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Knowledge and Attitudes of Students of the Medical University of Lodz Regarding Legal Aspects of Organ Transplantation in Poland. A Cross-sectional Study

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Abstract

Background: *Nowadays, the transplantation of organs, tissues, and cells is a popular medical technique, but it still raises conflicting opinions in society.*

Objectives: *The study aimed to analyze the knowledge and attitudes of students of the Medical University of Lodz regarding legal aspects in the field of organ transplantation.*

Material and methods: *The cross-sectional study was conducted from March to May 2024 as part of a bachelor's thesis. The study involved 274 undergraduate and graduate students at the Faculty of Health Sciences of the Medical University of Lodz. The anonymous survey consisted of two parts: the first part contained questions about general knowledge about the legal aspects of transplantation and attitudes toward transplantation, and the second part of the questionnaire included questions about socio-demographic data (gender, education, degree of studies, and place of residence).*

Results: *The level of students' knowledge in the field of transplantology is average. Almost all respondents (95%) stated that society needs knowledge about transplantation. About 70% of students would consent to having their organs harvested after death to save the lives of other people. A similarly high result (73%) concerns becoming a living donor for a loved one. The large majority (81%) of respondents supported harvesting organs from deceased persons and transplanting them to other people to save lives. A greater chance of having high knowledge about transplantation was observed among female students ($OR = 4.32$; $p < 0.001$) and students living in large cities ($OR = 3.92$; $p < 0.01$) and small towns ($OR = 5.2$; $p < 0.01$).*

Conclusions: *There is a need to promote ideas and knowledge in the field of transplantology among students of medical universities as future healthcare workers.*

Key words: *knowledge, transplantation, opinions, medical students, organ donation*

Introduction

Transplantation (from Latin *transplantare* – „to graft", from *trans* – „outside of something", *plantare* – „to plant") is the transport of body fragments within the same organism or between two organisms. Fragments of an organism can be transferred within the same individual or within a genetically similar individual. Donation can take place during a person's life but also after death [1].

Transplantology can be called one of the youngest branches of medicine, but the first information about transplants can be found in the literature describing ancient times [2]. Nowadays, the transplantation of organs, tissues, and cells is a popular medical technique, but it still raises conflicting opinions in society. The constantly developing transplantology has led to a large number of people waiting for a transplant. Unfortunately, the demand for organs for transplantation does not match the number of donor organs. This situation in transplantation medicine applies not only to Poland, it occurs all over the world [1]. The second half of the last century was a period of intensive development of clinical transplantology. Polish doctors make a great contribution in this regard. The first successful transplant was performed in 1966 by Nielubowicz, a kidney transplant from a deceased donor [3]. In the late 1990s, Krawczyk and Kaliciński transplanted part of the liver from a living person. The first attempt at a heart transplant was made by Moll, but it was not until 1985 that Religa and a team of cardiac surgeons performed a successful heart transplant [3–5].

In 2006, Jabłecki performed a hand transplant in Poland [5]. Cell, tissue, and organ transplantation has become a reality [6]. Improvements in post-transplant care also mean that patients live longer and have an increasingly better quality of life after surgery [6].

In Poland, transplantation is regulated by the 2005 Act on the Removal, Storage and Transplantation of Cells, Tissues and Organs (so-called Transplant Act of 1 July 2005) [7]. Currently, every activity before and after transplantation is carried out by the Transplant Act with a few exceptions (such as blood distribution and transplantation issues related to the reproductive system) [8, 9].

In 2022, donation activity resulted in the possibility of transplanting 1650 organs from deceased donors in Poland, almost 200 more than in 2021. These were mostly kidneys, liver, and lungs. 101 organs were collected from living donors (37 more than in 2021). However, there were 1495 recipients of these organs in 2022 [10].

All organs are much more often collected from dead donors. The scale of the demand for organs in transplantology is best illustrated by the demand for liver and kidneys, which in 2020 amounted to 138 and 2101, respectively, much more than were obtained from donors [10].

In other countries active in transplantology, the number of transplantations performed is two or three times higher than in Poland, which results from the acceptance of local societies for the idea of transplantation [11]. The observed shortage of donors is a problem not only in our country but globally. Many patients with organ failure die each year on transplant waiting lists because of this shortage [12]. The number of donors cannot keep up with the demand [13].

Organ donation is a multifactorial and complex issue, involving factors such as legal, ethical, medical, social, cultural, and organizational factors as well as personal beliefs [14, 15]. It has been shown that socio-demographic factors such as gender, level of education, age, and religious beliefs influence attitudes toward transplantation [16].

Undertaking a transplant procedure does not only require accuracy and caution but also extensive knowledge. Patients and their families should be approached with full awareness and respect regarding their faith, culture, and beliefs. Everyone has the right to freedom of belief, and being treated with respect [17, 18]. Specialists performing transplants must, therefore, provide not only high-quality patient care but also respect the religious approach. It is known that the data of both recipients and donors are confidential. A person who accepts organs from an unknown donor usually wonders who that person was and what kind of life he or she led. It evokes emotionality not only in the recipient and his or her relatives but also in the relatives of the person who became the donor. Society needs to be sensitized and educated in this area [19].

Individuals' attitudes and knowledge toward organ donation and transplantation may influence their behavioral intention or behavior [20].

Healthcare workers and medical students, as the new generation of clinicians, act as a link between recipients and donors [21]. Medical school students will have a role in the future in advising patients about organ donation and in identifying potential donors, so their level of knowledge and attitude are very important [22].

The study aimed to analyze the knowledge and attitudes of students of the Medical University of Lodz regarding legal aspects in the field of organ transplantation. Moreover, the aim was to examine how the student's level of knowledge about transplantation affects their personal feelings toward the removal of organs after death to save the lives of other people and whether they would decide to donate their organs posthumously.

Materials and methods

Study design and characteristics of the study group

The cross-sectional study was conducted from March to May 2024 as part of a master's thesis. The study involved 275 undergraduate and graduate students at the Faculty of Health Sciences of the Medical University of Lodz. The respondents were Faculty of Health Sciences students majoring in public health, dietetics, and nursing. 274 students completed the research. One survey was excluded due to incomplete responses. The response rate was 99.6%. Criteria for inclusion in the study group: being a student, age over 18, willingness to participate in the study. Exclusion criteria from the study group: people other than students, age below 18, lack of willingness to participate in the study. The developed survey questionnaire was disseminated via social media in the form of a link. Informed consent was obtained from all participants in the study. The study was conducted by the ethical principles set out in the Declaration of Helsinki. The Bioethics Committee of the Medical University of Lodz does not provide opinion research works that form the basis for preparing bachelor's and master's theses.

Questionnaire

The survey questionnaire included self-developed questions. The anonymous questionnaire consisted of two parts. The first part included 25 questions relating to general knowledge about the legal aspects of transplantation and attitudes toward transplantation. These included: questions about legal provisions in Poland regulating the procurement, storage, and transplantation of organs, what is meant by the term transplantation, living donor, autogenous, allogeneic, xenogeneic transplant, presumed consent, declaration of will, and a question about registration of an objection to recover cells, tissues, and organs in the Central Objection Register. This part of the survey also included questions about respondents' attitudes toward transplantation. These were questions about the acceptance of harvesting organs from deceased people to save lives and questions about consent to donation during life and after death. The second part of the questionnaire included questions related to socio-demographic data, such as gender, education, degree of studies, and place of residence. A test of the questionnaire was conducted on ten students to assess the comprehensiveness of the questions, repetitive questions, and response time. Minor changes have been made according to students' suggestions. In the question about the level of knowledge, the following answers were combined: high level of knowledge (very high and rather high); and low level of knowledge (very low and rather low).

Statistical analysis

Statistica, version 13.3, licensed by the Medical University of Lodz, and the Microsoft Office package were used to analyze the data. Categorical variables were shown as numbers and percentages. The chi-square test was used to compare categorical variables. A p-value was considered significant when $p < 0.05$. Univariate and multivariate logistic regression analyses were used to identify factors predicting students' level of knowledge about transplantation. Results are shown using OR (odds ratio) and 95% CI (95% confidence interval). Statistically significant variables in the univariate model ($p < 0.1$) were included in the multivariate model.

Results

Characteristics of the respondents

Of the 274 students participating in the study, 61% were women, and 39% were men. Most respondents (28%) lived in large cities with over 100,000 inhabitants, while the fewest people lived in villages (23%). 57% of the respondents were students with secondary education and first-cycle studies, while 43% were second-cycle students with higher education (Table 1).

Table 1. Sociodemographic data of students

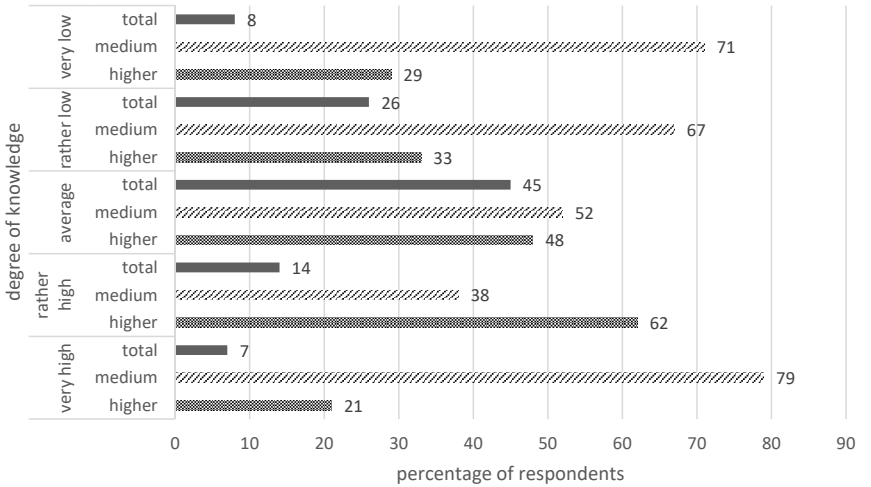
Variables (N = 274)		N = 274	%
Sex	female	167	61
	male	107	39
Place of residence	village	64	23
	large city (over 100,000 inhabitants)	77	28
	medium-sized city (over 20,000 to 100,000 inhabitants)	66	24
	small city (up to 20,000 inhabitants)	67	25
Education	medium	157	57
	higher	117	43
Level of study	first cycle studies	157	57
	second cycle studies	117	43

Source: own elaboration.

Knowledge of medical school students about transplantation

The subjective assessment of the respondents' knowledge about transplantology is presented in Figure 1. Most people stated that their level of knowledge about transplantology was average (45%), of which 52% had secondary education.

Figure 1. Students' level of knowledge about transplantalogy according to the level of education



Source: own elaboration.

Students' knowledge about transplantation is presented in Table 2. Transplantation, according to the definition, is the transplantation of an organ, tissue, or cell from one organism to another. This question was answered correctly by ¾ of the respondents, of which over half (51%) had higher education. The definition of a living donor is sharing your organ with another person during your life. This answer was given by the majority of respondents, as many as 82%, of which almost half (49%) had higher education. Half of the surveyed students answered that to become an organ donor, all the ways of expressing one's will listed in the question were accepted and possible, which was the correct answer. The most frequently transplanted organ in Poland are the kidneys, and this was the answer given by 63% of the respondents, of whom more than half had medium education (54%).

Table 2. Students' knowledge about transplantation

Knowledge status	Secondary education (first-cycle students) n = 157 (%)	Higher education (second cycle students) n = 117 (%)	Total N = 274 (%)
1. What is transplantation?			
selling your organs	11(100%)	-	11(4%)
donating your organs after death	20(77%)	6(23%)	26(9%)
organ transplant only from deceased persons	25(83%)	5(17%)	30(11%)
transplantation of an organ, tissue, or cell from one organism to another	101(49%)	106(51%)	207(76%)
2. What does the term living donor mean?			
donating an organ for transplantation to another person during life	114(51%)	110(49%)	224(82%)
selling an organ during life	31(82%)	7(18%)	38(14%)
I don't know	12(100%)	-	12(4%)
3. To become a donor you must…			
complete declarations of intention to donate tissues and organs for transplantation	51(65%)	28(35%)	79(29%)
inform your loved ones about your will	24(89%)	3(11%)	27(10%)
carry a completed declaration of will with you	26(81%)	6(19%)	32(11%)
all ways of expressing one's will are accepted and possible	56(41%)	80(59%)	136(50%)
4. Which organs are transplanted most often in Poland?			
heart	26(68%)	12(32%)	38(14%)
kidney	93(54%)	80(46%)	173(63%)
liver	103(51%)	99(49%)	202(74%)
lung	58(62%)	36(38%)	94(34%)
other	47(72%)	18(28%)	65(24%)
5. Which institution in Poland coordinates the collection and transplantation of cells, tissues, and organs?			
National Center for the Development of Transplantation Medicine	78(63%)	45(37%)	123(45%)
National Transplantation Council	42(62%)	26(38%)	68(25%)
Poltransplant Organizational and Coordination Center for Transplantation	37(45%)	46(55%)	83(30%)

Knowledge status	Secondary education (first-cycle students) n = 157 (%)	Higher education (second cycle students) n = 117 (%)	Total N = 274 (%)
6. Which legal act regulates aspects of transplantation in Poland			
Act of October 26, 1995 on the collection, storage, and transplantation of cells, tissues, and organs	41(57%)	31(43%)	72(26%)
Act of July 1, 2005, on the collection, storage, and transplantation of cells, tissues, and organs	64(50%)	65(50%)	129(47%)
Act of July 3, 2007 on transplantation	52(71%)	21(29%)	73(27%)
7. Autogenous transplant is:			
transplantation of your own cells or tissues (e.g. skin graft)	87(50%)	87(50%)	174(64%)
transplantation of cells or tissues from one organism to another	30(62%)	18(38%)	48(18%)
transplantation of cells and tissues from another species	30(81%)	7(19%)	37(13%)
bone marrow transplant	10(67%)	5(33%)	15(5%)
8. Allogeneic transplant is:			
transplantation of an organ, tissue, or cell from a donor of a compatible species	72(47%)	81(53%)	153(56%)
transplantation of an organ, tissue or cell from a donor of another species	55(72%)	21(28%)	76(28%)
I don't know	30(67%)	15(33%)	45(16%)
9. A xenogeneic transplant is:			
transplantation of your own cells	28(70%)	12(30%)	40(14%)
transplantation of cells, tissues, or organs between the same species	54(71%)	22(29%)	76(28%)
transplantation of cells, tissues, or organs between individuals of different species	75(47%)	83(53%)	158(58%)
10. Implied consent is:			
consent to organ donation after death	70(57%)	52(43%)	122(45%)
consent of the closest family to donating organs for transplantation after the death of a loved one	68(54%)	59(46%)	127(46%)
I don't know	19(76%)	6(24%)	25(9%)

Knowledge status	Secondary education (first-cycle students) n = 157 (%)	Higher education (second cycle students) n = 117 (%)	Total N = 274 (%)
11. The declaration of will is:			
a written record of the will to donate organs	106(52%)	96(48%)	202(74%)
informal consent to organ donation	36(67%)	18(33%)	54(20%)
I don't know	15(83%)	3(17%)	18(6%)
12. How to submit an objection so that it is legally honored			
Registration of the opposition in the Central Register of Oppositions	53(52%)	48(48%)	101(37%)
oral statement in the presence of witnesses	30(62%)	18(38%)	48(18%)
submitting a declaration of refusal to consent to organ donation after death, signed by two witnesses	47(63%)	28(37%)	75(27%)
I don't know	27(54%)	23(46%)	50(18%)

Source: own elaboration.

The coordination of the transplantation process in Poland is managed by the Poltransplant Organizational and Coordination Center for Transplantation. This answer was given by only 30% of the respondents, of which 55% had higher education.

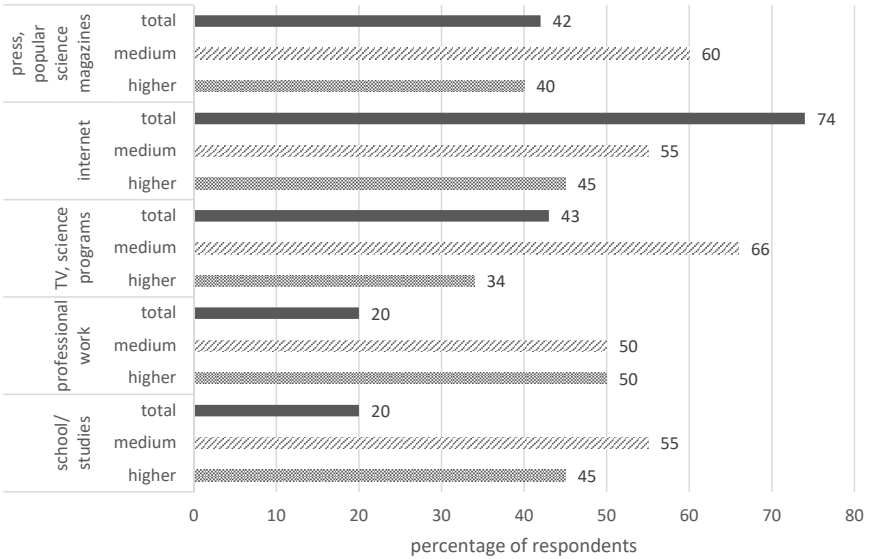
The correct provision (Transplant Act of 1 July 2005) regulating aspects of transplantation in Poland were indicated by 47% of students. No differences were found between secondary and higher education. The correct answer, that an autogenous transplant is a transplant of one's cells or tissues, was given by 64% of respondents. An allogeneic transplant is a transplant of an organ, tissue, or cell from a donor that is species-compatible. More than half of the respondents confirmed this answer (56%). The correct answer, that a transplant of a cell, tissue, or organ between individuals of different species is a xenogeneic transplant, was given by 58% of students. Consent to organ donation after death is presumed consent, this answer was given by 45% of respondents, 43% of whom had higher education. Almost ¾ of the students indicated that a declaration of will is a written record referring to the personal will to collect

organs posthumously for transplantation. Informal consent to obtain organs for transplantation was chosen by 20% of respondents. 6% of people did not know the answer, most of whom had secondary education (83%).

For an objection to be legally taken into account, it must be made orally in the presence of two witnesses, and the witnesses must additionally have written confirmation of their will to object. 27% of respondents answered „yes". Another way is to report to the central register of objections, as 37% of respondents agreed with this. About 64% of respondents chose the correct answers.

When asked where students get their knowledge about transplantation, 3 out of 4 respondents indicated the Internet, 42% indicated the press and magazines, and 20% from school and studies (Figure 2).

Figure 2. Sources of respondents' knowledge about transplantation according to education level



Source: own elaboration.

Table 3. Students' attitudes about transplantation

Attitudes	Secondary education (first-cycle students) n = 157(%)	Higher education (second cycle students) n = 117(%)	Total N = 274(%)
1. Would you consent to having your organs harvested after death?			
Yes	97(50%)	96(50%)	193(70%)
No	38(79%)	10(21%)	48(18%)
I don't know	22(67%)	11(33%)	33(12%)
2. Do you support harvesting organs from deceased people to save other people's lives?			
Yes	115(52%)	106(48%)	221(81%)
No	25(81%)	6(19%)	31(11%)
I have no opinion	17(77%)	5(23%)	22(8%)
3. Do you accept the removal of organs from healthy people to save the health and lives of sick people?			
Yes	93(48%)	101(52%)	194(71%)
No	31(84%)	6(16%)	37(13%)
I don't know	33(77%)	10(23%)	43(16%)
4. Would you agree to become a living donor for a loved one?			
Yes	97(48%)	103(52%)	200(73%)
No	31(89%)	4(11%)	35(13%)
I don't know	29(74%)	10(26%)	39(14%)
5. Is a sufficient number of organs transplanted in Poland?			
Yes	45(92%)	4(8%)	49(18%)
No	73(45%)	91(55%)	164(60%)
I don't know	39(64%)	22(36%)	61(22%)
6. Should doctors harvest organs if the family objects?			
Yes	58(60%)	38(40%)	96(35%)
No	60(53%)	54(47%)	114(42%)
I don't know	39(61%)	25(39%)	64(23%)
7. What are the most common reasons for the family's opposition to the intention to collect organs and tissues for transplantation?			
fear of disfigurement of the deceased's body	74(60%)	50(40%)	124(45%)
emotional bonds with the deceased	97(52%)	89(48%)	186(68%)
religion beliefs	90(53%)	79(47%)	169(62%)
lack of trust in medical staff	57(71%)	23(29%)	80(29%)
fear of disconnecting the patient from life support equipment	60(53%)	53(47%)	113(41%)
concern about the unfair use of harvested organs	28(55%)	32(45%)	60(28%)
8. Does society need knowledge about transplantation?			
Yes	147(57%)	113(43%)	260(95%)
No	10(71%)	4(29%)	14(5%)

Source: own elaboration.

Attitudes of medical school students toward transplantation

The majority of students (70%) agreed to have their organs removed after death for transplantation, both in the first and second cycle of studies (Table 3). Similarly, 81% of students support the removal of organs from dead people to save another human being. 71% of students accepted harvesting organs from healthy people to save the health and life of sick people. Similarly, 73% of students would become a donor to a loved one during their lifetime. When asked whether an adequate number of organs are transplanted in our country, 60% answered „no". 35% of students agree with the opinion that doctors can remove organs for transplantation if the family does not allow it. As many as 95% of respondents agree with the statement that society needs knowledge about transplantation.

When asked what, in your opinion, are the most common reasons for family opposition to the intention to collect organs and tissues for transplantation, respondents indicated: emotional bonds with the deceased (68%), religious beliefs (62%), and fear of disfigurement of the deceased's body (45%).

Correlates of knowledge about transplantation

The relationship between sociodemographic characteristics and students' knowledge about transplantation was based on logistic regression analyses (supplementary material Table S1– S3). In the univariate analysis, no statistically significant results were obtained.

In the univariate model, women (OR = 3.69; $p < 0.001$), students living in large cities (OR = 3.39; $p < 0.01$), and small towns (OR = 3.83; $p < 0.01$) had greater knowledge about transplantation. Students with medium education were almost twice as likely to have a low level of knowledge (OR = 1.99; $p < 0.05$) than students with higher education. However, students with higher education had an average level of knowledge about transplantation 1.5 times more often (OR = 1.53; $p < 0.05$) than students with medium education.

In the multivariate model, a greater chance of having high knowledge about transplantation was observed among female students (OR = 4.32;

$p < 0.001$) and students living in large cities (OR = 3.92; $p < 0.01$) and small towns (OR = 5.2; $p < 0.01$).

The question should be asked whether there is statistical significance between theoretical and empirical distributions that arise from probability theory. H0 – There is no statistical significance in the comparison of the level of knowledge about transplantation and the education of the respondents. H1 – There is statistical significance in the comparison of the level of knowledge about transplantation and the education of the respondents.

The OR in the group with higher education is 1.32, which indicates that in this group of people, there is a greater chance that they will rate their knowledge highly (Table 4). The OR among people with secondary education is 0.76. Therefore, it can be concluded that in this group of surveyed people, there is less chance that respondents will define their level of knowledge as high. From the chi^2 test, it can be concluded that there is no statistically significant relationship between the education and the level of knowledge of the respondents ($p = 0.35$).

Table 4. The odds ratio (OR) between the respondents' knowledge and their education

OR	Chance		Odds ratio		p-*value*
	higher	medium	higher	medium	
	30.00%	22.66%	1.32	0.76	p = 0.350

Source: own elaboration.

Moreover, the question should be asked whether there is a connection between the respondents' answers whether they support the removal of organs from dead people to save the lives of other sick or dying people, and the education level of the students. H0 – There is no connection between the answers given by respondents whether they are in favor of harvesting organs from dead people to save other people's lives and their education. H1 – There is a connection between the answers given by the surveyed students to the question of whether they are in favor of harvesting organs from dead people to save the lives of other sick people and their education.

From the results of the chi^2 test, it can be concluded that there is a statistically significant relationship ($p < 0.0003$) between support for the removal of organs from deceased persons and the respondents' education. The odds ratio in the group of people with higher education is 0.28, which means that in this group of respondents, there is a smaller chance that the respondents do not support the removal of organs from deceased people to save the lives of other people. The odds ratio in the group of people with secondary education is 3.52, which means that in this group of respondents, there is a high chance that the respondents do not support the removal of organs from deceased people to save the lives of other people (Table 5).

Table 5. The odds ratio (OR) between supporting the removal of organs from deceased persons to save the lives of others and the education level of the surveyed students

OR	Chance		Odds ratio		p-*value*
	higher	medium	higher	medium	
	10.38%	36.52%	0.28	3.52	p = 0.00032

Source: own elaboration.

Discussion

The results of this study indicate that students of the Medical University of Lodz at the Faculty of Health Sciences assess their knowledge about transplantation at an average level. Similarly, in the study by Smoleń et al., nearly half of the students rated their knowledge about transplantation at an average level [23]. The low level of knowledge of health sciences and medical students about organ donation was demonstrated in a study in Saudi Arabia and India [24–26]. In a study in Ethiopia, undergraduate health sciences students had positive attitudes toward and high knowledge about organ donation [27]. These differences may result from the cultural context and the use of different questionnaires.

More than ¾ of the respondents in our study correctly answered the question of what transplantation is. This result is lower than in the study by Wojczyk et al., where the definition of organ transplantation was correctly understood

by the surveyed students of both medical and sports faculties (100%), as well as students of humanities, social sciences, and technology (92%) [28].

Almost all respondents (95%) stated that society needs knowledge about transplantation. These results are comparable to the results of the study by Smoleń et al., where the vast majority of respondents expressed the need to increase their knowledge in this area [23]. Knowledge about organ donation can be of key importance in the transplant process [29]. It is, therefore, important that healthcare professionals have enough knowledge to inform people and facilitate this process [12, 26, 27].

The positive attitude of students of the Medical University of Lodz toward organ donation and transplantation is crucial for their future professional work, including in persuading patients and their relatives to donate organs. They can also become role models for patients.

A very satisfactory result of our study is that 70% of students would consent to having their organs harvested after death to save the lives of other people. Lower results were obtained in the study by Kamińska et al., where 60% of students would consent to their organs being taken for transplantation after death [30]. Higher results were obtained in the study by Humańska et al., where 75% of respondents would agree to have an organ removed after their death to transplant it to another person [31]. Similarly, in studies conducted in other countries, the majority of students (73.8% and 85%, respectively) reported that they agreed to donate their organs [32, 33]. The positive attitude toward organ donation is confirmed by studies conducted in Turkey, Spain, and Canada, in which 71%, 80%, and 96% of medical students, respectively, supported organ donation and transplantation [16, 34, 35]. In a study in Canada, 96% of medical students wanted to become organ donors after death [16]. Lower results were reported in Iran and Malaysia, where 50% of medical students wanted to donate their organs [36, 37]. Other research indicates that university students had poor attitudes toward transplantation and organ donation (70%) [38]. In Turkey, in a pilot study among medical students, only 35.8% would donate their organs to save a life [39].

A similarly high result (73%) in this study concerns becoming a living donor for a loved one. This is confirmed by other studies, where 75% of students

would donate their kidney if a member of their family suffered from kidney failure [38]. In another study, 78% of students would donate their organs to their family, relatives or friends [33]. High results were also obtained in another study in Poland, where 89% of medical students declared their willingness to donate organs to their families [40]. In the study by Rydzewska et al., 54.5% would donate their organs to any person [41].

The large majority (81%) of respondents supported harvesting organs from deceased persons and transplanting them to other people to save lives. A lower result (76%) was obtained in the study by Kamińska et al., and a higher result (85%) in the study by Lisowska et al. [30, 42]. In the study by Strzok-Kliś et al., the majority of respondents (97%) supported the transplantation of organs from deceased donors [43].

Students of the medical university in Łódź indicated that they gained knowledge about transplantation mainly from the Internet. Similar results were obtained in other studies in which young people gained knowledge from this source [38, 44]. In other countries, the main source of information about organ donation for medical students was television [25, 29, 32, 37, 45–52], followed by the Internet and family, relatives, and/or friends [52].

A study by Amani et al. showed that mass media can be of key importance in increasing the knowledge and attitudes of the population and in encouraging people to donate organs and transplants [53]. Newspapers and posters had a minor role in providing information about transplantation [38].

Over 47% of students of the Medical University of Lodz know the legal provisions based on which transplantation may be carried out. In other studies, the number of students knowing the regulations regarding organ donation also turned out to be quite low [54], e.g., in a study in Brazil, 51% of students have already heard about the transplant law [55]. Lower results were obtained in a study conducted among students of an Iranian medical university (32.8%) [32].

About 60% of students indicated that not enough organs are transplanted in Poland. This result is lower than the results of research by Gorzkowicz et al., where students of a medical school and a university believed that in relation to the demand in Poland, there is not a sufficient number of organs collected (this was claimed by 95% and 94% of students of these universities,

respectively) [56]. Similar results were obtained by Mikla et al., where 97% of medical students disagreed with the opinion that the number of organ donors is sufficient to meet the demand [40].

Limitations and strengths of the study

This study is one of the first to address the topic of knowledge and attitudes toward organ donation and transplantation, which was conducted among students of health sciences at the Medical University of Lodz. The study has weaknesses. First of all, the cross-sectional design of the study, which limits firm conclusions regarding causality. Secondly, only medical students participated in this study. Including students from other universities could yield more valuable results. Thirdly, the result of this study may not be generalizable to all students of medical universities in Poland and other countries. A small number of undergraduate and graduate students participated in the study.

Implication

According to this study, health sciences students are willing to donate their organs. However, their knowledge about transplantation is at an average level. It seems necessary to raise the issue of transplantation at the early stages of higher education. It is also suggested by the students themselves that appropriate education should be provided in schools [54]. Educational programs regarding transplantation procedures should also be introduced and improved. Transplantation courses can be added to the medical education curriculum from the beginning of your studies [54]. Greater awareness among students about transplantation may later contribute to the discussion of this issue among patients, family members, relatives, and friends.

Conclusions

Students self-assessed their knowledge about transplantation as average, and coming mainly from the Internet. The surveyed students support collecting

organs from the deceased and transplanting them to other people in order to save lives, and they themselves would consent to having their organs harvested after death. Students believe that society needs knowledge about transplantation. There is a need to promote ideas and knowledge in the field of transplantology among students of medical universities as future healthcare workers. Conducting education and intervention in this area and introducing the issues into university curricula may change people's attitudes toward organ donation and increase the number of transplants performed.

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Supplementary material

Table S1. The odds ratio (OR) of sociodemographic characteristics and high level of knowledge

Variable	Total	High level of knowledge	Univariable Logistic Regression		Multivariable Logistic Regression	
	N = 274(%)	n = 56 (%)	OR – Odds ratio	95% CI	OR – Odds ratio	95% CI
Sex						
female	167(61%)	46(82%)	3.69	1.77–7.68***	4.32	2.02–9.24 ***
male	107(39%)	10(18%)	1.00	Ref.	1.00	Ref.
Place of residence						
village	64(23%)	6(11%)	1.00	Ref.	1.00	Ref.
large city (over 100,000 inhabitants)	77(28%)	20(36%)	3.39	1.27–9.06**	3.92	1.44–10.72**
medium-sized city (over 20,000 to 100,000 inhabitants)	66(24%)	11(19%)	1.93	0.67–5.58	2.80	0.93–8.37
small city (up to 20,000 inhabitants)	67(25%)	19(34%)	3.83	1.42–10.34**	5.20	1.85–14.57**
Education						
medium	157(57%)	29(52%)	1.00	Ref.		
higher	117(43%)	27(48%)	1.32	0.73–2.39		

*p < 0.05, **p < 0.01, ***p < 0.001, Fully adjusted model, including all statistically significant characteristics

Source: own elaboration.

Table S2. The odds ratio (OR) of sociodemographic characteristics and average level of knowledge

Variable	Total	Average level of knowledge	Univariable Logistic Regression		Multivariable Logistic Regression	
	N= 274(%)	n = 124(%)	OR – Odds ratio	95% CI	OR – Odds ratio	95% CI
Sex						
female	167(61%)	69(56%)	1.00	Ref.		
male	107(39%)	55(44%)	1.50	0.92–2.45		
Place of residence						
village	64(23%)	30(24%)	1.23	0.62–2.45		
large city (over 100,000 inhabitants)	77(28%)	34(27%)	1.10	0.57–2.14		
medi-um-sized city (over 20,000 to 100,000 inhabitants)	66(24%)	32(26%)	1.31	0.66–2.60		
small city (up to 20,000 inhabitants)	67(25%)	28(23%)	1.00	Ref.		
Education						
medium	157(57%)	64(52%)	1.00	Ref.		
higher	117(43%)	60(48%)	1.53	0.94–2.48*		

*$p < 0.05$

Source: own elaboration.

Table S3. The odds ratio (OR) of sociodemographic characteristics and low level of knowledge

Variable	Total	Low level of knowledge	Univariable Logistic Regression		Multivariable Logistic Regression	
	N = 274(%)	n = 94(%)	OR – Odds ratio	95% CI	OR – Odds ratio	95% CI
Sex						
female	167(61%)	52(55%)	1.00	Ref.		
male	107(39%)	42(45%)	1.43	0.86–2.37		
Place of residence						
village	64(23%)	28(29%)	1.83	0.89–3.75		
large city (over 100,000 inhabitants)	77(28%)	23(25%)	1.00	0.49–2.05		
medi-um-sized city (over 20,000 to 100,000 inhabitants)	66(24%)	23(25%)	1.26	0.61–2.60		
small city (up to 20,000 inhabitants)	67(25%)	20(21%)	1.00	Ref.		
Education						
medium	157(57%)	64(68%)	1.99	1.18–3.37*		
higher	117(43%)	30(32%)	1.00	Ref.		

*$p < 0.05$

Source: own elaboration.