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ORIGINAL PAPER

Reinsertion into the Labor Market for Liver Transplant Recipients: Evidence from a Transplant Unit

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ABSTRACT

Introduction: The world's pioneering liver transplant occurred on March 1, 1963. In Brazil, the initiative for this procedure took place in 1968 at the Hospital das Clínicas, Universidade de São Paulo. Liver transplantation should only be indicated when conventional therapeutic methods have been exhausted, with the probability of survival and quality of life being greater with the procedure. **Objectives:** To statistically and econometrically analyze the reintegration into the labor market of post-liver transplant patients followed in a liver transplant unit in the state of Pernambuco who underwent the procedure from 2012 to 2021. **Methods:** A descriptive, cross-sectional study with a quantitative approach was carried out at the Unidade de Transplante de Fígado (UTF), Hospital Universitário Oswaldo Cruz (HUOC). The following inclusion criteria were used: age over 18 years, patients who were in the labor market before liver transplantation, and workers in the same sector who did not undergo the procedure. To analyze the collected data, the difference-in-differences statistical technique, event study, was used, since the treatment of the treated group occurred on different occasions within the researched period. During this period, individuals who had not yet received surgical treatment acted as a control group for those who had already undergone liver transplantation. **Results:** Liver transplantation reduced the chances of employability of patients followed up at the UTF/HUOC by 20%, despite the increased survival of these patients after the procedure. **Conclusion:** The study concluded that the high unemployment rate among the transplanted population indicates that these individuals are more predisposed to informal employment, causing a greater tendency to infectious diseases and a lower level of education due to less opportunity for professional improvement.

Descriptors: Liver Transplant; Liver Diseases; Health Care; Quality of Life; Labor Market.

Reinserção no Mercado de Trabalho de Transplantados de Fígado: Evidências de Uma Unidade de Transplante

RESUMO

Introdução: O transplante de fígado pioneiro no mundo ocorreu em 1º de março de 1963. No Brasil, a iniciativa para esse procedimento ocorreu em 1968, no Hospital das Clínicas da Universidade de São Paulo. O transplante hepático (TxH) só deve ser indicado quando estiverem esgotados os métodos terapêuticos convencionais, sendo a probabilidade de sobrevida e a qualidade de vida maiores com a realização do procedimento. **Objetivos:** Analisar estatística e econometricamente a reinserção no mercado de trabalho de pacientes pós-TxH acompanhados em uma unidade de transplante de fígado do estado de Pernambuco que realizaram o procedimento no período de 2012 a 2021. **Métodos:** Realizou-se um estudo descritivo, transversal, com abordagem quantitativa, na Unidade de Transplante de Fígado (UTF) do Hospital Universitário Oswaldo Cruz (HUOC). Foram utilizados os seguintes critérios de inclusão: idade a partir de 18 anos, pacientes que estavam inseridos no mercado de trabalho antes do TxH e trabalhadores do mesmo setor não submetidos ao procedimento. Para a análise dos dados coletados, foi utilizada a técnica estatística *difference-in-differences*, *event study*, visto que a terapêutica do grupo tratado ocorreu em ocasiões diferentes no período pesquisado. Nesse determinado período, os indivíduos que ainda não receberam o tratamento cirúrgico se comportam como grupo-controle daqueles que já foram submetidos ao TxH. **Resultados:** O TxH reduziu em 20% as chances de empregabilidade dos pacientes acompanhados na UTF do HUOC, apesar do aumento da sobrevida desses pacientes após o procedimento. **Conclusão:** O estudo concluiu que a alta taxa de desemprego entre a população transplantada indica que esses indivíduos estão mais predispostos à empregabilidade informal, ocasionando maior tendência a doenças infectocontagiosas e menor índice de escolaridade, devido à menor oportunidade de aprimoramento profissional.

Descritores: Transplante de Fígado; Hepatopatias; Atenção à Saúde; Qualidade de Vida; Mercado de Trabalho.

INTRODUCTION

The world's first liver transplant occurred on March 1, 1963. In Brazil, the initiative for this procedure began in 1968 at the Hospital das Clínicas of the University of São Paulo (USP). In 1985, the liver transplant program (LTx) was restarted at USP under the leadership of Professor Silvano Raia. In 1989, Brazil became a reference in transplants worldwide after the publication in the Lancet of the first description of LTx, using grafts from living donors, carried out by Professors Sérgio Mies and Silvano Raia[1].

The first LTx in the North and Northeast of Brazil took place in 1993[2]. However, it was only in August 1999 that a group of specialists, in partnership with the Oswaldo Cruz University Hospital (HUOC), began a liver transplant program with the capacity to meet part of the regional demand. Although there is a great deal of effort to increase the number of surgeries, many patients awaiting surgery die because the number of solid organ donors is not sufficient to meet the demand[3].

In the state of Pernambuco (PE), 2,911 people are on the waiting list for an organ transplant. The kidney transplant list has the most potential recipients, with 1,591, followed by cornea transplants (1,114), LTx (149) and heart transplants (12). From January to June 2023, 727 transplants were performed in PE, placing the state seventh among the federative units[4].

LTx is considered the most suitable treatment for patients with chronic, end-stage liver disease, enabling an increase in their survival[5]. Due to medical advances, organ and tissue transplantation is currently considered a safe and efficient therapy in the treatment of terminal illnesses, enabling improvements in quality and life expectancy[6].

Liver disease involvement indicates when an organ transplant is necessary. In adults, the most common recommendations are chronic hepatitis B or C, alcoholic liver disease, primary biliary cirrhosis, sclerosing cholangitis, and autoimmune hepatitis[7]. In pediatric cases, the indication for LTx is usually related to acute irreversible or chronic liver disease in the terminal stage[8].

In addition, patients on transplant waiting lists face frustrating feelings that lead to reduced self-esteem, depression, anxiety, and loss of confidence, among others, leading to reactive behavior on the part of the patient and their family members when faced with the disease. After the transplant, there are other challenges since the change in routine, involving regular medical follow-up, exams, risks of new surgical procedures, post-transplant complications, and immunosuppressive therapy, among others, also affect the quality of life[9].

Despite all these implications, transplantation was highlighted not only as a curative strategy but also as a means of prolonging survival and improving the quality of life of patients undergoing this procedure[10]. Therefore, it is valid to argue that LTx favors enhancing patients' quality of life in the terminal stage of chronic liver disease, positively impacting all individual dimensions, whether biological, psychological or social[11].

From this perspective, it is clear that the difficulty of employability of transplanted individuals is not something obvious, and, until now, there has been no careful survey in this direction.

Even if, intuitively, a reduction in the employability of this portion of the population is expected, measuring this quantity is essential, as it will support scholars in the area and the design of public policies.

Thus, the research aims to evaluate the reintegration into the labor market of post-LTx patients followed at a liver transplant unit in the state of PE from 2012 to 2021, with the guiding question: "What is the effect of liver transplantation on the reintegration of the individual/patient into the labor market?", by outlining the profile of the transplanted patient and subsequently estimating the effects of this therapy on employability.

METHODS

A descriptive, cross-sectional study with a quantitative approach was carried out at the Liver Transplant Unit (Unidade de Transplante de Fígado-UTF) of the HUOC, reference in the North and Northeast regions, considered the second largest/best LTx medical team in Brazil in number of successful transplants.

The population size considered the number of patients who underwent LTx in the last 10 years (2012-2021), who are alive, 18 years of age or older, in addition to having their name, date of birth and Individual Taxpayer Registry (Cadastro de Pessoa Física-CPF) registered in the spreadsheets and/or medical records used in data collection. The calculation was performed for the finite sample, with a 95% confidence coefficient and a sampling error of 5%.

The following inclusion criteria were used: being 18 or older, being in the labor market before LTx and not having undergone this procedure. Patients who died immediately and mediately after LTx, that is, up to 24 hours after surgery and from 24 hours to 7 days, respectively, were excluded, as well as those under 18 years of age.

Data collection was carried out from June to November 2023, with the application of a brief instrument produced by the researcher containing the following aspects:

Name, date of birth, sex, LTx date, National Health Card (Cartão Nacional de Saúde-CNS) of the Unified Health System (Sistema Único de Saúde-SUS), CPF, hospital records, profession/occupation before LTx, place/institution where the procedure was performed, date of death, if applicable, and whether the patient had already undergone more than one LTx and how many there had been.

The author's instrument collected secondary data from the patient's medical records. The difference-in-differences (DID) statistical technique was used to analyze the collected data. This technique aims to imitate an experimental research design using data from observational studies, studying the differential effect of a treatment in a "treatment group" versus a “control group” in a natural experiment.

The DID statistical technique used, in turn, is a DID event study; that is, it is a dynamic DID since the treatment of the treated group occurred on different occasions during the period studied, contributing to the database's homogenization. During this specific period, individuals who have not yet received surgical treatment act as a control group for those who have already undergone LTx.

The reintegration into the labor market of transplant patients was tracked through the Annual Social Information Report (Relação Anual de Informações Sociais-RAIS), aiming to make a comparative analysis of the individual's employability before LTx and the individual's reintegration into the labor market after the procedure.

This study was developed under national and international ethical precepts, as per Operational Standard 001/2013, Resolution 466/12 and Resolution 510/10 of the Research Ethics Committee (Comitê de Ética em Pesquisa-CEP)/National Health Council (Conselho Nacional de Saúde-CONEP)/ Ministry of Health (Ministério da Saúde-MS) involving human beings, with a favorable opinion from the CEP of Universidade Federal de Pernambuco (UFPE) – Plataforma Brasil and the HUOC/Cardiology Emergency Room of the University of Pernambuco, Professor Luiz Tavares (Pronto-Socorro Cardiológico Universitário de Pernambuco Professor Luiz Tavares-PROCAPE).

The risks that research incurs to human beings are those of misinterpretation of the information collected, since from the user/patient's CPF, we will have access to the RAIS to verify the individual's employability, in addition to the sociodemographic and clinical questionnaire used to describe the succinct profile of the transplant population. As for the benefits, it is clear that knowledge about this problem may provide a glimpse into the possibility of creating a protective statute for transplant recipients.

RESULTS

The information was consolidated according to the data collected at the UTF by year of occurrence. Table 1 describes the number of LTxs performed by the UTF medical team in hospitals accredited by the Ministry of Health to perform the procedure: HUOC, Hospital Jayme da Fonte (HJF) and Instituto de Medicina Integral Professor Fernando Figueira (IMIP), in PE, and Hospital Nossa Senhora das Neves (HNSN), in the state of Paraíba.

Table 1. Number of LTxs performed by the UTF/HUOC medical team from 2012 to 2021.

Year	Number of procedures
2012	114
2013	101
2014	114
2015	123
2016	96
2017	109
2018	115
2019	130
2020	74
2021	75
Total	**1,051**

Source: Elaborated by the author.

Table 2 describes the number of patients who underwent LTx between 2012 and 2021, removing duplications or triplicates of names that underwent more than one procedure in the same year.

The data collection date, June to November 2023, was considered to describe the patients' vital situation. The prevalence rate of live patients was more significant in the initial years of the period defined for the study, which corresponds to 2012 to 2014 and 2017, reaching values above 40% of transplanted patients.

Table 2. Number of patients followed by UTF/HUOC who underwent LTx from 2012 to 2021.

Year	Number of patients
2012	107
2013	98
2014	109
2015	117
2016	92
2017	105
2018	111
2019	116
2020	71
2021	72
Total	**998**

Source: Elaborated by the author.

As for deaths, the highest prevalence is observed in the years 2012 to 2017, reaching rates close to or above 30%, a fact that may also be related to the decrease in the survival of transplanted patients after 5 years of the procedure1, as shown in Table 2.

Regarding patients for whom there is no information regarding the life or death situation after transplantation, a higher prevalence was observed in the period from 2018 to 2021, which may be related to the loss of follow-up of these patients, that is, to the abandonment of treatment/monitoring after LTx. This issue may be related to several factors, including the difficulty in releasing the work day/shift when there is a formal or informal employment relationship for multidisciplinary health monitoring after LTx, as reported by patients to some UTF professionals.

Finally, there was a general prevalence of more live patients (38.6%) than deaths (32%) among patients who underwent LTx over the 10 years studied, without considering those who were lost to follow-up. This demonstrates that LTx is a necessary procedure when conventional treatment is no longer possible to prolong survival and improve the quality of life of patients[5].

When analyzing transplant patients concerning sex, a male predominance of 2/3 is observed. This data may be associated with lifestyle habits that contribute to the development of liver diseases, leading to the need for LTx, such as chronic alcoholism, one of the main risk factors for liver cirrhosis[10].

According to studies on alcoholism, in the future, the prevalence of disorders related to alcohol abuse among men and women may converge; however, currently, alcohol dependence is still greater among men (8.6%) compared to women (1.7%) worldwide[11].

The UTF/HUOC monitored the number of patients who underwent LTx from 2012 to 2021. Most patients underwent LTx only once; however, a portion (7.4%) underwent the procedure two, three or even four times. In most cases, retransplantation was needed due to chronic rejection of the organ received.

Regarding the number of LTxs performed by the UTF team in each accredited hospital from 2012 to 2021, it was observed that most of the transplants performed in this period occurred at HJF.

The age range of patients who underwent LTx from 2012 to 2021 and were monitored by UTF/HUOC was noted to be predominantly in the 50—to 69 age range, corresponding to approximately 47.4%. This population is already at a higher risk of developing comorbidities, both due to factors related to lifestyle habits and complications of chronic non-communicable diseases[10].

The number of patients who underwent LTx from 2012 to 2021, monitored by UTF/HUOC and registered with name, date of birth and/or CPF, is relevant data for research on formal employability in RAIS. Thus, in constructing the pre-and post-LTx employability graph, the population aged 18 or over was considered, allowing a profile of these individuals concerning the labor market to be drawn up.

As for legal age, 750 patients aged 18 or over correspond to 75.2% of the population surveyed. When evaluating the number of patients aged 18 years or older and with a death record in the immediate postoperative period (up to 24 hours) and mediate postoperative period (24 hours to 7 days), monitored by the UTF/HUOC and who underwent LTx from 2012 to 2021, it can be seen that the population of transplanted patients in this period totaled 998 patients.

Of these, 750 were 18 years or older at the time of transplantation, and excluding those who died in the immediate and mediate postoperative periods, there were 709 patients eligible for research in RAIS, aiming to verify employability before and after LTx.

As shown in Table 3, only 369 of the 750 patients over 18 had records in RAIS, corresponding to 49.2% of the sample.

Table 3. Profile of patients found in RAIS (49.2%) monitored by UTF/HUOC and underwent LTx from 2012 to 2021.

Profile	n	Medium	SD	Minimum	Maximum
Salary (R$)	369	2,376.04	3,990.66	3,090.00	38,548.56
Sex (female/male)	369	0.76	0.43	0.00	1.00
Level of education (years of study)	369	7.06	1.73	1.00	11.00
Age (years)	369	50.93	12.66	18.00	77.00
Post-transplant life expectancy (years)	369	6.08	3.13	0.00	10.00
Time employed pre-transplant (months)	369	111.41	123.18	0.10	497.45
Age at transplant (years)	212	50.95	12.80	20.00	73.00

Source: Elaborated by the author.

The salary range of transplant patients found in RAIS varied from R$3,090.00 to R$38,548.56, with a standard deviation (SD) of R$3,990.66; most salaries varied around this last value. Regarding gender/sex, there was a characterization as female or male, with no intersex individuals or no information regarding gender being registered.

The level of education showed a minimum of 1 year of study and a maximum of 11 years, indicating that there were patients employed under the Brazilian Consolidation of Labor Laws or statutory employees with a minimum level of educational training.

The minimum age of transplant patients researched in RAIS was 18 since this is when the individual becomes an adult and can be formally employed. The maximum age was 77, demonstrating that elderly people were still included in the labor market, even with health problems that could make it challenging to carry out a work activity.

Among patients registered in RAIS, the post-LTx survival time ranged from 0 to 10 years, with an average of 6 years and an SD of slightly over 3 years.

The time of employability of patients before undergoing LTx ranged from 0.1 to 497.45 months, corresponding to 3 days and 41.45 years, with an average of 111 months and an SD of 123 months, equivalent to 9.25 years and 10.25 years, respectively.

The individual's age at the time of the surgical therapeutic procedure ranged from 20 to 73 years, with an average wait of 2 years from registration in the queue to the day of LTx.

Table 3 also shows that of the 750 patients aged 18 or over who underwent LTx, 369 were registered in the RAIS, corresponding to 49.2% of the sample. This rate is not close to 100% since approximately half of this percentage (50.8%) corresponds to patients with informal employment, jobless or unemployed, and not looking for work. However, since the research objective is to verify patients' employability after the surgical therapeutic procedure, this information becomes insignificant.

Finally, 80% of the sample returned to the labor market after the surgical procedure and recovery period since their formal employability dropped by 20% in the post-surgical therapy phase.

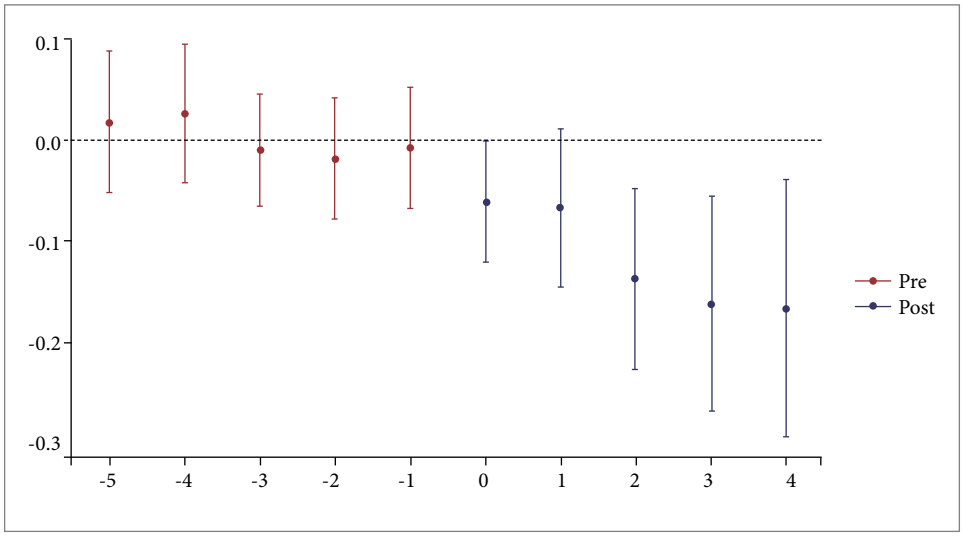
DISCUSSION

Given the complexity of assessing the reintegration into the labor market of patients undergoing LTx, causality emerges as a central concern, making it necessary to incorporate causal inference as part of this proces[s12].

Based on this assumption, the causal inference paradigm used in this analysis allows us to explain better the observed cause-and-effect relationships in the liver transplant process by verifying the value of treatment and non-treatment in the same unit[13].

In this sense, Fig. 1 shows the employability percentage of patients undergoing LTx by semester, before and after the surgical procedure.

In statistics, nonlinear regression, used in this study, is a form of regression analysis in which observational data are modeled by a function that is a nonlinear combination of the model parameters and depends on one or more independent variables. The data are adjusted by a method of successive approximations[14]. Therefore, it is assumed that the best-fitting curve is the one that minimizes the sum of the squares of the residuals[15].

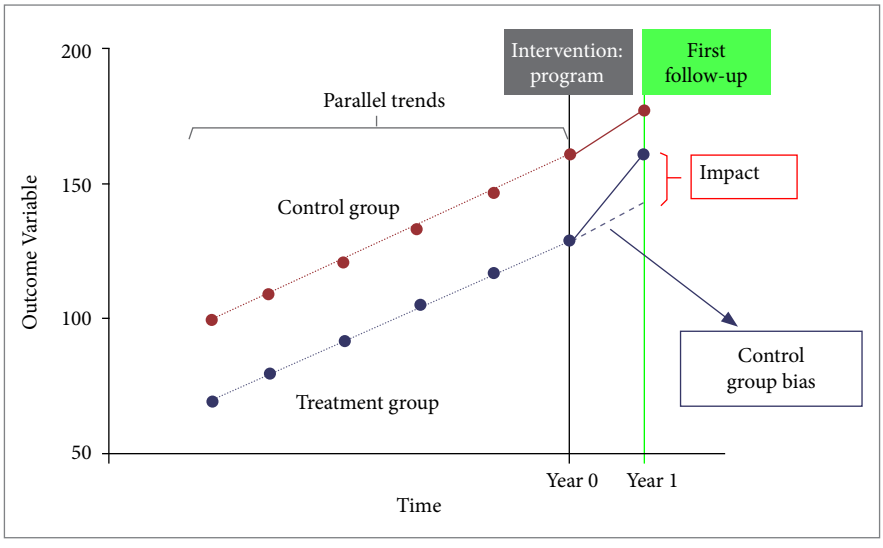


Source: Elaborated by the author.

Figure 1. Dynamic aggregate effect on the probability of being employed.

One of the main problems faced in regression is heteroscedasticity[16]. However, heterogeneity is acceptable as a rule, not an exception, and therefore, homoscedasticity should be considered. The problem lies in the propagation of the coefficients. Thus, the "robust" standard error solves these heteroscedasticities.

Therefore, we can conclude that LTx reduced the chances of employability of patients followed at the UTF of HUOC by 20% since, when verifying the impact of the surgical intervention, randomization might not be feasible due to logistical difficulties, ethical or political issues or because the intervention had already occurred. Thus, this problem could be corrected by having several points in time, mainly data before and after the intervention.[17] (Fig. 2).



Source: Gertler et al.[18].

Figure 2. DID model

It can be seen in Fig. 1 that the employability chances of patients who did not receive LTx are similar, with a decrease after surgical treatment. The dynamic DID design is generally presented in a configuration of two time periods, i.e., pre- and post-intervention, and two groups, Treated and Control. Thus, the event study introduces the concept of "parallel trends".

Lead coefficients represent the early effect of the policy and are examples of the most common tests in this type of design. Algebraically, we have:

$$Y = \alpha Treated + \lambda Post + \beta Treated \times Post = \varepsilon$$

where *Treated* is a binary variable that assumes the value 1 for observations in the treatment group and 0 otherwise. *Post* is a *dummy* that represents the temporal dimension of the intervention, taking the value 1 for all observations after the event. The coefficient of interest, in turn, is β, which captures the causal effect of the event on Y and comes from the interaction between *Treated* and *Post*. Put another way, β can take the following form:

$$\beta = [E(Y|Treated = 1, Post = 1) - E(Y|Treated = 1, Post = 0)] - [E(Y|Treated = 0, Post = 1) - E(Y|Treated = 0, Post = 0)]$$

From this perspective, an event analysis will be estimated as an extension of the DID to capture the policy's dynamic effect. In addition, the pre-event parallel trends test will be possible to verify the model's validity. However, it is worth considering that, in the research design used in this work, the *Post* variable refers to each individual's post-transplant period.

The estimate, in turn, is generally performed with standard errors clustered at the group level. In addition, one of the periods must be discarded to avoid perfect multicollinearity (a common problem in regressions, in which the independent variables have exact or approximately exact linear relationships), as occurs in most fixed effects configurations, since, in most case studies, the time interval -1 is used as the abandoned reference[18].

Although the regression analysis and statistical technique used were quite significant in the study in question, it is worth highlighting that this decrease in the percentage of employability after the surgical procedure may not be directly related to the LTx itself but to the individual's weak clinical condition before the therapeutic procedure, which may have contributed to the rehabilitation period being more laborious, thus postponing the patient's return to the labor market.

Taking into account that the main objective of LTx is to increase the individual's survival, improve quality of life and return to daily activities, such as work, statistical regression analysis shows that this therapeutic procedure is effective; however, the acceptance of these patients by the labor market, in 2 years after the surgical procedure, is not satisfactory, either due to the patient's weakness or due to discrimination/prejudice in employing a transplanted individual who will need to attend periodic consultations for clinical monitoring of their health condition[19].

CONCLUSION

Based on the regressive analysis of the study, it was possible to verify a 20% reduction in formal employability among transplant patients. This percentage is considered a high rate compared to the percentage of unemployed people among the active population, which varied from 7 to 14% from 2012 to 2021, the study period[20]. Scientifically, this high unemployment rate among the transplant population indicates that these individuals are more predisposed to informal employment, which can lead to a greater tendency to infectious diseases and a lower level of education, leading to fewer chances for professional improvement.

Regarding the prevalence of LTxs, it was found that this therapy was performed, in its majority, in the age group of individuals from 50 to 69 years old, a population that has a compromised clinical condition in most cases, and since liver disease would be related to other comorbidities, such as hypertension and diabetes. The reintegration into the labor market of people in this age group would be even more challenging. At the same time, statistically, the regions of Brazil with the highest employment rates of 40 to 59 years old and elderly population are the Southeast and South regions, to the detriment of the North, Northeast and Central-West regions[21].

Post-transplant life expectancy ranged from 0 to 10 years, with an average of 6 years and an SD of slightly over 3 years for individuals formally employed before the surgical therapeutic procedure. This shows a significant survival period for these individuals, thus enabling possible conditions for returning to the labor market, verified in 80% of cases.

Concerning the social security contributions of these patients before undergoing LTx, an average period of 10 years was observed, corresponding to two-thirds of the minimum contribution time to Social Security.

In this sense, public health is seen as a guiding axis for greater awareness among the population about diseases that can lead to LTx, not limited to alcohol abuse but also viral diseases, such as hepatitis in its various forms of transmission and fatty diets that can trigger liver failure. Although LTx is a successful therapy, it is necessary to consider that it is also a last resort treatment and that the transplant patient may develop rejection of the organ, in addition to the waiting list for a compatible donor.

CONFLICT OF INTEREST

Nothing to declare.

DATA AVAILABILITY STATEMENT

Data will be available upon request.

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