

Adherence to therapy among liver transplant patients as related to depression, anxiety, acceptance of the disease, and social support

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Abstract. – OBJECTIVE: This study aimed to assess the patients' adherence to therapeutic regimens after liver transplantation, taking into account the levels of depression and anxiety, acceptance of the disease, and social support.

PATIENTS AND METHODS: The study group included N = 112 patients selected from 669 patients after liver transplantation. The Delphi method was used to develop a tool to assess the level of adherence to treatment regimens. The sources of data for this study were recommendations and the work of an expert panel. The next method used in the study was a diagnostic survey based on the following standardized research instruments: Inventory of Socially Supportive Behaviors (ISSB), Acceptance of Illness Scale (AIS), Beck Depression Inventory-II (BDI-II) and State-Trait Anxiety Inventory (STAI).

RESULTS: The study group showed a medium level of adherence to therapeutic recommendations (6.8 ± 1.85). We observed a statistically significant positive correlation between acceptance of the disease and adherence to therapeutic recommendations ($r = -0.20$, $t = -2.040$, $p = 0.044$). Among the factors analyzed, six predictors were identified that significantly affect the level of adherence to therapeutic recommendations in a group of liver transplant patients.

CONCLUSIONS: 1. Patients who accept their disease are a group of people who significantly worse adhere to therapeutic recommendations. 2. The main positive predictors of treatment adherence in the group of transplant patients are the search for various sources of information and declarative adherence to treatment recommendations. Negative predictors include the duration of the disease, side effects of the applied

treatment, and comorbidities. 3. The patients who were informed that results depend on regular medication intake significantly more often followed therapeutic recommendations.

Key Words:

Liver, Transplantation, Adherence, Depression, Anxiety, Acceptance of the disease, Social support.

Introduction

In transplantology, nonadherence stands for the patient's lack of cooperation in taking medications, undergoing laboratory and imaging tests, attending medical appointments, and following dietary and lifestyle recommendations¹⁻⁴. According to the Asian Liver Transplant Network (ALTN), factors contributing to not following therapeutic recommendations are high costs, psychiatric disorders, belief in the harmfulness and side effects of using immunosuppressive drugs, as well as rejection episodes, infections, stress related to having a chronic disease, and inadequate social support^{5,6}. Other factors that may influence the implementation of the therapeutic plan are patient's views, lack of understanding of the treatment purpose, poor knowledge of the disease and its therapy, limited cognitive functions, personality traits (pessimism, forgetfulness, disorganization), and demographic characteristics (sex, age, marital status). Long-term therapy and the asymptomatic nature of the disease may also decrease the patient's motivation to continue the therapy.

The form of administration and doses of medicines play also an important part. Therefore, immunosuppressive treatment should be tailored to an organ recipient, taking into account the underlying cause of their condition and concomitant diseases^{7,9}. Optimally, the immunosuppressive treatment should minimally suppress the immune system so that the transplanted organ can function properly^{7,9}. Compared to the kidneys, heart, lungs, or intestines, the liver is an immunologically privileged organ, and its recipients require less intensive immunosuppressive treatment, so it is easier to achieve tolerance for the transplant^{7,8}. On the other hand, a 20% non-adherence margin, which is allowed in most chronic diseases, is absolutely unacceptable in the case of immunosuppressive treatment^{10,11}. However, taking immunosuppressants for a long time may cause a number of adverse side effects, such as neuro- and nephrotoxicity, arterial hypertension, hyperglycemia, hyperlipidemia, anemia, leukopenia, thrombocytopenia, gingival hyperplasia, hair loss, intestine disorders, mood disorders, pain (myalgia, arthralgia, headache), loss of or increase in body mass. Health problems that may also occur are new-onset diabetes mellitus (NODM) and post-transplant diabetes mellitus (PTDM). Additionally, there is a higher risk of developing neoplastic diseases and an increased risk of infections^{8,9,12-14}.

As far as social and economic factors affecting the adherence to therapeutic recommendations are concerned, those most important are health insurance (including the ability to buy reimbursable drugs), economic status, support from family and friends, as well as acceptance of the disease by the patient and their environment¹⁵⁻¹⁷. The majority of the available studies⁶ indicate that social support improves the patients' quality of life, has a positive impact on their self-esteem and ability to cope with the disease, and prevents the development of depression. The American Association for the Study of Liver Disease (AASLD) recommends that before a potential receiver is placed on the transplant list, they should meet the criteria in terms of compliance to therapeutic recommendations (give up smoking, treat obesity and alcohol dependence), and what is also important, they should have support from their closest family and friends¹⁸. One of the key variables that influence patient's cooperation with a physician is the quality of their relationship^{15,16,19}. In order to undertake targeted educational efforts, it may be essential to assess the adherence of liver transplant patients to therapeutic regimens, and to identify the causes of difficulties in following therapeutic recommendations.

The aim of this study was to assess the patients' adherence to therapeutic regimens after liver transplantation, taking into account the levels of depression and anxiety, acceptance of the disease, and social support.

Patients and Methods

The study included a group of 112 respondents from 669 patients after liver transplantation, who were under the care of the Transplant Outpatient Clinic of the Independent Public Provincial Complex Hospital in Szczecin or were hospitalized in the Department of Infectious Diseases, Hepatology and Liver Transplantation of that hospital. The criteria for inclusion in the study were: liver transplant patients, the lack of alcoholic cirrhosis, the absence of neoplastic lesions, the lack of psychiatric diseases, and patients who gave written consent to participate in the study. The criteria for exclusion in the study were: those patients who failed to meet the mentioned inclusion criteria, patients who did not report to the Transplant Outpatient Clinic for a medical check-up, and patients hospitalized in the department whose health condition made it impossible to participate in the study.

The Delphi method was used to develop a tool to assess the level of adherence to treatment regimens. The sources of data for this study were recommendations²⁰⁻²² and the work of an expert panel. The team of experts consisted of six physicians: hepatologist-transplantologist, hepatologist, transplant surgeon, two nurses working in the transplantology department, and one working in the hepatology outpatient clinic of the Independent Public Provincial Complex Hospital in Szczecin. The main criterion for recruitment to the team was that the expert should have a minimum of five years of work experience in the transplantation department of a high-referral hospital. The purpose of the expert team's work was to develop the research tool "The scale of adherence to therapeutic recommendations by liver transplant patients". During the discussion, each of the experts presented their own observations regarding adherence to therapeutic recommendations and the factors that influence them. As a result of a brainstorming discussion and data from the recommendations, a pilot version of the scale was prepared, which was used in the preliminary qualitative study (semi-structured

interview) among 10 patients who underwent liver transplantation. The patients participating in the pilot study presented their comments on the scope and quality of the statements included in the scale. After the pilot study was completed, the revised and completed questionnaire was discussed again by a group of experts consisting of the same people. Finally, after thorough analysis, 14 scale items were distinguished for which norms for the level of adherence were established. The items to be scored in the adherence scale were: the reason for transplantation, time since surgery, drinking alcohol in any form, presence of comorbidities, taking medications other than those related to transplantation, number of pills taken per wday, frequency of medications taken daily, skipping doses, information from a doctor that test results may indicate improper drug intake, adherence to recommendations, seeking various sources of information, self-reported knowledge of currently taken medications, experiencing side effects of treatment. Each item is scored from 0 to 1, where 0 denotes adherence and 1 indicates nonadherence to therapeutic recommendations. The results were interpreted as follows. 0-4 points: a high level of adherence, 5-7 points: a medium level of adherence, and 8-14 points: a low level of adherence.

The next method used in the study was a diagnostic survey based on the following standardized research instruments:

1. A sociodemographic questionnaire concerning variables such as age, sex, place of residence, employment status, education, marital status, family, financial standing, and social status.
2. The Inventory of Socially Supportive Behaviors (ISSB) developed by M. Barrera, I. Sandler, and T. Ramsay, and adapted to Polish conditions by H. Sęk. This tool is used to analyze the types of social support received: informational, emotional, instrumental, and appraisal. It consists of 40 statements rated on a five-point scale from 0 (not at all) to 4 (almost every day)²³.
3. The Acceptance of Illness Scale (AIS) by B. J. Felton, T. A. Revenson, G. A. Hinrichsen, adapted by Z. Juczyński. It is used to assess the degree to which the patient accepts the disease. The questionnaire consists of eight statements, describing the negative consequences of poor health. Patients rate the statements on a scale from 1-5. The higher the result, the better the adaptation to illness²⁴.
4. The Beck Depression Inventory-II (BDI-II) is a widely used 21-item self-report inventory measuring the severity of depression in adolescents and adults. The items are rated on a four-point scale from 0 to 3. The results are interpreted as follows: 0-1: lack of depression or its minimal symptoms, 14-19: mild depression, 20-28: moderate depression, and 29-63: severe depression²⁵.
5. The State-Trait Anxiety Inventory (STAI) by C. D. Spielberger, adapted to Polish conditions by J. Strelau, M. Tysarczyk, and K. Wrześniewski. It consists of two subscales measuring two types of anxiety: anxiety as a state (X-1), understood as a transient state caused by a particular situation, and anxiety as a trait (X-2), understood as a relatively constant personality trait. Each subscale includes 20 statements with categorized direct and indirect answers²⁶.

Patient and Public Involvement

The respondents were informed about the purpose of the study and agreed to take part in it.

Ethics Approval

The study was approved by the Bioethics Committee of the Pomeranian Medical University in Szczecin (KB-0012/248/08/17) and was carried out in accordance with the Declaration of Helsinki.

Statistical Analysis

The data obtained were presented using descriptive statistics. Depending on the type of variable, the following were used: mean and standard deviation (metric scale), as well as a structure ratio frequency and percentage (non-metric scale). Additional parameters such as median, coefficient of variation, as well as minimum and maximum were used when presenting variables expressed on a metric (quantitative) scale. The dependent variable expressed on the metric scale was the score obtained from measurement with standardized tools with confirmed psychometric properties. Analysis of differences between the two samples (groups) was performed using the parametric Student's *t*-test. To estimate the relationship between two metric variables, the Pearson correlation coefficient (*r*) was applied, while Goodman and Kruskal's gamma was used for non-metric variables. The significance of the correlation, its strength, and the direction of the relationship were calculated. In order to determine

the influence of selected independent variables on the dependent variable (score obtained from measurement with standardized tools), modeling by means of multivariate regression analysis was used. The model parameters were estimated using the least squares method. Non-standardized and standardized regression coefficients were determined, along with 95% confidence intervals. The percentage of variance explained for the dependent variable was determined using an adjusted R^2 value. All statistical calculations were performed using STATISTICA version 13.3 software (TIBCO Software Inc. Palo Alto, CA, United States). The statistical hypotheses were verified with a predetermined significance level of $p < 0.05$.

Results

The mean age of the subjects was 51.33 years, the minimum age was 20 years, and the maximum was 74 years. Women constituted 50.9% of the study sample. The majority of the surveyed lived in a city (74.1%), only 25.9% indicated rural areas as their place of residence. Most of the respondents were disability pensioners (42.9%), 25% employed people, 23.2% retirees, and 9% unemployed. The respondents more often declared secondary education (42.9%) and primary/vocational education (37.6%) than higher education (19.6%). Of the 112 patients, 41 (36.6%) were single and 71 (63.4%) were in a relationship. Most of the surveyed (83%) declared they lived with their families. 43.8% of the respondents considered their financial standing and living conditions as sufficient, 36.6% as good, 11.6% as very good, and 8% as bad. Half of the respondents (50%) said they rarely meet with friends, 49.1% said they meet often, and 0.9% said they never met. 75% of respondents declared that they do not smoke cigarettes, 81.3% do not consume alcohol, 17.9% declared that they consume alcohol occasionally, 46.4% declare that they follow the recommended diet, and 36.6% do not follow the diet (Table I).

Most respondents (54.5%) showed an average level of adherence to therapeutic recommendations, 34.8% of the respondents were characterized by poor adherence, and only 10.7% scrupulously followed the recommendations (Table II).

Analysis of the severity of depression according to the BDI revealed that most of the respondents had no or few depressive symptoms (55.2%), 19% suffered from moderate, 13.8% mild, and 12.1% severe depressive symptoms (Table III).

According to our “scale of adherence to therapeutic recommendations by liver transplant patients”, the study group showed a medium level of adherence to therapeutic recommendations (6.8 ± 1.85). The mean value of the received emotional support was 29.2 ± 10.81 , informational support 30.1 ± 13.76 , instrumental support 32.1 ± 13.88 , and appraisal support 14.2 ± 6.04 . The respondents declared a rather high level of disease acceptance according to the AIS scale ($M = 27.5 \pm 8.03$). The mean level of depressive symptoms according to the BDI was 9.3 ± 8.97 , which denotes no or few depressive symptoms. The incidence of both anxiety as a state ($M = 5.3 \pm 2.13$) and anxiety as a trait ($M = 5.2 \pm 2.08$) was on a medium level (Table IV).

We observed a statistically significant negative correlation between acceptance of the disease and adherence to therapeutic recommendations ($r = -0.20$, $t = -2.040$; $p = 0.044$). No statistically significant correlations were found between social support as measured by the ISSB, depressive symptoms measured by the BDI, and anxiety measured by the STAI ($p > 0.05$) (Table V).

Among the factors analyzed, six predictors were identified that significantly affect the level of adherence to therapeutic recommendations in a group of liver transplant patients. A regression model consisting of these six independent variables explains 55% of the variation in the dependent variable ($r^2_{\text{adjusted}} = 0.55$, $F_{(6, 98)} = 22.127$, $p < 0.001$). Positive factors include: ‘always follows recommendations’ ($\beta = -0.23$, $p = 0.002$), and ‘seeks various sources of information’ ($\beta = -0.34$, $p < 0.001$); while negative ones are: illness duration’ ($\beta = 0.18$, $p = 0.008$), ‘experiencing side effects’ ($\beta = 0.40$, $p < 0.001$), and ‘presence of comorbidities’ ($\beta = 0.40$, $p < 0.001$) (Table VI).

Additionally, it was shown that patients who were informed by their doctor about the impact of irregular medication intake showed lower levels of adherence than patients who did not receive such information [$t_{(110)} = 4.084$, $p < 0.001$, $d_{\text{Cohen}} = 0.78$, 95% CI (0.39-1.17)].

Discussion

Organ transplantation is a life-saving procedure for people with end-stage organ failure. Patients after transplantation take medications and remain under a doctor’s care for the rest of their lives. They not only suffer from minor health complaints, but very often also have serious side effects^{27,28}. The need for constant and systematic

Table I. Sociodemographic data.

Variable		n	%
Age	< 40 years	22	19.6
	40-60 years	54	48.2
	> 60 years	36	32.1
Sex	female	57	50.9
	male	54	48.2
	no data	1	0.9
Place of residence	village	29	25.9
	city	83	74.1
Employment status	employed	28	25
	retired	26	23.2
	disability pensioners	48	42.9
	unemployed	10	9
Education	primary/vocational	42	37.6
	secondary	48	42.9
	tertiary	22	19.6
Marital status	in a relationship	71	63.4
	single	41	36.6
Place of residence with family	no	19	17
	yes	93	83
Self-reported financial standing and living conditions	bad	9	8
	sufficient	49	43.8
	good	41	36.6
	very good	13	11.6
Meeting with friends	never	1	0.9
	rarely	56	50
	frequently	55	49.1
Smoking	no	84	75
	occasionally	12	10.7
	yes	16	14.3
Drinking alcohol	no	91	81.3
	occasionally	20	17.9
	yes	1	0.9
Adherence to the recommended diet	no	41	36.6
	irregularly	18	16.1
	yes	52	46.4

n, number of cases; %, percentage of the whole study sample.

diagnostic follow-up, as well as adherence to immunosuppressive therapy regimens and a certain lifestyle, makes it necessary to make sure that the patient can build a cooperative relationship with

the treatment team²⁷⁻³¹. Nonadherence to therapeutic regimens in a group of organ transplant patients can lead to malfunction of the transplanted organ, organ rejection, and even death^{1,32}. In one

Table II. The level of adherence to therapeutic recommendations.

Level of adherence to therapeutic recommendations	n	%
Low (8-14 points)	39	34.8
Average (5-7 points)	61	54.5
High (0-4 points)	12	10.7

n, number of cases; %, percentage of the whole study sample.

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Table III. The level of depression measured by the Beck Depression Inventory-II (BDI).

Level of depression	n	%
No. or few symptoms of depression (0-13 pts)	32	55.2
Mild depression (14-19 pts)	8	13.8
Moderate depression (20-28 pts)	11	19
Major depression (29-63 pts)	7	12.1

n, number of cases; %, percentage of the whole study sample.

Table IV. Adherence to therapeutic recommendations, social support according to the ISSB, disease acceptance according to the AIS, depressive symptoms according to the BDI, and anxiety according to the STAI.

Scale	N	M	SD	Mdn	IQR	Min	Max
Adherence to therapeutic recommendations	112	6.8	1.85	7	3	3	11
Social support							
Emotional support	112	29.2	10.81	30	19	9	45
Informational support	112	30.1	13.76	25.5	22.5	12	60
Instrumental support	112	32.1	13.88	28	20.5	14	70
Appraisal support	112	14.2	6.04	14	9.5	5	25
Disease acceptance	112	27.5	8.03	28	11.5	8	40
Depressive symptoms	112	9.3	8.97	6.5	9.5	0	40
Anxiety							
as a state (sten scores)	107	5.3	2.13	5	3	0	10
as a trait (sten scores)	106	5.2	2.08	5	3	1	10

M, mean; SD, standard deviation; Mdn, median; IQR, interquartile range; ISSB, Inventory of Socially Supportive Behaviors; AIS, Acceptance of Illness Scale; BDI-II, Beck Depression Inventory-II, STAI, State-Trait Anxiety Inventory.

Table V. Correlations between adherence to therapeutic recommendations and social support according to the ISSB, disease acceptance according to the AIS, depressive symptoms according to the BDI, and anxiety according to the STAI.

Variable – the level of adherence to therapeutic recommendations	Pearson's r	t	p
Social support			
Emotional support	-0.02	-0.237	0.813
Informational support	-0.08	-0.771	0.442
Instrumental support	-0.06	-0.593	0.554
Appraisal support	-0.07	-0.763	0.447
Disease acceptance	-0.20	-2.040	0.044
Depressive symptoms	0.18	1.876	0.063
Anxiety			
as a state (sten scores)	0.11	1.077	0.284
as a trait (sten scores)	0.11	1.146	0.254

Pearson's r, Pearson's correlation coefficient; t, the power of a test; p, test probability; AIS, Acceptance of Illness Scale, BDI-II, Beck Depression Inventory-II, STAI, State-Trait Anxiety Inventory.

Scottish study³³, nearly 10% of liver recipients died because of non-adherence. Organ transplant patients take immunosuppressive drugs throughout their lives, and the risk of non-adherence in this group of patients is up to 70%, which can be

one of the three main causes of organ rejection¹. A study³⁴ of 135 liver transplant patients in France found that 51% of the subjects did not follow therapeutic recommendations, which resulted in significant difficulties in managing the treatment.

Table VI. Regression model that best explains the level of adherence to treatment recommendations – a linear regression model with progressive stepwise entry of variables into the analysis was used.

Dependent variable	Adjusted R ²	df Model	df Rest	F	p	
Level of adherence to therapeutic recommendations	0.55	6	98	22.127	< 0.001	
Predictor	b	β	-95% CI	+95% CI	t	p
Absolute term	7.22	-	-	-	19.988	< 0.001
Time since surgery [months]	0.01	0.18	0.05	0.32	2.718	0.008
Do they follow all recommendations? 0: no 1: sometimes	0.66	0.12	-0.02	0.26	1.663	0.100
Do they follow all recommendations? 0: no 1: yes	-1.07	-0.23	-0.37	-0.08	-3.162	0.002
Do they seek various sources of information? 0: no 1: yes	-0.63	-0.34	-0.47	-0.20	-4.883	<0.001
Do they experience side effects of medicines? 0: no 1: yes	0.73	0.40	0.26	0.53	5.812	< 0.001
Additional illnesses 0: no 1: yes	0.87	0.44	0.30	0.57	6.471	< 0.001

B, not standardized regression coefficient; β, standardized regression coefficient; 95% CI - 95% of trust for beta.

The average five-year survival rate for patients with transplanted liver from a deceased donor in Poland is more than 75%, which is comparable to the rates in the United States and higher than in other European countries³⁵.

The results of our study showed no effect of depression and the drug on treatment adherence. There are differences in the results of various studies^{36,37} on the effects of depression, anxiety, and social support on treatment adherence. A study by Liber et al³⁶ evaluating the usefulness of psychosocial measures before liver transplantation, found no significant association between psychosocial risk factors and nonadherence to therapeutic recommendations after liver transplantation and biopsy-proven rejection. The authors point out the difficulty in identifying nonadherence to treatment due to problems in including “inconsistent” patients in the study. The use of different methodologies makes it difficult to compare studies or combine them, which may lead to inconsistent results³⁶. Other findings regarding the occurrence of depression and anxiety before transplantation indicate that suicidal thoughts before the surgery are associated with post-transplant depression³⁷.

In our study, no correlation was found between adherence to therapeutic recommendations and social support.

The results of a study³⁸ based on The Stanford Integrated Psychosocial Assessment for Transplant (SIPAT) – a standardized psychosocial tool used to assess liver transplantation – show that nonadherence to immunosuppressive treatment after transplantation is associated with poor medical knowledge, mood disorders, lack of social support, and nonadherence before transplantation. Lack of social support as a potential contributor to nonadherence among liver transplant patients was described by Rodrigue et al³⁹. Also, Olivier et al⁴⁰ in their literature review concerning nonadherence risk factors, mentioned low social support, as well as medical care, sex, divorce, alcohol and drug abuse, and mental illnesses⁴⁰. In our study, no correlation was found between adherence to therapeutic recommendations and social support.

Our research showed a statistically significant negative correlation between acceptance of the disease and adherence to therapeutic recommendations in liver transplant patients; higher acceptance of the disease was accompanied by lower adherence to the therapeutic regimen.

According to the literature, acceptance of illness, self-efficacy, and optimism contribute to adopting health-promoting behaviors. Social support is also a positive factor in accepting the disease^{41,42}. Wang et al⁴³, on the other hand, found that patients with depression receiving low self-reported social support had poorer outcomes in terms of symptoms, recovery, and social functioning⁴³. Patients' education, interventions focused on developing good habits, and the use of simplest therapy schemes with the possibly lowest number and frequency of pills taken per day are crucial for improving adherence to therapeutic recommendations⁴⁴. In the research initiative undertaken to increase adherence to therapeutic regimens among heart, liver, and lungs recipients, the patients were randomly assigned to two groups: an intervention group that received staged multicomponent tailored behavioral interventions, and a control group that received standard post-transplant care. After the end of the study, patients from the intervention group followed recommendations significantly more often than those from the control group⁴⁵. Moayed et al⁴⁶, during 23 educational sessions with 18 patients after liver transplantation, noted that the search for information allowed the patients to adhere better to recommendations, and was an important contributor to better self-reported health status⁴⁶. In another study⁴⁷ of liver transplant patients, based on the Immunosuppressant Therapy Adherence Scale (ITAS), the respondents scored poorly on adherence, whereas after the implementation of a systematic education program, non-adherence, pharmacotherapy-related problems, and the number of drug side effects significantly decreased^{47,48}.

In the self-analysis, statistically significant positive predictors of adherence to therapeutic recommendations were observed among liver transplant patients, including seeking sources of information and respondents declaring that they always follow therapeutic recommendations. In addition, it was shown that respondents who were informed by their doctor about the effect of irregular medication intake had lower levels of adherence than patients who did not receive such information. We also established negative predictors for adherence to therapeutic recommendations, namely the disease duration, treatment side effects, and comorbidities.

Summing up, it should be noted that the analysis of the results was hampered by factors, such as the use of an author's questionnaire measuring adherence to therapeutic recommendations, the

lack of Polish publications concerning liver recipients, and the use of different methods in various research projects. Discrepancies between scientific findings on adherence to therapeutic recommendations worldwide are undoubtedly associated with different healthcare financing systems (including reimbursement for medications), and sociocultural differences between organ recipients on different continents.

It is worth mentioning that the size of the study sample in relation to the number of all liver recipients registered at the Transplantology Outpatient Clinic was satisfactory ($n = 112$ vs. 669), and the percentage of completely completed questionnaires was quite high (the study excluded 18 questionnaires that were only partially completed). To date, this was the first national study to analyze the effects of depression, anxiety, social support, and acceptance of disease on adherence to therapeutic regimens among liver recipients. The aspects discussed in our paper can be used to develop more effective programs to educate and help recipients who do not cope with following therapeutic recommendations. There is a need for multicenter studies on patient adherence after liver transplantation performed using uniform research tools.

Limitations

This is a monocentric study, and a control group is lacking. The study requires further research with a larger study sample and a control group included, as well as other transplant centers. This would allow for the formulation of generalized conclusions that go beyond the studied group of patients after liver transplantation.

Conclusions

To sum up: 1) patients who accept their disease are a group of people who significantly worse adhere to therapeutic recommendations after liver transplantation. 2) The main positive predictors of treatment adherence in the group of transplant patients are the search for various sources of information and declarative adherence to treatment recommendations. Negative predictors include the duration of the disease, side effects of the applied treatment, and comorbidities. 3) The patients who were informed that transplant results depend on regular medication intake significantly more often follow therapeutic recommendations, which might suggest an unintended nonadherence.

Authors' Contributions

Conceptualization, A.K. and D.S.M.; methodology, A.K.; A.J.; A.M.C.; software, J.B.; validation, J.B., E.G.; formal analysis, E.G.; A.J.; A.M.C. investigation, A.K.; resources, A.R.; data curation, D.S.M.; writing-original draft preparation, D.S.M.; writing-review and editing, A.K. and D.S.M.; visualization, K.R.; supervision, A.R. and E.G.; project administration, A.R.; funding acquisition, E.G.

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Funding

This study was partly funded by the Pomeranian Medical University in Szczecin (WNoZ-302-03/S/16/2022).

Conflicts of Interest

The authors declare no conflict of interest.

Data Availability

The datasets generated during and/or analyzed during the current study may be made available by the corresponding author on request.

Ethics Approval

The study was approved by the Bioethics Committee of the Pomeranian Medical University in Szczecin (KB-0012/248/08/17) and was carried out in accordance with the Declaration of Helsinki.

Informed Consent

Informed consent was obtained from all subjects involved in the study.

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