

Original Research

Illness Perceptions and Their Impact on Treatment Adherence among Renal Transplant Patients in the COVID-19 Pandemic

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Abstract

Although immunosuppressive drugs are essential and effective in improving the health status of renal transplant patients, they also make them more vulnerable to the risk of infection with COVID-19, which has become a significant concern for many patients. Perhaps this is what makes their way of thinking and perception impact their adherence to taking immunosuppressants. Therefore, this study reveals the possibility of an impact of illness perception and some sociodemographic and clinical factors on treatment adherence in renal transplant patients. The study sample was deliberately selected to include 80 participants of both sexes who underwent a renal transplant and are continuing their treatment at the University Hospital in Batna (Algeria), aged between 20 and 61 years. The data were collected during the COVID-19 period between June and December 2020. Using the relational descriptive method. The study relied on two measures, the Illness Perceptions Questionnaire (Brief IPQ) and the Satisfaction Questionnaire on Medicines treatment



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(Satmed-Q). Multiple regression analysis (step by step) was used to evaluate the predictive ability of the study variables. This study has provided insights into the relationship between several variables in the considered sample. Also, cognitive representations impact the side effects of treatment and medical follow-up of the illness. Furthermore, the results show the impact of the duration of implantation in conjunction with the economic condition and urea rate on the ease of treatment with Medicines. Finally, the patient's weight impacts the ease of treatment with Medicines. This study recommends paying attention to the psychological and social factors that are essential in improving renal transplant patients' health status, especially during the pandemic.

Keywords

Illness perception; treatment adherence; renal transplant patients; COVID-19

1. Introduction

In December 2019, the COVID-19 virus spread around the world, including in Algeria, and had a significant impact on patients with chronic diseases, especially renal transplant patients whose immune systems are weakened due to immunosuppressive therapy, which may increase the risk of infection and its complications [1]. Renal transplantation is considered the best treatment for kidney failure, especially considering the progress of medical science. However, although immunosuppressive drugs to prevent renal transplant rejection are becoming increasingly effective, these treatments also increase the risk of COVID-19 infection, which is a significant concern for patients. Especially since March 2020, when the World Health Organization reported that the virus had infected more than 4.5 million people and caused more than 300,000 deaths, prompting governments to implement strict social restrictions [2]. This may be why the perceptions and attitudes of renal transplant patients affect their adherence to immunosuppressive therapy.

Illness perception is a fundamental concept of the meaning theory or common sense model. Leventhal (1980) introduced it to describe how individuals form beliefs about illness based on personal experiences [3]. The perception process includes several elements, such as the identity, cause, duration, consequences, and controllability of the illness. According to the self-regulation model of health and illness, patients construct personal representations that help them understand and cope with their illness and influence their behavioral and emotional responses [4]. These representations are called "illness representations" and change over time, affecting coping strategies and treatment adherence [5].

Illness perception is a key factor in renal transplant patients' treatment adherence, as negative beliefs and false expectations about returning to everyday life after transplantation can affect these patients' physical and mental health. Research has shown that illness perception influences emotional and adaptive responses, which are reflected in treatment adherence [6]. Research by Golded et al. (2011) showed that although kidney transplant patients were aware of the importance of adhering to medical appointments, there were significant barriers to doing so. Research by Keddis et al. (2018) demonstrated that American Indian patients were less likely to

receive renal transplant education and did not consider economic or cultural factors to be significant barriers to their treatment decisions [7].

Adherence to treatment remains one of the biggest challenges facing renal transplant patients. Therefore, more research is needed to increase patient awareness and improve coping strategies. The World Health Organization (WHO) defines adherence as the degree to which a patient's behavior complies with medical recommendations, including taking medications, maintaining a healthy diet, adopting appropriate lifestyle habits, modifying behaviors, and following medical instructions and recommendations [8, 9]. Non-adherence to immunosuppressive medications is a common problem that increases the risk of renal transplant rejection and even death. Hamdan and Aliha (2014) found that 19.8% of renal transplant patients were non-adherent to treatment [10]. Gonçalves (2016) also demonstrated that treatment adherence is influenced by socioeconomic, psychological, and clinical factors, such as age, daily living, depression, and the complexity of the treatment regimen [11].

The World Health Organization emphasizes the importance of renal transplant patients following medical advice, including taking medications and making lifestyle adjustments. Although most patients adhere to medication, adherence to lifestyle recommendations is limited and is affected by factors such as time since transplantation, family support, and education level [12]. Some studies have shown that patients taking immunosuppressants are not necessarily at higher risk for severe complications from COVID-19 than other patients, and therefore do not recommend reducing the use of these medications [13]. However, there is still some uncertainty about the impact of the pandemic, as there is limited understanding of its impact on patient behavior and lifestyle before and after transplantation [14]. The concepts addressed in this study include illness perception and treatment adherence in renal transplant patients.

2. Hypothesis

- There is a statistically significant relationship between illness perception, sociodemographic factors, clinical variables, and treatment adherence during COVID-19 in renal transplant patients.
- There is a statistically significant effect of illness perception, sociodemographic factors, and clinical variables on treatment adherence during COVID-19 in renal transplant patients.

3. Objectives

The overall Objective of this study is to explore the relationship and influence of illness perception, sociodemographic factors, and clinical variables on treatment adherence during COVID-19 in renal transplant patients.

4. Participants

The sample included 80 participants of both sexes, all of whom had undergone a renal transplant. The participants were deliberately selected based on their regular follow-up at Batna University Hospital (Algeria) and their willingness to participate in the study, as expressed by filling in a questionnaire. Sample selection was not based on specific clinical criteria but on the availability and consent of the participants. No patients were systematically excluded, except

those who did not attend regular follow-up at the center or refused to participate. After informed consent was obtained, the ages of the participants ranged from 20 to 61 years. Table 1 shows the demographic and clinical characteristics of the study sample.

Table 1 Sample of sociodemographic characteristics and clinical variables (n = 80).

Variables		N	%
Sex	Men	60	75
	Women	20	25
Age	20-30	32	40
	31-40	30	37.5
	41-50	10	12.5
	≥50	08	10
Marital Status	Single	42	52.5
	Married	36	45
	Divorced	02	2.5
Education level	Illiterate	04	5
	Primary school	06	7.5
	middle school	400	50
	high school	12	15
	University level	18	22.5
Economical Status	Weak	8	10
	Medium	56	70
	Good	16	20
Time since Transplantation	≤3 months	8	10
	>3 months and ≤6 months	18	22.5
	>6 months and ≤12 months	22	27.5
	>12 months	32	40
Donor relationship	the parents	50	62.5
	Sons	06	7.5
	the brothers	22	27.5
	Others	02	2.5
urea ratio	<0.45	62	77.5
	>0.45	18	22.5
Creatinine	<12	64	80
	>12	16	20
blood sugar	<1.1	76	95
	>1.1	4	5
blood pressure	High	12	15
	Moderate	68	85
Weight	Plus	14	17.5
	Moderate	66	82.5

5. Measures

5.1 Brief Illness Perception Questionnaire (B-IPQ)

The Brief Illness Perception Questionnaire (BIPQ) is a questionnaire that aims to assess illness perception. It contains eight items and consists of three axes. The first assesses cognitive representations (outcome, timeline, personal control, treatment control, identity), the second assesses emotional representations (anxiety, emotions), and the third assesses understanding of the illness. With Cronbach's coefficients (0.86), all items except the causal question are rated using a scale from 1 to 10. The last item is an open-ended question asking respondents to list three causal factors. The total illness perception score was calculated as the sum of the eight items [15].

5.2 Treatment Satisfaction with Medicines Questionnaire (SATMED-Q)

It was prepared and validated by Ruiz et al. and used for chronic patients undergoing drug treatment. It is a questionnaire that contains 17 items grouped into 6 axes: (Treatment effectiveness, Convenience of use, Impact on daily living activities, Medical care, Undesirable side effects, Global satisfaction). The scale items are answered according to a Likert scale with five grades: consistently (0), often (1), sometimes (2), rarely (3), and never (0) [16].

6. Results

6.1 Results of the 1st Hypothesis

- Time since transplantation has a positive correlation with Undesirable side effects (0.42), for a significance level of 0.05, and with Treatment effectiveness (0.72), for a significance level of 0.01.
- Blood pressure has a negative correlation with Treatment effectiveness of (-0.43) for a significance level of (0.05).
- Weight positively correlates with the Convenience of use of (0.38), for a significance level of (0.05).
- Cognitive representations have a negative correlation with Undesirable side effects of (-0.46), for a significance level of (0.01), and with medical care of (-0.51), for a significance level of (0.01).
- Understanding the illness positively correlates with medical care of (0.41), for a significance level of (0.05).

Table 2 presents the relationship between illness perception and treatment adherence.

Table 2 The relationship between illness perception and treatment adherence.

N	Variables	Undesirable side effects	Treatment Effectiveness	Convenience of use	Impact on daily living activities	Medical care	Global satisfaction
1	Time since Transplantation	0.427*	0.725**	0.092	0.209	0.118	0.171
2	blood pressure	-0.169	-0.439*	0.102	0.247	0.113	0.140
3	Weight	0.084	0.012	0.386*	0.070	0.339	0.279
4	Cognitive representation	-0.465**	-0.239	-0.336	-0.204	-0.518**	-0.234
5	Understanding the illness	0.361*	0.276	0.355	0.335	0.414*	0.360

Note: Pearson correlation coefficient ** $p < 0.01$; * $p < 0.05$.

6.2 Results of the 2nd Hypothesis

To find the impact relationships between the study variables, we used a multiple linear regression model “step by step”, It was seen through the results of the analysis that:

- Cognitive representations impact Undesirable side effects, where values indicate [$R^2 = 0.21$, SIG = 0.01, F = 7.72], which is statistically significant because it is less than 0.05.
- Cognitive representations impact medical care, where values indicate [$R^2 = 0.26$, SIG = 0.03, F = 10.28], which is statistically significant because it is less than 0.05.
- Time since transplantation in conjunction with economic status and urea ratio impacts the Convenience of use:
 - Time since transplantation impacts Convenience of use, where values indicate [$R^2 = 0.52$, SIG = 0.00, F = 31.02], which is statistically significant because it is less than 0.05.
 - Economic Status impacts Convenience of use, where values indicate [$R^2 = 0.59$, SIG = 0.04, F = 19.84], which is statistically significant because it is less than 0.05.
 - Urea ratio impacts Convenience of use, where values indicate [$R^2 = 0.66$, SIG = 0.02, F = 17.93], which is statistically significant because it is less than 0.05.
- Weight impacts Convenience of use, where values indicate [$R^2 = 0.14$, SIG = 0.03, F = 4.89], which is statistically significant because it is less than 0.05.

Table 3 presents the impact of illness perception on treatment adherence.

Table 3 The impact of illness perception on treatment adherence.

N	predictor variable	dependent variable	R	R ²	F	SIG	T	BETA
1	cognitive representations	Undesirable side effects	0.46	0.21	-7.72	0.01	-2.77	-0.46
2	cognitive representations	Medical care	0.51	0.26	10.28	0.03	3.20	-0.46
3	Time since Transplantation	Convenience of use	0.72	0.52	31.02	0.00	5.57	0.72
	Economical Status		0.77	0.59	19.84	0.04	-2.15	-0.26
	urea ratio		0.81	0.66	17.39	0.02	2.37	0.28

4	Weight	Convenience of use	0.38	0.14	4.89	0.03	2.21	0.38
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Note:

Beta (β): indicates the predictive effect of the independent variable on the dependent variable.

T value (T): tests the significance of each regression coefficient.

F value (F): evaluates the overall importance of the regression model.

R: Correlation coefficient measures the strength of the relationship between variables.

R²: Coefficient of determination, indicating how much variance of the dependent variable is explained by the model.

Sig.: p value of ANOVA, indicating the statistical significance of the model.

7. Discussion

7.1 Discussion of the 1st Hypothesis

There is a positive correlation between weight and the ease of treatment with medications and taking them, meaning that the more the patient has a moderate weight, the more stable their health condition. Thus, the treatment is easier and more practical. On the other hand, we find that patients who suffer from obesity find it difficult to take medications and adhere to their diet. Thus Their level of adherence decreases, especially during the Covid period, where movement is reduced due to quarantine and fear of infection, Because solid organ transplant recipients (SOTRs) are at much higher risk of developing severe SARS-CoV-2 infection due to the long-term use of immunosuppressive therapy to prevent organ rejection, especially in the period before the introduction of vaccines. A nationwide study by TRAPANI et al. (2021) in Italy showed that the cumulative incidence of COVID-19 infection in SOTRs was 1.02%, significantly higher than in non-transplanted individuals (0.4%, $p < 0.05$); the highest rate was found in the Lombardy region (2.89%). Moreover, the 60-day mortality rate in SOTRs reached 30.6%, almost double that of non-transplanted COVID-19 patients (15.4%). After adjustment for age and sex, SOTRs showed a 3.83-fold increased risk of mortality (95% CI [3.03–4.85]). These results highlight the increased susceptibility of transplant recipients to a severe COVID-19 course, mainly due to their immunosuppressive therapy [17]. Several studies have shown that transplant recipients who suffer from obesity, defined by a high body mass index (BMI), suffer from a group of negative outcomes that are more common than those in kidney transplant recipients with obesity. Normal weight, including wound infections, delayed function of the transplanted kidney, graft failure, and heart disease [18].

There is a negative correlation between blood pressure and the effectiveness of immunosuppressive drugs, meaning that the higher the blood pressure, the more it negatively affects the effectiveness of the treatment. This problem of high blood pressure in renal transplant patients is a common problem and has adverse effects on the psychological and physical performance of renal transplant patients. This was confirmed by Gerhard's study in 2006, showing that high blood pressure hurts long-term results after renal transplantation [19]. In the same context, Hamedan et Aliha's survey in 2014 "on the relationship between adherence to immunosuppressive medications, quality of life, and some factors among patients undergoing renal transplantation in Iran," indicated that the frequency of distribution of types of Chronic

diseases was high blood pressure (47.96%), then diabetes (14.47%), and the least related to other diseases such as asthma was (1.8%). Most patients were non-adherent [10].

There is a negative correlation between cognitive representations and the side effects of immunosuppressants, meaning that the more the identity of the illness is not clear to the patient and the extent of the seriousness of infection with COVID-19, and the lower the level of self-control over the illness and the use of medications in an unorganized and controlled manner, which leads to decreased control over the illness. Treatment and thus an increase in the appearance of more side effects of the drug inevitably leads to a negative impact on the patient's physical abilities, which affects the performance of his daily tasks and recreational activities. For example, we find renal transplant patients who take medications that contain corticoids and do not follow a healthy diet, such as reducing salty foods, which contain a high percentage of sugar, that will lead them to other complications such as high blood pressure, diabetes, etc. According to research by Wang et al. a study of 627 kidney transplant recipients conducted at the Leiden University Medical Center in 2022 demonstrated an inverse relationship between illness perception and adherence to immunosuppressive medications. Specifically, negative illness cognitions (such as strong illness identification, increased worry, and lack of illness coherence) were significantly correlated with poor medication adherence. These findings are consistent with the broader literature, indicating that a lack of understanding of the disease and its severity often leads to irregular medication use, which in turn increases the side effects of treatment and worsens the patient's physical condition. For example, kidney transplant patients are at increased risk for complications such as hypertension and diabetes if they do not follow appropriate dietary guidelines while taking corticosteroids. These findings highlight the importance of psychoeducational interventions targeting illness perceptions to increase medication adherence and improve health outcomes in this vulnerable population [20]. There is much recent evidence that there is no direct and consistent association between the type of immunosuppressive therapy and immune response or disease progression in renal transplant recipients (KTRs) infected with SARS-CoV-2. A systematic review of 554 KTRs found that adjustments in immunosuppressive therapy were largely individualized and based on clinical disease severity rather than specific immunosuppressants. In asymptomatic or mildly symptomatic patients, immunosuppressive therapy was often maintained or slightly reduced, whereas in patients with severe symptoms, it was often temporarily discontinued, particularly antimetabolites or mTOR inhibitors. These results emphasize a patient-specific approach rather than standardized adjustments based solely on medication type. This suggests that there is no consistent association between specific immunosuppressants and COVID-19 progression or immune response [21]. In the same context, a study by Manzia et al. confirms the lack of a clear association between the type of immunosuppressive therapy and humoral immune response to the SARS-CoV-2 vaccine in organ transplant recipients. Their study showed that kidney transplant recipients undergoing different immunosuppression regimens did not show significant differences in their immune response to the vaccine; the findings are consistent with those observed in liver transplant recipients who underwent specifically tailored immunosuppressive therapies. These findings reinforce the hypothesis that the type of immunosuppression used does not significantly affect post-vaccination antibody production. This supports adopting standardized prophylactic strategies for all transplant recipients, regardless of the treatment regimen used [22].

The study results also showed that There is a positive relationship between cognitive representations and medical follow-up, meaning the more the relationship between the health care team and the patient is good and the patient is involved in the treatment plan, the more the identity of the illness is clear to the patient in terms of the nature of his illness, its schedule, symptoms, causes and results, and also the patient receives health education about Corona disease increases his self-control, which further improves his medical follow-up and thus increases his adherence. This is consistent with the results of a 2011 study by Goldade et al. on renal transplant patients' perceptions, beliefs, and barriers related to regular kidney visits in outpatient clinics, which showed that the perception of patients who benefited from the importance of maintaining regular visits to the nephrologist was reflected positively on them despite the presence of obstacles to these visits [6].

In addition to a positive relationship between understanding the illness and medical follow-up. The patient who receives detailed information about his health condition and the practical method of treatment will increase his health awareness, so he will have a clear picture of his new health condition after the renal transplant operation, and he will have a high level of understanding of the requirements of this sensitive period, especially with the emergence of Corona disease is a health obligation, which will inevitably give greater importance to medical follow-up and adherence to medical examination appointments. The positive interaction between the health care team and the patient increases the patient's understanding of the treatment. The patient becomes more satisfied with the treatment, which positively affects his level of adherence to it, and this is consistent with the study of Savage et al. Armstrong in 1990 aimed to reveal the effects of the general doctors' examination method on patient satisfaction and treatment adherence. The results of his study showed that the directive method affects patient satisfaction. Still, its effect is more evident in consultations with patients who suffer from physical problems and patients who receive a prescription [23], in the same context, we found a study by Spitz et Chateaux on illness perception and therapeutic adherence among children with bronchial asthma, where the results of the study were that children's sound understanding of their illness led to therapeutic adherence through therapeutic control and control [24].

7.2 Discussion of the 2nd Hypothesis

There is an impact of cognitive representations on the side effects of treatment, as we expect more patients undergoing a renal transplant to have a clear vision of their new health status after the renal transplant and know the necessary preventive measures to avoid infection with COVID-19, in addition to the patient's control over his health status in a positive way. This is what Raising the level of his treatment adherence will have a positive impact on alleviating the side effects of medications, especially immunosuppressants, which will help the renal transplant patient improve his physical performance, be able to carry out his daily tasks in a better way, and be able to practice his various recreational activities. This relationship was supported by the results of the Gentile study in 2013, which aimed to identify factors associated with health-related quality of life through a comprehensive analysis of social, demographic, and clinical variables among a representative sample of renal transplant patients in France, which indicated that it is one of the variables predicted to hurt health-related quality of life. Health is the increase in side effects of treatment [25]. Also, a study by Kim et al. 2020 confirms that insufficient knowledge about COVID-

19 and the potential risks of COVID-19 limits organ transplantation in candidates on the waiting list and makes it difficult for Basic health care for solid organ transplant recipients [26]. On the other hand, the COVID-19 pandemic has created significant ethical and medical dilemmas for patients on the waiting list for renal transplantation (KT). Candidates face a difficult decision: accept a potentially life-saving kidney transplant, which requires lifelong immunosuppression and carries an increased risk of severe COVID-19 infection, or refuse a kidney transplant to avoid infection risk but continue dialysis, which holds its long-term complications. Our survey highlights this dilemma, with 35% of KT candidates wanting to refuse any kidney donation [27].

There is an impact of the duration of the transplant, in conjunction with both the economic situation and the clinical variable urea, on the ease of treatment with medications, as we can predict that the longer the period for the renal transplantation process and the lower the economic status of the patient and the higher the percentage of urea in the patient, the more this negatively impacts the ease of treatment with medications and thus the decrease in treatment adherence. In this context, the issue of prolonged treatment is raised, as cases of chronic illness do not stop with prolonged treatment only, but extend to many changes in the patient's lifestyle, which may be difficult for them if they are isolated. So what if these changes are combined with the complexities of the Chronic illness and its complications, treatment complications and side effects, and social and economic conditions, especially during the Covid-19 period, then non-adherence becomes an expected and complex behavior at the same time [28], in addition to the Gonçalves study in 2016, which focused on adherence to immunosuppressive therapy for patients who have received a renal transplant, and aimed to identify factors that impact adherence to immunosuppressive therapy among kidney transplant recipients. The literature was reviewed. After analyzing the studies, the results of the study showed that treatment adherence with immunosuppressants was mainly influenced by social, economic, and cultural factors (age, gender, education, professional status), patient-related factors (forgetfulness, daily routine), factors related to the condition (duration of transplantation, depression). And treatment-related factors (complexity of the therapeutic regimen) [11].

There is an impact of weight gain on the ease of treatment with medications, as we predict that a patient who has had a renal transplant and suffers from obesity will find it difficult to be treated with medications, because weight gain is considered a risk factor that threatens the patient's health status, Especially during the COVID-19 pandemic, when quarantine was imposed to avoid infection with SARS-CoV-2, a highly contagious virus with a high basic reproduction number (R_0), posing a significant threat to immunocompromised patients, including renal transplant recipients. Recent comparative studies have shown that renal transplant recipients are at increased risk for severe illness and higher mortality associated with COVID-19 compared with non-transplant patients. In a cohort of 306 kidney transplant recipients and 795 non-transplant patients hospitalized for COVID-19, despite matching age and other risk factors, 30-day COVID-19-related mortality was significantly higher in renal transplant recipients (17.9% vs. 11.4%, $p = 0.038$). In addition, renal transplant recipients were more likely to develop acute kidney injury during infection. Although the overall severity of COVID-19 (requiring intensive care unit admission, mechanical ventilation, or death) was similar in both groups, the increased mortality in KTRs highlights their increased vulnerability, likely due to long-term immunosuppressive therapy that impairs the immune response to SARS-CoV-2. [29]. This forces patients to adhere to certain healthy behaviors, such as adhering to a strict diet and practicing regular physical activities, and

this is confirmed to us through the study of Potluri and Hou in 2010 on obesity in renal transplant recipients, the results of which indicate that weight gain after transplantation is typical. Comparatively, although sustained weight loss is difficult to achieve with conservative intervention, prevention of weight gain is a more feasible goal that should be addressed routinely. Although obesity is a complex and often multifactorial clinical condition that involves non-modifiable factors [30].

Overall, the COVID-19 pandemic has significantly impacted renal and liver transplantation, similar to other chronic diseases such as cardiovascular disease, posing complex medical and ethical challenges. Organ transplant recipients face increased risks due to immunodeficiency and comorbidities. Although liver transplant patients with COVID-19 were more likely to require intensive care and mechanical ventilation, the transplant procedure itself was not independently associated with increased mortality after adjusting for other risk factors. Instead, advanced age, impaired renal function, and cancer were identified as key predictors of death. Similarly, many renal transplant candidates were reluctant to proceed with transplantation due to concerns about infection, while cardiovascular patients faced an increased risk of severe COVID-19 complications. These findings underscore the need for personalized care and careful risk assessment. In this context, studies highlight that treatment adherence is a critical factor in improving clinical outcomes and reducing long-term complications in renal transplant recipients. Poor adherence to immunosuppressive therapy increases the risk of graft rejection, while strict adherence improves renal function and reduces the need for urgent medical interventions. With rising concerns about infection during the pandemic, the challenges related to adherence have increased, underscoring the need for psychological support and patient education to ensure continuity of adequate medical care [31].

Despite the remarkable results of this study, some limitations should be considered:

- The study sample was limited to a single medical center, which may affect the generalizability of the results to renal transplant patients in other centers.
- The use of self-report questionnaires may lead to response bias, as patients tend to give more positive answers than their actual behavior.
- The limited follow-up period makes it difficult to assess the long-term impact of psychological factors on adherence.

Although baseline demographic and clinical variables were considered, other unmeasured factors may affect the results. Future studies with multiple medical centers, more extended follow-up periods, and objective clinical assessments are needed to confirm these results and provide a deeper understanding of the effects of immunosuppressive therapy and adherence in transplant patients.

8. Conclusions

To maintain the health status of renal transplant patients, it is crucial to consider psychological and social factors, especially during the COVID-19 pandemic. To this end, treatment plans for renal transplant patients need to be prepared to improve their health awareness and increase their commitment to pre- and post-transplant treatment. Health education is considered one of the most important methods to promote compliance with preventive measures to avoid possible

infection with COVID-19. In addition, the need for multidisciplinary teamwork among the medical team must be emphasized to ensure a better quality of life for patients.

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Author Contributions

The authors jointly completed the study conception and design, data collection, and analysis. The authors also participated in writing and reviewing the manuscript. The roles of each contributor are as follows: Dr. Moussa Hamidani was responsible for the conception and design of the study, supervision of the research process, and manuscript preparation. Dr. Salah Aberkane was responsible for data collection, statistical analysis, and interpretation of results. Dr. Moudjahid Aissaoui participated in the literature review, hypothesis formulation, and manuscript revision. All authors reviewed and approved the final version of the manuscript.

Competing Interests

We have no conflict of interest to disclose.

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