

## Impact of social vulnerability on the outcomes of predialysis chronic kidney disease patients in an interdisciplinary center

Impacto da vulnerabilidade social nos desfechos de pacientes com doença renal crônica pré-dialítica em um centro interdisciplinar

### Autores

Luciana dos Santos Tirapani<sup>1</sup>  
Hélady Sanders Pinheiro<sup>1</sup>  
Henrique Novais Mansur<sup>2</sup>  
Dilmerson de Oliveira<sup>2</sup>  
Rosália Maria Nunes  
Henriques Huaira<sup>2</sup>  
Carlos Contreras Huaira<sup>2</sup>  
Fabiane Rossi dos Santos  
Grincenkov<sup>2</sup>  
Marcus Gomes Bastos<sup>1</sup>  
Natália Maria da Silva  
Fernandes<sup>1</sup>

<sup>1</sup> Federal University of Juiz de Fora.

<sup>2</sup> Minas Gerais Institute of Nephrology Teaching and Research (IMEPEN).

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### Correspondência para:

Natália Maria da Silva Fernandes.  
Fundação Instituto Mineiro de Ensino e Pesquisas em Nefrologia (IMEPEN) Faculdade de Medicina da Universidade Federal de Juiz de Fora.  
Rua Jamil Altaff, nº 132, Vale do Ipê, Juiz de Fora, MG, Brazil.  
CEP: 36035-380.  
E-mail: nataliafernandes02@gmail.com

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### ABSTRACT

**Introduction:** Numerous studies examined the associations between socio-demographic, economic and individual factors and chronic kidney disease (CKD) outcomes and observed that the associations were complex and multifactorial. Socioeconomic factors can be evaluated by a model of social vulnerability (SV). **Objective:** To analyze the impact of SV on the outcomes of predialysis patients. **Methods:** Demographic, clinical and laboratory data were collected from a cohort of patients with predialysis stage 3 to 5 who were treated by an interdisciplinary team (January 2002 and December 2009) in Minas Gerais, Brazil. Factor, cluster and discriminant analysis were performed in sequence to identify the most important variables and develop a model of SV that allowed for classification of the patients as vulnerable or non-vulnerable. Cox regression was performed to examine the impact of SV on the outcomes of mortality and need for renal replacement therapy (RRT). **Results:** Of the 209 patients examined, 29.4% were classified as vulnerable. No significance difference was found between the vulnerable and non-vulnerable groups regarding either mortality (log rank: 0.23) or need for RRT (log rank: 0.17). In the Cox regression model, the hazard ratios (HRs) for the unadjusted and adjusted impact of SV on mortality were found to be 1.87 (confidence interval [CI]: 0.64-5.41) and 1.47 (CI: 0.35-6.0), respectively, and the unadjusted and adjusted impact of need for RRT to be 1.85 (CI: 0.71-4.8) and 2.19 (CI: 0.50-9.6), respectively. **Conclusion:** These findings indicate that SV did not influence the outcomes of patients with predialysis CKD treated in an interdisciplinary center.

**Keywords:** kidney failure, chronic; renal dialysis; social vulnerability; survival.

### RESUMO

**Introdução:** Inúmeros estudos avaliaram as associações entre fatores sociodemográficos, econômicos e doença renal crônica (DRC) e demonstraram que essas associações foram complexas e multifatoriais. Um método para avaliar os fatores socioeconômicos é construir um modelo de vulnerabilidade social (VS). **Objetivo:** Identificar a influência de vulnerabilidade social (VS) sobre os desfechos de uma coorte de pacientes com doença renal crônica (DRC) pré-dialítica. **Métodos:** Foram coletados dados demográficos, clínicos e laboratoriais, em uma coorte retrospectiva com pacientes nos estágios 3 a 5, que foram acompanhados por uma equipe interdisciplinar, no período compreendido entre janeiro de 2002 e dezembro de 2009, em Minas Gerais, Brasil. Para calcular a VS, foram utilizadas três técnicas estatísticas em sequência, análise fatorial, análise de agrupamento e análise discriminante. A sobrevida foi analisada com as curvas de Kaplan-Meier. O desfecho foi mortalidade ou iniciar a terapia renal substitutiva (TRS), analisadas por uma regressão de Cox. **Resultados:** Foram avaliados 209 pacientes, 29,4% eram vulneráveis. Não observamos diferença na mortalidade entre os grupos VS pela Kaplan Meier. Na regressão de Cox, *hazard ratio* (HR) e intervalo de confiança (CI) para o impacto da VS sobre a mortalidade, não ajustado foi HR: 1,87 (CI: 0,64-5,41) e HR ajustado: 1,47 (CI: 0,35-6,0). O impacto da VS em TRS mostrou o HR e CI HR não ajustado: 1,85 (CI: 0,71-4,8) e HR ajustado: 2,19 (CI: 0,50-9,6). **Conclusão:** Estes resultados indicam que a VS não influenciou os resultados de pacientes com DRC na pré-diálise tratados em um centro interdisciplinar.

**Palavras-chave:** diálise renal; falência renal crônica; sobrevida; vulnerabilidade social.

## INTRODUCTION

Identifying the modifiable factors that lead to progression of chronic kidney disease (CKD), which has been estimated to affect 2.9 million<sup>1-3</sup> of the Brazilian population, is a challenging yet important task. Numerous studies that have examined the associations between socio-demographic, economic, and individual factors, such as race, ethnicity,<sup>4-8</sup> socioeconomic status,<sup>3,8-12</sup> health literacy, and compliance,<sup>13,14</sup> and CKD outcomes have found the associations to be complex and multifactorial.<sup>15,16</sup> Whereas research focusing on measurement of socio-demographic and economic factors, and investigation of socioeconomic inequalities have a long history in high-income countries, they have a relatively brief history in low- and middle-income countries, with publication of the findings of such research only beginning to appear in the late twentieth century.<sup>17</sup>

One means of assessing socioeconomic factors is to construct a model of social vulnerability (SV). While there is no consensus regarding the concept of SV, with some researchers considering it synonymous to social support, almost all researchers have concluded that is a multifaceted concept encompassing various individual dimensions linked to exposure to risk factors and threats.<sup>18-23</sup> Social vulnerability is often defined as the entirety of the social deficits faced by patients, including social and environmental inequalities and deprivation, that affect their social cohesion and capacity to respond to situations of social risk and is associated with the health/disease process.<sup>21</sup> As such, SV is a more comprehensive concept than poverty, as it includes not only consideration of access to material needs, such as food, housing, and employment, but also access to public services and basic social policies and ability to actively respond to risks.

The results of many recent studies suggest that using an interdisciplinary approach to CKD treatment is superior to CKD treatment by a nephrologist alone. Specifically, interdisciplinary intervention has been found to reduce the need for hospitalization, improve clinical variables associated with decrease in glomerular filtration rate (GFR), and reduce the need for renal replacement therapy (RRT).<sup>24-28</sup> The aim of this study was to examine the impact of SV on the outcomes of patients in a developing country being treated for predialysis stage 3 to 5 CKD using an interdisciplinary approach.

## PATIENTS AND VARIABLES

This study was conducted by the Interdisciplinary Program for Prevention of CKD (PREVENRIM) at the Center for Interdisciplinary Studies, Research and Treatment in Nephrology and Federal University of Juiz de Fora (UFJF). Approval for conducting this study was obtained by the Ethics Committee in Research of the University Hospital of UFJF (Nº 203/2011). All study procedures and protocols were conducted in compliance with the ethical principles described in the Declaration of Helsinki. A consecutive cohort of predialysis stage 3 to 5 CKD patients who began treatment using the interdisciplinary approach provided by PREVENRIM between January 2002 and December 2009 were enrolled. Of the 211 patients initially enrolled, 2 were later omitted due to missing data (sociodemographic). PREVENRIM provides treatment via an interdisciplinary team composed of a social worker, nurse, nephrologist, nutritionist, and psychologist. At each visit, which occurred quarterly, bimonthly, and monthly for stage 3, 4, and 5 patients, respectively, the patient was attended by all staff, which ensured immediate biopsychosocial intervention when a problem was identified. The inclusion criteria were age over 18 years; presence of stage 3A, 3B, 4, or 5 CKD for at least the past 3 months; and ability to provide a signed informed consent. The exclusion criteria were patients with comorbidities that had higher impact on outcomes than CKD: cancer and AIDS.

Self-reported social factors such as marital status; family composition; number of children; type of housing; access to transportation, free medication, and health care; alcohol and drug use; presence of gambling addiction; employment status; religion; educational level; and income,<sup>29</sup> were assessed at baseline. Income was categorized by comparison to national values for the minimum individual wage and the minimum family wage per month, which are the reference values used in Brazil. Demographic, clinical, and laboratory data were also collected at baseline. The baseline was three months because this is the time required for confirmation of CKD diagnosis according to the Kidney Disease Outcomes Quality Initiative criteria.<sup>30</sup> During this time (first three months) the number of patients that did not had criteria for CKD was five. In the baseline were assessed by all the team members, including the social worker who had assessed them at the initial visit. Age, sex, and race

were the demographic variables assessed; presence of comorbidities, cause of CKD, blood pressure, body mass index (BMI), and medication were the clinical variables assessed; 24-h proteinuria level, serum creatinine level, and GFR as estimated using the MDRD formula<sup>31</sup> were the laboratory variables assessed; and mortality and the need for RRT were the outcomes assessed. Patients were followed until end of the study, death or started RRT.

### SOCIAL VULNERABILITY

SV was defined according to the results of factor analysis, cluster analysis, and discriminant analysis, in sequence, of the demographic and socioeconomic variables of the patients. Factorial analysis was used to identify and determine the importance of a set of latent or abstract variables, based on the order of importance of these factors for the data set analyzed and to subsequently describe each factor based on the variables that are most important for this. Initially, the entire socioeconomic database was evaluated. Many of these variables were both categorical and dichotomous and, when possible, ordinal variables were created. Various configurations of a set of variables were tested to determine the set that best described SV (Table 1).

In the order of importance, the most important variables were identified as (1) individual characteristics, of which wealth was found to be associated with decreased SV and black race with increased SV; (2) household structure, with larger household size found to be associated with decreased SV; and (3) social surroundings, with residence outside of urban areas but continued provision of support from the municipalities of origin found to be associated with decreased SV. Cluster analysis was performed to identify 2 study groups, a vulnerable and a non-vulnerable group, using data regarding individual characteristics, household structure, and social environment. Noting this for each individual can help in determining a value for each factor. In all cases, a higher weight indicated decreased SV.

Cluster analysis using the K mean was used to create a single combined score for the 3 groups of variables with which to determine the 2 study groups. Discriminant analysis was then used to validate the creation of the groups using the results of cluster analysis and develop a model that allowed for classification of all patients into the vulnerable and non-vulnerable groups. Model validation using the Wilks' Lambda test indicated that the model was appropriate for the sample examined. Of the 209 patients, 100% were classified correctly by the proposed model, indicating that the proposed allocation process would ensure correct classification (Tables 2 and 3).

**TABLE 1** RESULTS OF FACTOR ANALYSIS

Validation of factor analysis		Factor	% of variability
KMO	0.7	1	25.46
Bartlett test	438.4	2	41.57
Sig.	0	3	54.45
Factor loadings (rotated)			
	Factor 1	Factor 2	Factor 3
	Individual characteristics	Household Structure	Social environment
Has health insurance	0.76		
Literacy	0.7		
Has own car	0.65		
Individual income	0.57		
Black race	-0.5		
Living alone		-0.82	
Number of family members		0.77	
Family income	0.4	0.59	
Number of rooms	0.4	0.55	
Transportation City Hall Area			0.84
			0.72

Considered values greater than 0.40 for better understanding.

**TABLE 2** RESULTS OF CLUSTER ANALYSIS

Group	Number	%	% valid
Vulnerable	62	29.4	29.7
Non-vulnerable	147	69.7	70.3
Omitted from the study	2	0.9	
Total	211	100.0	

**TABLE 3** RESULTS OF DISCRIMINANT ANALYSIS

Group	Number	%
Vulnerable	62	29.4
Non-vulnerable	129	61.1
Total	211	100

### STATISTICAL ANALYSIS

After the patients had been divided into the vulnerable and non-vulnerable groups, the sociodemographic, clinical, and laboratory data of each group were evaluated. Normally distributed variables were expressed as means  $\pm$  SD unless noted otherwise, and non-normally distributed variables were expressed as either medians and ranges or percentages. Differences between the groups were examined using the t-test for independent samples or the Wilcoxon test for non-parametric comparisons. The  $\chi^2$  test was used to examine categorical variables. Survival was analyzed using Kaplan-Meier survival curve analysis, log rank, Breslow, Tarone-Ware (for identifying differences between groups).

The data collected from patients who were lost to follow-up or terminated study participation were deleted from the database (two patients). The impact of SV on mortality and the need for RRT was determined by Cox proportional hazard analysis using absence of SV as the reference. The Cox model was used because there is proportionality of the risk between the groups and the incidence density of events is presented independent of time. Multivariate Cox proportional hazard analysis was performed to adjust for additional potentially explanatory variables, first for demographic variables (age, sex, race, income), then for clinical (early stage of CKD, systolic and diastolic blood pressure and use of IECA e BRA) and laboratory variables (proteinuria). All analyses were conducted using SPSS 15.0 for Windows statistical software, and the statistical significance of the results was set at  $p < 0.05$ .

### RESULTS

Of the 209 patients followed for 7 years, 29.4% were classified as SV, 66% were older than 60 years (mean age,  $65.6 \pm 15.1$  years), 52% were women, and 63% were white/Caucasian. Public transportation was the only means of transportation for 60%, and treatment at the National Health System (SUS) was the only healthcare option for 74%. Regarding employment, only 11% remained active within the labor market, with 64% having retired, of whom 46% had retired owing to disability. The rates of illiteracy and functional illiteracy were 12% and 23%, respectively (Table 4). Of those who earned an income, 70.1% earned an individual income less than twice the minimum wage and 63.1% earned a family income twice as high as the minimum wage.

Among all the patients, the main cause of CKD was hypertensive nephrosclerosis (29%), followed by diabetic kidney disease (17%), and stage 4 was the most common stage of CKD (47%). Patients began treatment with a mean estimated GFR of  $30.7 \pm 14.4$  mL/[min $\cdot$ 1.73 m $^2$ ], a median 24-h proteinuria level of 400 mg (interquartile range: 170-880 mg), a mean BMI of  $26 \pm 4.8$ , a mean number of comorbidities of  $2.2 \pm 1.4$ , and taking a mean of  $2.4 \pm 2.0$  medications provided by the SUS. Regarding hypertension, 47.94% had systolic blood pressure above 140 mmHg and 26.8% had diastolic blood pressure above 90 mmHg. As shown in Figure 1, no significance difference was found between the vulnerable and non-vulnerable groups regarding either mortality (log rank: 0.23, Breslow 0.27, Tarone-Ware 0.19) or the need for RRT (log rank: 0.17, Breslow 0.86, Tarone-Ware 0.60). In the resultant Cox regression model, the hazard ratios (HRs) for the unadjusted and adjusted impact of SV on mortality were found to be 1.87 (confidence interval [CI]: 0.64-5.41) and 1.47 (CI: 0.35-6.0), respectively, and the unadjusted and adjusted impact of the need for RRT to be 1.85 (CI: 0.71-4.8) and 2.19 (CI: 0.50-9.6), respectively.

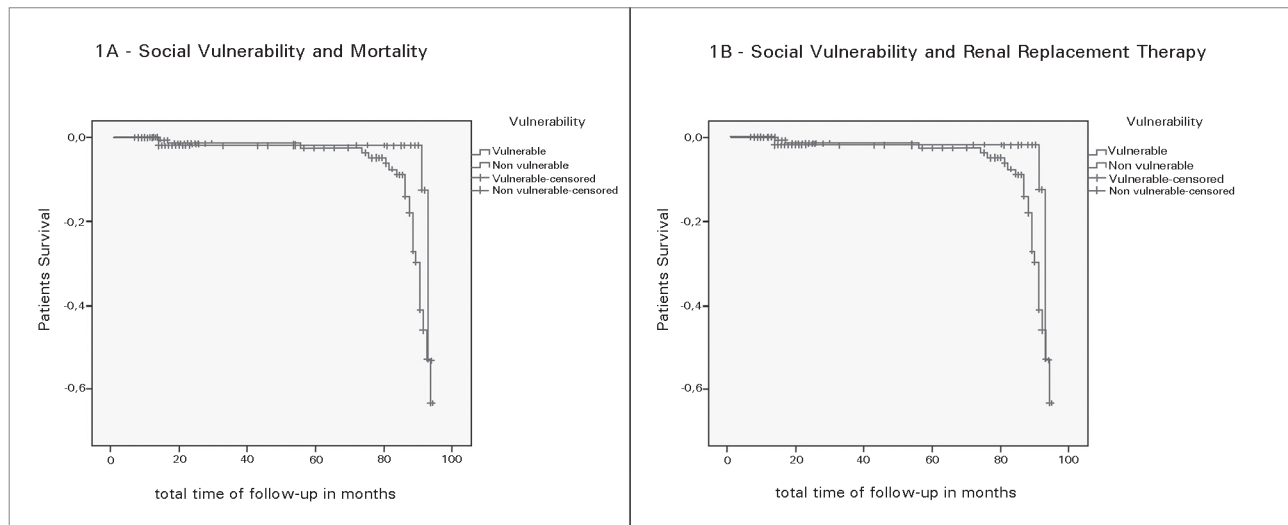
### DISCUSSION

This 7-year evaluation of a cohort of CKD patients presenting at a single health care center for treatment using an interdisciplinary approach found that SV did not have a significant impact on mortality and the need for RRT, the outcomes assessed. Review of the social indicator data collected by the Brazilian Institute of

**TABLE 4** SOCIAL AND DEMOGRAPHIC CHARACTERISTICS AT BASELINE (N = 209)

Variable	All	Vulnerable patients	Non-vulnerable patients	p value
Age, years	65.6 ± 15.1	67.1 ± 14.6	62.1 ± 15.7	0.02
Female sex, %	52	47	51	0.37
Caucasian, %	63	60	70	0.32
Married with children, %	52	58	35	0.02
Number of family members, mean ± SD	3.0 ± 1.7	3.3 ± 1.5	2.3 ± 1.9	0.0001
Number of rooms, mean ± SD	6.6 ± 2.6	6.9 ± 2.6	5.9 ± 2.3	0.005
Access to public transport only, %	60	71	35	0.0001
Catholic religion, %	82	80	84	0.45
No health insurance, %	74	76	71	0.49
No alcohol use, %	88	88	87	0.91
No tobacco use, %	91	91	92	0.83
Retired, %	64	71	55	0.30
Retired due to disability, %	46	42	57	0.05
Employed, %	11	12	10	0.70
Has no gratuity in public transport, %	73	71	77	0.39
Education, %				0.58
Illiterate	12	10	16	
Functionally illiterate/only 3 years of study	23	24	21	
Basic education	43	44	40	
High school	13	12	14	
College	10	10	10	

P-value refers to comparison between vulnerable and non-vulnerable patients. % refers to frequency intragroup.

**Figure 1.** Relationship between social vulnerability and mortality and the need for Renal Replacement Therapy.

Geography and Statistical (IBGE) in the 2010 census indicates that the social characteristics of the population studied are similar to those of the general population of the elderly in Brazil.<sup>29</sup> In 2011, those Brazilians aged 60 years or more, 76.8% were retired, 55.7% were women, 32% illiterate and functionally illiterate, and 55% self-reported as white/Caucasian. In the current

study, 66% of the patients were 60 years or older, these 64% were retired, 52% were women, 35% illiterate and functionally illiterate, and 63% self-reported as white/Caucasian. To our knowledge, the current study was the first to assess the social characteristics of predialysis CKD patients in Brazil and compare them to those of the general elderly population.

The high prevalence of elderly individuals in the study population accords with the findings of other studies.<sup>32</sup> The findings regarding the cause of CKD also accord with the Brazilian Society of Nephrology (SBN) Annual Census of 2011,<sup>33</sup> which reported that the main causes for CKD are hypertensive nephrosclerosis and diabetic kidney disease followed by glomerulonephritis, the same causes identified in the study population.

When conducting epidemiological research in developing countries, measuring social issues, such as socioeconomic status, requires the use of sensitive measures and instruments and knowledge of the relevant economic and social policies. As such, it is often more appropriate to use individual and domestic indicators than ecological and general indicators. Based on this understanding, the model for evaluating SV in this study was based on assessment of the social characteristics of the study population, with a focus on social context and access to resources.<sup>17</sup> Using this model, no relationship was found between SV and CKD progression; specifically, the patients in the vulnerable and non-vulnerable groups were found to have a similar mean blood pressure and proteinuria levels, factors that have been identified to impact the progression of CKD,<sup>34</sup> and the blood pressure and proteinuria level at admission in neither group was found to impact the progression of CKD, which accorded with the findings of previous research.<sup>32</sup>

Another important factor regarding the progression of CKD is the extent of access to medication and treatment. No significant difference was found between the vulnerable and non-vulnerable groups regarding the number of medications prescribed on admission, nor regarding the number of medications provided by the SUS free of charge. Current policy regarding pharmaceutical care in Brazil requires the dispensing of medications free of charge at the 3 levels of care: basic, specialized, and strategic. Medications for the treatment of some chronic diseases such as *diabetes mellitus* and arterial hypertension are available at the primary care level.

Research into the efficacy of use of an interdisciplinary approach toward treatment has been conducted for more than a decade. A study conducted in 1997 found that use of this approach resulted in lower cost of treatment, decrease in the number of patients that initiate urgent dialysis, and decrease in the number of days of hospitalization in the first months

of RRT.<sup>28</sup> Likewise, a comparison of 68 predialysis patients being treated by an interdisciplinary team with 35 predialysis patients being treated by a nephrologist observed that the former required fewer emergency room visits and hospitalizations, as well as fewer and briefer use of temporary catheterization, at the initiation of dialysis.<sup>27</sup> However, to our knowledge no previous study had evaluated the impact of using an interdisciplinary approach on the improvement of CKD patients within a social context, and consequentially on clinical outcome.

Although the findings of the current study agreed with much of the previous research, they do not agree with the findings of all past studies. Whereas no association was found between SV and the need for RRT or mortality in this study, a study of renal transplant recipients using the SAI (social adaptability index) identified an association between graft loss and survival,<sup>22</sup> while a study of CKD patients observed an association between survival and SAI.<sup>23</sup> The discrepancy between these findings and those of the present study may be attributable to the fact that the patients in the current study were provided with intervention by an interdisciplinary team from the initiation of treatment, thus preventing the factors associated with SV from interfering with treatment. Although access to health care in Brazil is theoretically universal, social barriers often prevent practical access to specialized treatment. Use of an interdisciplinary approach in the current study likely allowed patients who may have faced social barriers to pass through them to gain access to specialized care (i.e., prevented selection bias), allowing them to realize better outcomes than had they been treated by a specialist.

This study faced 2 major limitations that should be considered when considering the results regarding the effectiveness of use of an interdisciplinary approach. The first limitation was the use of a retrospective design to evaluate patients after they had received care using an interdisciplinary approach. The second limitation was the study population's ability to overcome social barriers to gain access to specialized health care using an interdisciplinary approach. Despite these limitations, this first study of the impact of SV on predialysis CKD patients in Brazil over 7 years yielded important findings that should be investigated further and applied to current practice.

In conclusion, this is the first study that evaluated the impact of social variables on outcomes of CKD pre-dialysis patients in Brazil and did not showed impact of the SV on the outcomes in an ambulatory using an interdisciplinary approach.

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