertation are based:
- to disseminate information on kidney transplantation;

- to develop a disease-specific questionnaire especially for patients with chronic renal failure in order to measure their knowledge level about kidney transplantation, and thus to identify areas where deficiencies and misconceptions exist;
- to identify factors influencing the knowledge of chronic renal patients in order to implement targeted patient education that takes into account the specificities of this patient group;
- to improve patients' knowledge in the framework of an organized, program-based patient education programme;
- to evaluate the effectiveness of our patient education programme in order to develop an effective, professionally validated programme; and
- to develop the methodology of a targeted patient education programme that takes into account the specificities of this patient group.

Among the long-term goals, it is worth mentioning:
- an increase in the number of patients on the kidney transplant waiting list,
- an expected increase in the number of living donor kidney transplants.

2. Patients and methods

Study population

Debrecen, as a transplant centre, is responsible for kidney transplants of patients from three counties of the Eastern Hungarian region, such as Hajdú-Bihar County, Szabolcs-Szatmár-Bereg County, and Borsod-Abaúj-Zemplén County.

Our follow-up study consisted of two data collections. During the first data collection of our study, patients of 18-75 years of age with the following criteria were contacted: patients on the Eurotransplant (ET) waiting list, patients undergoing medical evaluation for kidney transplantation, and patients who refuse a kidney transplant. From eight dialysis centres in the region, a total of 254 renal patients, either with pre-dialysis, or peritoneal dialysis, or haemodialysis, participated in our study. During the second round of data collection, we contacted renal patients who participated in the first data collection and received education about kidney transplantation in the framework of our education programme. A total of 115 renal patients were included in the second round of our follow-up study.

Measurement tools

The questionnaire used in the first data collection to record the basic level of knowledge, included questions related to the patient's socio-demographic background, financial data, and health status, source of information on kidney transplantation, health literacy, and knowledge level.

Considering international recommendations, two different measurement tools were used due to the complex nature of health literacy. On the one hand, we used the first three questions of the Brief Health Literacy Screening Tool (BHLS), the Chew items, which measures subjective health literacy, and on the other hand, the Newest Vital Sign (NVS) test, which measures functional health literacy. When compiling our knowledge-testing tool, first we reviewed the tests available in the national and international literature. Secondly, we took into account the latest results of the studies measuring the transplant attitude of renal patients in the region regarding the most common beliefs and misconceptions about kidney transplantation, and lastly we reviewed the booklet for patients referred for transplantation approved by our physicians. Based mainly on the international questionnaires but concerted with the national specificities, we selected the questions, and created our knowledge-test tool. The test of 15 questions included 10 true-false questions and 5 multiple-choice questions to assess the knowledge level. The questions covered the following topics: 1) before transplantation: dialysis treatment; 2) transplantation surgery: cadaver and living donor transplantation, paired-organ donation, and surgical complications; 3) after transplantation: immunosuppressive drugs, and lifestyle.

The questionnaire used during the second data collection, following patient education, consisted of two main parts. In the first part, opinions about the patient education programme, the information obtained from another person, and the current transplant status were surveyed. The second part included questions from an extended knowledge test. The 15 questions used in the first survey were used, but the order of both the questions and the answers were different to reduce the likelihood that the respondent would answer the questions from memory. Moreover, an additional 5 questions were added to the test, so a total of 20 questions were used.

Data collection

The first round of data collection for our follow-up study started in September 2018 and lasted for a year. The second data collection could take place after 6 months at the earliest, but not later than 12 months after the first round of data collection and patient education.

We chose interviewers on voluntary basis from among kidney transplant patients who have undergone successful transplantation and regularly participate in aftercare. In addition to the questionnaire data collection, they also participated in the implementation of the patient education programme.

Data collection combined with education took approximately 60-90 minutes. After the data collection based on patients' needs, education was provided on the following topics: 1) waiting list and Eurotransplant; 2) cadaver and living donor transplantation; 3) surgical outcomes and possible complications; 4) follow-up and lifestyle. In addition, after data collection, interviewers, who underwent successful kidney transplantation, shared their own experience in kidney transplant process. We also provided the opportunity for the patients to ask questions, which we answered within our competence. At the end of patient education, the patients received a booklet edited and validated by the physicians from the Department of Transplantation, Institute of Surgery, Faculty of Medicine, and the University of Debrecen. This included the most common questions and answers about kidney transplantation, along with key contact information.

The Impact of COVID-19 epidemic on our study

The COVID-19 epidemic posed unexpected challenges to our planned investigation. The restrictive measures imposed due to the epidemic situation did not allow us to collect data and have patient education through personal presence, therefore data collection stopped in March 2020. We hoped to continue the investigations after the restrictive measures were lifted, but this could not happen mainly because of the time interval that elapsed after the first round of data collection, which could have greatly distorted the results obtained. Therefore, we started processing the already data available. Although the number of participants were lower in the second round of data collection than expected, the main calculations, analyzes and comparisons were possible to make.

Statistical analysis

Statistical analysis was performed with SPSS Version 22.0 statistic software package. The p-values of less than 0.05 were regarded as statistically significant. When comparing the data

from the first and second surveys, proportions and their associated 95% confidence intervals were calculated as a response option. As for age, 95% confidence intervals for the means were calculated. Normality of the data was confirmed by a Shapiro-Wilk test. Descriptive statistics were used for each variable, indicating the median and interquartile range of continuous variables, and, in case of categorical variables, the number and percentage distribution of respondents per answer option. Statistical methodology, during the selection of statistical analyzes, the conditions of application of statistical tests were examined. Data were analyzed for continuous variables and for two groups using Wilcoxon signed-rank tests, and for more than two groups with Kruskal-Wallis and post hoc Dunn's tests. The influence and relationship of the continuous variables were analyzed using Spearman's rank correlations. In the knowledge level test, the proportion of correct respondents was examined using the McNemar test. Factors influencing patients' knowledge were assessed by multiple linear regression analysis adjusted for ten explanatory variables, with the dependent variable being the knowledge score. Independent variables included socio-demographic factors (age, gender, education, and ethnicity), dialysis treatment (dialysis modality and location), and transplantation (waiting list, willingness to accept kidney transplantation, previous kidney transplantation), and health literacy.

3. Results

3.1. Characteristics of study population and changes during the follow-up

A total of 254 renal patients participated during the first round of data collection. The mean age of the patients was 48.8 years (SD: 13.2). 35.4% of the respondents were women and 64.6% were men. Regarding ethnicity, 16.5% of respondents declared themselves Roma. Most of the participants had high school equivalency diploma. With respect to the modality of dialysis, the majority of patients receive haemodialysis treatment. Regarding the dialysis centres, 32.3% received treatment in the dialysis centre of Hajdú-Bihar County, 32.3% in Szabolcs-Szatmár-Bereg County, and 35.4% in Borsod-Abaúj-Zemplén County. 38.2% were on the kidney transplant waiting list. Kidney transplantation was rejected by 24.4%. Previously 17.5% of the patients had had kidney transplantation. Based on the scores of the functional health literacy test, 37.4% of participants had inadequate and 62.6% had adequate health literacy level.

A total of 115 patients participated in the study during the second round of data collection. The final sample size was influenced by several factors. On the one hand, those who in the meantime received a kidney transplant or changed the place of residence (not to one of the three counties) were excluded. Patients who refused to participate were also excluded from the study. In addition, the number of deceased patients and the restrictive measures of the COVID-19 epidemic, which did not allow data collection, influenced the final sample. In the second study, the mean age of the renal patients was 50.3 years (SD: 11.9). 30.4% of the respondents were women and 69.6% were men. Regarding ethnicity, 19.1% of the respondents declared themselves Roma. The majority of participants had high school equivalent certificate. Regarding the modality of dialysis, most of them received haemodialysis. With regard to the dialysis centres, 38.3% received treatment in the dialysis centre of Hajdú-Bihar County, 41.7% in Szabolcs-Szatmár-Bereg County and 20.0% in the dialysis centre of Borsod-Abaúj-Zemplén County. 34.8% of them were on the waiting list. Kidney transplantation was rejected by 25.2% of the participants. Previously 18.3% of respondents had had kidney transplantation. 40.0% of renal patients had inadequate, while 60.0% had adequate health literacy level.

3.2. Source of information on kidney transplantation

During the first data collection, the respondents were able to select the source of information related to kidney transplantation from several given answers. They had the possibility to mark an unlimited number of answers. Based on the proportion of each source mentioned, the patients most often received information from health care professionals, physicians, and nurse. In addition, the media, television, and the Internet have also played an important role in providing information on transplantation to chronic renal patients. Participants in the study received information from a dialysis patient or a transplant recipient nearly in the same proportion. However, obtaining information from printed materials like newspaper or magazine, was very low among the respondents. Furthermore, relatively few of them received information from family members, relatives, or friends.

63.8% of the respondents received information from several sources. Information from multiple sources was found to be contradictory by 38.9% of kidney patients.

During the first data collection, we measured where and from whom the renal patients received information. During the second data collection, we measured whether they had received information from another person about kidney transplantation since the first data collection and patient education. 39.1% of respondents sought or received information. As expected, patients received most of the information from a healthcare professional, from either physicians or nurses. While in the first data collection, we found that patients received information from a dialysis patient and from a transplant recipient nearly in the same proportion. In the second data collection, we observed that they received information primarily from a transplant recipient. The proportion of information searched on the Internet and content seen on television has also decreased.

3.3. Knowledge of kidney transplantation and factors influencing it

3.3.1. Knowledge level of renal patients before patient education

Descriptive statistical characteristics of the factors influencing the knowledge

We found a significant positive relationship between age and knowledge score. No significant association was found when we compared the female and male mean scores. A significant relationship was found between knowledge score and education level. Patients with less than high school equivalency diploma had significantly lower knowledge scores compared to patients with high school equivalent ceertificate and with greater than high school equivalent certificate. Regarding ethnicity, those belonging to the Roma ethnic minority group reached significantly lower knowledge scores than those belonging to non-ethnic groups. Patients receiving haemodialysis (HD) treatment did not achieve a higher knowledge score compared to patients treated with peritoneal dialysis (PD), however compared with predialysis patients a significant relationship was found. With regard to the location of dialysis centre, the patients treated in Hajdú-Bihar county did not achieve a significantly higher or lower knowledge score compared to the patients treated in Szabolcs-Szatmár-Bereg county or Borsod-Abaúj-Zemplén county. A significant relationship was found between the knowledge scores and previous kidney transplantations. The mean knowledge score was significantly higher among patients who were kidney transplant recipients than that of patients who were not recipients before. No significant relationship was found between the median scores of patients who refused a kidney transplant compared to patients who did not refuse it. Regarding patients' health literacy level, those with adequate health literacy scored significantly higher than the ones with limited health literacy.

Examination of factors influencing knowledge score by multiple linear regression analysis

Based on our results, it can be said that patients with greater than high school education and patients with high school education achieved higher knowledge scores compared to patients with less education. Patients who had a kidney transplant previously scored 2 points higher than those who did not have a kidney transplant. Patients with an adequate health literacy level also scored higher when compared to those with inadequate health literacy level. Borderline significance was observed in waiting list. The knowledge score proved to be independent of the patient's age, gender, ethnicity, modality of dialysis, location of dialysis centre, and willingness to receive a kidney transplant.

3.3.2. Knowledge level of renal patients after patient education

Overall, we found a significant difference between the mean of the patients' knowledge score before patient education and the value measured after the education, according to which patients scored higher after education. We also examined which test questions had improved results. Based on our analyses, it can be said that in the case of all questions, the proportion of those who answered correctly in the repeated test is higher than in the initial test. Moreover, in the case of seven questions, significantly higher proportions were observed. However, (similarly to the first survey), questions on living donor transplantation, paired-organ donation, and surgical complications received the lowest correct response rates.

3.4. Opinion of the study population on the patient education program

We surveyed the opinion of the renal patients participating in the data collection about the implemented patient education program, the usefulness of personal interviews conducted in dialysis centres, the satisfaction and the usefulness of the information received. The majority of participants were very satisfied with the program, with a sample mean of 8.8 (SD = 1.6) compared to a maximum of 10 points.

4. Discussion

In our study, we examined the knowledge level of chronic renal patients related to kidney transplantation, and we analyzed the influencing factors in particular, to identify gaps and barriers in patient knowledge in this area. Based on our research-related patient education

programme, we also obtained information about the effectiveness of personalized patient education.

Source of information regarding kidney transplantation

Renal patients nominated physicians and nurses as primary source of information, both during the first and second rounds of data collection. This result can be related on the one hand to the appropriate knowledge score achieved in the knowledge level test, furthermore, to the high-quality work of the physicians and nurses working in the kidney transplantation process in the region. Moreover, the role of dialysis patients cannot be neglected. Frustration of not being elected or suitable for a kidney transplant or experiencing failure in returning to the dialysis program after a kidney transplant can be observed among dialysis patients. The long-term relationship with them can influence renal patients 'opinions and their decision-making. A previous study showed that patients who refused a kidney transplant reported a higher proportion of cases with negative outcomes, and most of them believed that kidney transplantation had more disadvantages than benefits. That is why involving transplant recipients is the key to success in the education programme as they will be able to share their own experience in a credible way. The results of the second round of data collection also confirm the importance of this, as the participants get more information from kidney transplant recipients than dialysis patients comparing the two data collections.

Health literacy level of chronic renal patients

In our study, patients had adequate health literacy level both in functional and subjective sense. However, it is important to note that 38.2% of the renal patients in the sample were on the waiting list, and a further 20.9% were under investigation for kidney transplantation. Based on this data, our results are not surprising, as several studies have confirmed that renal patients with higher health literacy level are more likely to be referred for kidney transplantation and are more likely to be on the waiting list.

Knowledge level related to kidney transplantation

Our results proved that higher educational level, history of previous kidney transplantation, and higher health literacy level proved to be a significant influencing factor for the knowledge score. Proper understanding and acceptance of knowledge transferred is facilitated by the education level, therefore low-skilled patients need to be educated in a different way, because an experienced mediator opts for the most understandable way of education. The good news is

that not a single determined, unchangeable factor affects the acquisition of knowledge, nor age, gender, or ethnicity. This means that with the right activity, good results can be achieved by anyone. Certainly, the education is not the only advantage. In our study, we found a significant correlation between patients' knowledge and the level of health literacy, which coincides with the results of previous studies. Regarding the variables related to kidney transplantation, not surprisingly, patients who were kidney recipients before had more knowledge about kidney transplantation. These patients can be considered the most experienced ones in kidney transplantation; however, the objectivity of their experience may be affected by their personal history if they have experienced it as a failure. However, given our results into account, it can be said that the majority of these patients did not experience the first kidney transplant as a failure, as most of them were on the kidney transplant waiting list so they are willing to accept it again. They are the best mediators of knowledge transfer, as they have experience, and they have remained motivated. At the same time, they regularly meet other patients who are still naive about kidney transplantation. This reinforces the key role of current kidney transplant recipients in the design of patient education programs.

The value of Cronbach-α is 0.725, indicating good internal consistency. The value obtained is nearly the same with the values of international knowledge assessment tests developed for renal patients.

Our results indicate that our program is effective. On the one hand, the participating renal patients scored significantly higher knowledge score in the second test, which followed the patient education after several months, regardless of whether the patients received information from another person or source (not from the staff of the transplant centre in Debrecen) after the education. On the other hand, for each factor influencing the level of knowledge, an increase in knowledge scores can be observed within all variables, so it cannot be stated that our programme is more effective or less effective within certain groups. In most cases, it is clear that personalized education with peers results in a positive change. Despite the fact that the knowledge score achieved by the patients is adequate, after the analysis of each question group, it can be stated that they were in lack of knowledge about surgery, especially living donor kidney transplantation, and paired-organ donation. Our results are in line with previous studies obtained by Illés et all, where 66% of the respondents answered that they had never heard of living donor kidney transplantation in the Debrecen region. The lower living donation transplantation activity, compared to the average of the Hungarian capital and the

Eurotransplantation countries, is mainly caused by lack of proper information transfer or misunderstanding.

In conclusion, a risk group has been identified where targeted, personalized patient education is essential. Mainly among patients with low education level, low health literacy level, and without previous kidney transplantation.

The gaps we have identified can help healthcare professionals to identify areas that need to be emphasized when designing patient education and self-management programs to improve patient collaboration and outcomes. There is a need to develop professionally validated and quality-assured educational programs from systematic and credible sources that are tailored to the needs of patients, and to provide appropriate media emphasis where current kidney transplant recipients play a key role. Due to the growing need to increase the living donation rate, the topic of living donation is an essential element of educational programs. It is important to note that not only lack of knowledge is crucial in patients' preferences regarding renal replacement therapy, as proper knowledge does not mean a direct change in their behaviour. However, proper, and credible information transfer and education play a significant role in dispelling the already existing misconceptions and fears related to kidney transplantation.

4.1. New findings of our study

The following new findings were made during our study:
- Renal patients nominated doctors and nurses as primary sources of information,
- It is crucial to involve kidney transplant recipients who can authentically tell their first-hand experiences,
- Factors influencing the patients' knowledge level were higher education, previous kidney transplant in the medical history, and higher health literacy level,
- The effectiveness of our program is indicated by the fact that the participants achieved significantly higher scores on the knowledge test, even several months after the education,
- Personalized education with the involvement of kidney transplant recipients leads to positive change.

4.2. Possible clinical application of our results

Adequate knowledge is a prerequisite for joint decision-making, and it is essential to monitor patients' knowledge in order to get a real picture of their knowledge level and possible deficiencies, misconceptions, and beliefs, which strongly influence the patient's decision about their health. The identification of all these factors, the design and implementation of personalized patient education can become smoother and focus on areas where there is a real need for improvement. In our study, we identified the factors that affect the knowledge level of renal patients. By considering these factors, information can be transmitted more efficiently, thus achieving a positive change. Examining the health literacy of patients undergoing kidney transplantation, especially using tests to measure functional health literacy, can provide information on the ability to take medications and to attend appointments that are of paramount importance in the post-transplant period.

Summary

In our study, we examined the knowledge level related to renal replacement therapies and its influencing factors among chronic kidney disease patients, in order to identify the patients' knowledge gaps. At the same time, we provided information, education on kidney transplantation. Factors influencing the patients' knowledge were evaluated using a multiple linear regression adjusted for ten factors, where the dependent variable was the knowledge score. During the first data collection of our follow-up study, we contacted patients on the Eurotransplant waiting list, patients undergoing medical evaluation, and patients who refuse a kidney transplant, between 18 and 75 years old. A total of 254 patients were involved in the first round of data collection (recording the basic level of knowledge), and 115 in the second one (after the education). Our results show that the knowledge score achieved by the patients is generally adequate, however, after the analysis of each question group, it can be said that their knowledge about surgery, especially living donor kidney transplantation, and paired-organ donation is inadequate. The rate of correct answers to these questions ranged from 50% to 70%. Regarding the influencing factors, our results show that patients with both tertiary and secondary educational attainment achieved higher knowledge scores. Patients with previous kidney transplantation scored higher than those without. Moreover, patients with adequate health literacy level achieved significantly higher knowledge scores. Our results prove the effectiveness of our programme since the participants achieved significantly higher scores on the knowledge test, even several months after the education. The gaps we have

identified can help healthcare professionals to identify areas that need to be emphasized in patient education and self-management programmes to improve patient collaboration and outcomes.

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List of publications related to the dissertation

1. **Barth, A.**, Szőllősi, G. J., Nemes, B. Á.: Factors Affecting Access to the Kidney Transplant Waiting List in Eastern Hungary.
   Transplant. Proc. 53 (5), 1418-1422, 2021.
   DOI: http://dx.doi.org/10.1016/j.transproceed.2021.01.044
   IF: 1.066 (2020)

2. **Barth, A.**, Szőllősi, G. J., Nemes, B. Á.: Measuring Patients' Level of Knowledge Regarding Kidney Transplantation in Eastern Hungary.
   Transplant. Proc. 53 (5), 1409-1413, 2021.
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List of other publications

3. Kiss, J., **Barth, A.**: A személyiség és az önismeret szerepe a mentori munkában, a duális képzés során.
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11. Kiss, J., **Barth, A.**, Takács, P.: Munkaérték preferenciák és más tényezők állandósága és változásai egyetemi hallgatók körében.
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