

Epidemiologic and Economic Aspects Related to Hemodialysis and Kidney Transplantation in Santa Catarina in the Period of 2012–2013

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ABSTRACT

Background. Chronic kidney disease (CKD) is a worldwide public health problem and is expressed by increasing amounts of patients on renal replacement therapy (RRT), with significant economic and social impacts. The aim of this work was to analyze socioeconomic and mortality aspects of CKD patients in Santa Catarina (SC), Brazil.

Methods. This was an ecologic study with the population of SC's CKD patients, who used RRT or underwent renal transplantation (RT) from 2012 to 2013. Data were obtained through electronic access to the information systems of the Brazilian Universal Health System, tabulated, and analyzed in the Statcalc software.

Results. The predominant therapy was hemodialysis (HD)—1–3 times per week—accounting for 97.62% of all procedures and 97.48% of the costs. RT from deceased donor (DD) was the most performed, with a frequency of 79.11%, and it was also responsible for the largest cost (81.78%). Mortality among patients in HD was higher in men (57.84%), and in the age group of 60–79 years ($P < .0001$). Among RT patients, mortality was also prevalent among men (75%) and in the age group of 50–64 years ($P < .057$).

Conclusions. Men, as well as older age groups, presented more prevalent mortality in HD and in RT. The costs of RRT were higher in HD and in RT from deceased donors and associated with its high prevalence.

CHANGES in mortality and fertility profiles occurred in developed countries in the course of the entire 20th century, and a similar phenomenon in Brazil, but faster, later, and still unfinished, occurred, called the “epidemiologic transition.” This social process is characterized, in its demographic dimension, by a proportional increase of the elderly in total population and, in its epidemiologic dimension, by reduced child mortality and prevalence of infectious diseases, replaced by the predominance of mortality caused by noncommunicable diseases [1]. Many of these “new epidemics” have been controlled by the accelerated development of medical technology, which is the case with chronic kidney disease (CKD) [2], suggesting that the changes in the population health condition induced an organized social response to face these conditions through a health care system [3].

Arterial hypertension and diabetes mellitus constitute the main risk factors for CKD and are frequent in the general population, contributing to the high incidence of kidney damage, especially in late adulthood and the

elderly [4]. The natural outcome of this pathology, however, was altered by the development of renal replacement therapy (RRT), such as hemodialysis, which allows the extension of life with some quality, and even healing with the advent of renal transplantation.

The treatment of renal failure is related to its evolution and comorbidities presented by the patient; and it considers prevention, monitoring, and intervention in complications and in other chronic diseases [5] to retard or even stop the advance of failure [6]. The final stage of CKD starts when the patient needs RRT to survive. The available RRTs are hemodialysis (HD), peritoneal dialysis (PD), and renal transplantation (RT) [7].

According to the Brazilian Society of Nephrology, it is estimated that there are 10 million people with some degree

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of CKD in the country, considering an estimated prevalence of 50 cases/100,000 inhabitants. Regarding the epidemiologic and clinical profile of patients on RRT in Brazil, it is predominant male and most patients are 45–64 years of age [8].

Currently, among developing countries, Brazil has the largest universal public health system in the world, which finances >80% of patients on HD and virtually every organ transplantation performed in the country [9]. In addition to the high economic cost of CKD, the social and psychologic repercussions and restriction in quality of life of patients submitted to RRT should also be taken into consideration [10].

The relevance of CKD and the social and economical importance of the RRT for maintenance of life of an increasingly significant amount of patients led to the present research, which sought to characterize, economically and epidemiologically, this problem in the state of Santa Catarina, Brazil, in the period of 2012–2013.

METHODS

This was an observational ecologic study with the use of descriptive and analytic statistics. The study was contextualized within public health policies in Brazil and developed with the use of data from the information systems of the Universal Health System (SUS) related to the procedures of interest to this study: RRT and RT.

The population covered was composed of chronic renal failure (CRF) patients >20 years old who used RRT (hemodialysis), or >18 years who underwent kidney transplantation (from deceased donors), funded by the SUS, in the years 2012 and 2013 in Santa Catarina, Brazil.

The survey data also included complications (CRF deaths occurring during the study period and deaths occurring in transplant patients an average of up to 2 years after the transplantation) and the frequency and cost of the procedures studied, which were tabulated, transferred, and organized in Microsoft Excel spreadsheets. To calculate mortality rates, we used the Statcalc program, and the data in Excel were exported to the SPSS 18.0 program for statistical analyses.

Association measures, the relative risk, the confidence interval, and *P* values were calculated when appropriate, and comparisons between the calculated rates were carried out by applying the chi-square test, with a confidence level of 5% (*P* < .05).

RESULTS

In Santa Catarina, in the biennium 2012–2013, an average of 6,363 patients/year were recorded to be in HD, with an average of 153 deaths/year. During the same period (2012–2013), there 427 RTs were performed, an average of 213.50/year. From that time period, 48 deaths occurred among transplant patients. The deaths of both HD as RT patients were evaluated according to sex and age. In addition, information related to the costs of such procedures was collected, as presented in Table 1.

Regarding Table 1, it was observed that HD (1–3 sessions/week) has been the most frequent and important procedure in terms of cost, accounting for 97.62% of the procedures performed, averaged over the years 2012–2013, and 97.48% of financial expenses in the period studied.

Regarding RT, deceased-donor transplantation was the most frequent, accounting for 79.11% of the procedures performed during the study period, and almost 82% (US\$ 3,590,033.44) of the costs with this type of procedure, considered the average of the years 2012 and 2013, noted in Table 1.

Regarding HD, men had a higher number of deaths, accounting for 177 deaths (57.84% of total), with an average mortality rate of 24.61 per 1,000 men undergoing the procedure and a relative risk of mortality 5% higher than women during the study period. The mortality of patients undergoing HD was strongly related to age: Deaths in the age group of 60–79 years were the most prevalent (43.79%), and the relative risk of mortality among HD patients >80 years of age was ≥ 72 times that of the age group of 20–39 years. Only the age groups of 60–79 years and >80 years showed strong statistical significance (*P* < .0001), shown in Table 2.

Regarding Table 2, RT mortality was also greater in men, representing 75% of the deaths that occurred during the study period and a mortality relative risk 14% higher than in women. The relative risk of death among RT patients in the age group of >65 years was 5.88 times higher than that of the age group of 18–34 years (*P* < .001). The mortality of the age groups >65 years was statistically significant (*P* < .015).

Table 1. Frequency and Cost of Dialysis and Renal Transplantation Procedures, Santa Catarina 2012–2013

Procedure	Average <i>n</i> (%)	Average Cost, US\$ (%)	Average Unit Cost, US\$
Hemodialysis (1–3/wk)	323,027 (97.62)	27,179,974.30 (97.48)	84.14
Hemodialysis, HIV	3,697.5 (1.12)	462,431.83 (1.66)	125.07
Arteriovenous fistula	992 (0.30)	119,117.23 (0.43)	120.08
Implant catheter	1,513.5 (0.46)	42,017.11 (0.15)	27.76
Catheter double lumen	1,654.5 (0.50)	78,555.14 (0.28)	47.48
Total dialysis	330,884 (100)	27,882,095.63 (100)	84.26
Deceased-donor transplantation	195 (79.11)	3,590,033.44 (81.78)	18,410.43
Living-donor transplantation	42 (17.04)	538,676.66 (12.27)	12,825.63
Pancreas/kidney transplantation	9.5 (3.85)	261,060.60 (5.95)	27,480.06
Treatment complications	174.5	219,630.71	1,258.63
Total transplantation*	246.5 (100.00)	4,389,770.70 (100.00)	17,808.40

*The frequency and proportion did not include the treatment of complications.

Source: SIA/APAC Nefro/DATASUS and National Transplant System, adapted by the author.

Table 2. Frequency and Mortality Rate for Hemodialysis and Renal Transplantation According to Sex and Age (y), Santa Catarina, Annual Average, 2012–2013

Group	n (%)	Mortality Rate*	RR (95% CI)	P Value
Hemodialysis				
Sex				
Male	88.50 (57.84)	24.61	1.05 (0.76–1.46)	.73
Female	64.50 (42.16)	23.31	1	–
Total	153 (100)	24.04	–	–
Age				
20–39	3 (1.96)	2.89	1	–
40–59	24 (15.69)	9.12	3.15 (0.95–10.47)	.075
60–79	67 (43.79)	27.75	9.60 (3.03–31.41)	<.0001
≥80	59 (38.56)	210.71	72.91 (23.04–231.01)	<.0001
Renal transplantation				
Sex				
Male	18 (75)	11.65	1.14 (0.47–2.75)	.753
Female	6 (25)	10.17	1	–
Total	24 (100)	11.24	–	–
Age				
18–34	1.5 (6.25)	3.03	1	–
35–49	7 (29.17)	9.15	2.27 (0.49–10.50)	.27
50–64	11.5 (47.92)	16.19	4.22 (0.98–18.05)	<.057
≥65	4 (16.66)	24.24	5.88 (1.18–29.30)	<.015

Abbreviations: RR, relative risk; CI, confidence interval.

*Hemodialysis, out of 1,000; renal transplantation, out of 100.

Source: SIA/APAC Nefro/DATASUS and National Transplant System, adapted by the author.

The average rate of mortality among HD patients in the years 2012 and 2013 was 24.04 per 1,000 patients, and that among RT patients was 11.29 deaths per 1,000 patients, which was quite significant and requires more detailed study to clarify the reasons for these outcomes.

DISCUSSION

Regarding frequency and cost, we found significant prevalence of HD (1–3 sessions per week) in terms of frequency and cost. Barbosa et al [11] found that the number of paid HD sessions in 2009 in Brazil was >5 million dollars, and the cost involved with RRTs reached 751 million dollars annually. Another study, conducted in 2014 by Cruz et al [12], analyzed the value of treatment in 16,891 patients in São Paulo in the years 2008–2012 and showed a high expenditure with HD procedures, which accounted for 88% of the total amount spent on the treatment of patients with CRF.

The findings reinforce the assertion that the amounts allocated to financing RRTs are very significant for health systems. The growing number of HD patients in Santa Catarina, as inferred by increased HD sessions paid in the 2 years studied, also suggests that control of the risk factors associated with CRF was not effective nor universal in past decades and may not even be comprehensive or effective enough to reduce the population that currently needs RRT.

Regarding RT, those performed with the use of kidneys from deceased donors were the most frequent and accounted for 79.11% of the transplants in the period studied. Barnieh et al [13], in a study conducted in Canada in 2011, found that 63.58% of patients undergoing RT from 1998 to 2006 received deceased-donor organs. On the other hand, from 2009 to 2011, the proportion of transplantations with the use of deceased-donor organs had a significant growth, when >70% of RTs performed were with the use of deceased donors, numbers very close to the ones found in Santa Catarina [14].

Hariharan et al, in 1996, showed that donors aged ≥50 years accounted for 18.2% of all deceased-donor kidney transplantations performed in the United States, compared with only 10.4% in 1988 [15]. In 1998, The National Organization of Transplants showed that an estimated 30% of deceased donors in Spain were >60 years of age [16]. Approximately 15% of deceased-donor transplants during each year under study (1996–2000) were from donors aged ≥55 years [17].

As for the annual average cost, RT from a deceased donor was the most significant, US\$ 3,590,033.44 dollars, a very significant amount (81.78% of the total) compared with other types of KT in the period studied. The value used to finance the RT from deceased donors proved to be quite significant for the relatively small number of HD patients.

Salonen et al [18], accompanying patients in RRT from 1991 to 1996 in Finland, noted that the costs associated with health in the 1st 6 months, in the HD, PD, and RT groups were, respectively, US\$ 32,256, US\$ 25,504, and US\$ 38,265. Over the six following months, the amounts spent were US\$ 26,272, US\$ 24,218 and US\$ 7,420 respectively. Subsequently, the annual costs amounted to US\$ 54,140 for HD, US\$ 45,262 for PD, and US\$ 11,446 for RT. With these results, they concluded that RT from a deceased donor has much lower costs in the medium term compared with the 2 modalities of dialysis.

Regarding mortality of patients undergoing HD, men had a higher death rate than women, accounting for 57.84% of the deaths. Borges et al [19], in 2013, observed that in the state of Paraná 56.3% of the deaths occurred in men. The values described came very close to those of the present study, confirming the male prevalence in deaths. This result reflects a male predominance among the RT patients as well as the hypothesis that men are generally more careless with their health, which makes them seek medical attention late, worsening their prognosis.

The results obtained in this study also indicated that mortality of HD patients was directly related to age. The CRF mortality in patients was concentrated in the age group of 60–79 years, with 43.79% of total deaths. Importantly, the highest relative risk of mortality among HD patients aged >80 years was almost 73 times that of the age group of 20–39 years. A paper published in 2013 by Bersan et al [20], accompanying HD patients from 2004 to 2008, identified the predominance in deaths of the age group of 65–79 years (40.2% of the total), with a value of $P < .05$. In the age

group >80 years, the same study [17] found a relative risk 12.12 times higher than the age group of 20–49 years (95% CI, 4.546–32.323; $P = .000$). Another study, conducted in 2009 by Lehmkuhl et al [21] observing patients from 2004 to 2008, showed that the frequency of mortality in the age group >60 years was 69%.

The mortality of patients undergoing RT was greater in men, accounting for 75% of the deaths that occurred from the study period. The relative risk of mortality in RT patients was 14% higher in men. A study conducted in 2012 by Oliveira et al [22] showed that from 2000 to 2008, 63.6% of the deaths were male, which was not a statistically significant value. The prevalence of deaths among male RT patients reflects considerable male prevalence among kidney receivers as well as the aspects mentioned above related to low adherence of men to the risk factors, control initiatives, and treatment of chronic degenerative diseases.

In the study presented here there was significant association of mortality with age of patients undergoing RT. The relative mortality risk among RT patients aged >65 years was 5.88 times that of the age group of 18–34 years. It is important to highlight that only mortality in the age group >65 years was statistically significant ($P < .015$). Oliveira et al's study in 2012 [22] showed that 77.3% of the deaths occurred in patients aged >40 years, an amount also significant. The relative risk of mortality of the population >40 years of age, in the same study, was 6.19 times that of the age group <40 years of age, a result also statistically significant ($P = .001$; 95% CI, 2.01–18.99), which corroborates with the results found in the study presented here.

The relative risk of death during the 1st 2 weeks after transplantation was 2.8 times as high as that for patients on dialysis who had equal lengths of follow-up since placement on the waiting list, but at 18 months the risk was much lower (relative risk, 0.32; 95% CI, 0.30–0.35; $P < .001$) [23].

The resources to finance the high-complexity outpatient SUS services responsible for covering the procedures associated with RRT have had an exponential growth, partly owing to the increase in life expectancy, which increased the share of population demanding health services [24].

Despite the relatively quick recovery of the costs involved in performing RT and the improved quality of life of these patients compared with those remaining in HD, which make RT a “cost-effective” procedure, the relatively small number of RTs performed in Santa Catarina (average 261/year during the study period) calls attention compared with the number of patients maintained on HD (average 6,363 patients/year) and therefore eligible for this procedure. At current numbers, it would take >24 years to transplant all patients now in HD in the state.

For these reasons, the increase in the number of transplant teams and improvement in the quality and productivity of the ones already installed seems to be a priority

objective to ensure timely access and adequate treatment to patients with CRF in Santa Catarina-Brazil.

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