ISSN: 1676-4285

OBJN Online Brazilian Journal of Nursing
ENGLISH
Federal Fluminense University
AURORA DE AFONSO COSTA NURSING SCHOOL
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Evaluation of the cognitive function in patients with chronic heart failure: A cross-sectional study

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ABSTRACT

Objective: To evaluate the cognitive function of patients with chronic heart failure and to verify the association of the cognitive function with clinical and socio-demographic variables. **Method:** A cross-sectional study conducted with 79 patients with heart failure followed up at a specialized clinic. The Mini-Mental State Exam questionnaire was used to assess the cognitive function. **Results:** Among the 79 eligible patients, 40 (50.6%) are female, 51 (64.6%) are older adults, with a mean age of 63.30±11.93 years old, 53.2% are retired, and 50.6% have NYHA III functional class. For 62.0%, non-ischemic is evidenced as the probable etiology of the disease. **Discussion:** Through the data of this study it was possible to identify the association between the socio-demographic and clinical conditions with the cognition of patients with HF, showing that age is a variable associated with cognition. **Conclusion:** It is expected to understand the level of cognition of patients with heart failure and the factors associated with their impairment.

Descriptors: Cognition; Hearth Failure; Cognitive Dysfunction

Bandeira GMS, Flores PVP, Alencar PC, Jardim PP, Tinoco JMVP, Cavalcanti ACD. Evaluation of the cognitive function in patients with chronic heart failure: A cross-sectional study. Online Braz J Nurs [Internet]. 2019 [cited year month day];18(4):e20196327. Available from: https://doi.org/10.17665/1676-4285.20196327

INTRODUCTION

Heart Failure (HF) is a complex clinical syndrome, in which the heart is unable to pump blood in order to meet tissue metabolic needs, or it can do so only with high filling pressures[1,2]. According to data from the Unified Health System (*Sistema Único de Saúde*, SUS), approximately 200,000 hospitalizations and approximately 22,000 deaths due to heart failure (HF) occur in Brazil[3] and it is estimated that the annual treatment cost in Brazil is around R$ 200 million[4].

(HF) affects physical, psychological, social, and spiritual aspects, among others. Dyspnea, fatigue, and edema stand out as physical symptoms, which make up the triad of signs and symptoms, and have a progressive worsening character. The patient with HF may present depressive symptoms and cognitive changes. This cognitive alteration is associated with executive functions, including difficulties in planning and executing actions, low problem solving, and behavior inhibition capacity[5,6,7].

As for the functional performance of these patients, the inability to work, difficulty in creating social relationships, and loss of autonomy are highlighted. In this aspect, autonomy is associated with the ability to perform the daily activities by their own means, being directly linked to the mobility and functional capacity, where the subjects do not need guidance or assistance in the performance of their activities. That is, it presupposes efficient and adequate cognitive and motor conditions for performing such activities[8].

HF is an age-associated disease with a high prevalence rate in the older adults. The presence of cognitive impairment in patients with HF is very latent and has been associated with a high mortality rate, compared with patients without this type of impairment[9].

A cross-sectional study examined the interference of cognitive performance in the memory, attention, and executive function in the diastolic dysfunction of 82 patients with HF. Systolic patients with HF with concomitant severe diastolic dysfunction had worse cognitive performance in verbal fluency than those without severe diastolic dysfunction. Concomitant systolic and severe diastolic dysfunction, moderate to severe, further reduced verbal fluency[10].

Another study with a cross-sectional observational design carried out with 116 adult patients undergoing outpatient follow-up due to HF in the state of São Paulo found a low self-care rate in these patients. Another relevant fact in this study is that 44.8% of these patients had cognitive impairment[11].

Since its initial dissemination, the MMSE has become an instrument of great relevance in the screening for cognitive impairment. As it is a clinical instrument, it is used in the detection of cognitive losses, in the evolutionary follow-up of diseases, and in the monitoring of the response to the treatment administered. As a research tool, it has been used constantly in population epidemiological studies, composing the framework of instruments used in several neuropsychological batteries[12].

A study carried out in the United States of America (USA) with 270 patients with a mean age of 72.5 years old, used the Mini-Mental State Examination (MMSE) in order to assess cognitive functioning and its relationship with self-care. The data in this study demonstrated

that older adults with HF may have reduced self-care behaviors because of their cognitive deficits, with age being the strongest predictor of the worst MMSE scores. Low skills in self-care can pose a problem for older patients with HF, as they affect important behaviors such as taking medications, monitoring and interpreting symptoms, keeping appointments, and contacting the medical team in case there are signs of de-compensation[13]. Difficulties with memory, attention, psychomotor speed, verbal learning, and executive functions are the most common types of cognitive deficits reported in patients with HF[14,15]. Despite this, there are still no studies in Brazil that have evaluated the cognitive function of these patients and their associations with clinical and socio-demographic characteristics. This study aims to assess the cognitive function of patients with HF in a specialized clinic and to verify the association of this function with clinical and socio-demographic variables of these patients.

METHOD

Study design

A cross-sectional observational study that evaluated the cognitive function of patients with HF in a specialized clinic.

Context (setting)

The study was conducted between March 2017 and October 2018 with Chronic Heart Failure patients undergoing outpatient follow-up at a specialized multidisciplinary clinic, located in the city of Niterói, RJ.

Participants

The sample included patients aged 18 years old and older, with a HF chronic diagnosis and active in the specialized clinic, that is, who have attended at least one multi-professional consultation in the period of six months and who have preserved their communication skills. Patients with hemodynamic instability at the time of the multi-professional consultation were excluded.

The patients were invited to participate in the study and, subsequently, to read and sign the Free and Informed Consent Form (FICF). The convenience sampling strategy was used to select patients who met the inclusion criteria and agreed to participate in the study.

Variables

The socio-demographic and clinical variables and scores for cognitive function, self-care, quality of life and depressive symptoms were investigated. The socio-demographic variables were the following: age, gender, family structure (living with the family, alone or in geriatric clinics), schooling (years of study), marital status, and the patient's monthly income (family income, if applicable). The clinical variables were the following: smoking, duration of disease progression, length of follow-up at the outpatient clinic, New York Heart Association functional (NYHA) class and comorbidities, such as Diabetes Mellitus, chronic renal failure, coronary artery disease, depression, cancer, and hypertension. We also collected the number of previous consultations with the multidisciplinary team at the specialized clinic.

Data sources/Measurement

Data was collected during the screening performed by nurses and nursing students

to apply a questionnaire with clinical and socio-demographic data. The cognitive function, self-care, quality of life, and depressive symptoms variables were collected through questionnaires validated in Brazil.

The cognitive function was assessed by the Mini-Mental State Examination (MMSE). It is an instrument composed by several questions that were grouped into seven categories aiming to assess specific cognitive "functions", such as: orientation for time (five points), orientation for location (five points), recording of three words (three points), attention and calculation (five points), remembering the three words(threepoints), language (eight points), and visual constructive ability (one point). The MMSE score ranges from a minimum of zero to a maximum total of 30 points[16].

The self-care outcome was verified using the Brazilian version of the Self-Care of Heart Failure Index (SCHFI)[17]. This instrument consists of 22 items divided into three scales: maintenance of self-care (10 items), management of self-care (6 items), and confidence in self-care (6 items). The score for each domain ranges from 0 to 100 points, calculated from the transformation of the pure scores (each item on the scale ranges from 1 to 4). Higher scores reflect higher self-care and scores ≥70 points for each subscale indicate adequate self-care.

Quality of life was assessed using the Minnesota Living With Heart Failure Questionnaire (MLWHFQ), composed of 21 questions related to limitations presented by patients with HF, and the questions must be answered considering the last month. The total score ranges from 0 to 105, with the highest scores reflecting the worst quality of life[18].

The depressive symptoms were assessed by means of Beck Depression Inventory (BDI), using 21 questions, with answers whose scores vary between 0 and 3. The scores are subdivided as follows: score below 10 (without depression or mild depression); between 10 and 18 (mild to moderate depression); between 19 and 29 (moderate to severe depression); between 30 and 63 (severe depression)[19].

Bias

To reduce the risk of bias, training of the research team with a 20-hour workload was carried out by the study advisor using validated questionnaires.

Study size

All the active patients in the clinic were included in the study, totaling 79 subjects.

Quantitative variables

The quantitative variables were the following: age, schooling (years of study), monthly income, time of disease progression, time of follow-up at the specialized clinic, number of previous consultations with the multi--professional team, and scores of cognitive function, self-care, quality of life, and depressive symptoms. These were described through means and standard deviation or median (interquartile range). The other variables were expressed as simple and percentage frequencies.

Statistic methods

Data was inserted into a database in Microsoft Excel and analyzed using the Statistical Package for Social Sciences (SPSS) program,

version 20.0. The continuous variables will be expressed as mean and standard deviation for those with symmetric and median distribution, and as interquartile range for those with asymmetric distribution. The categorical variables will be expressed as absolute numbers and percentages. The association between the Mini-Mental State Examination scores and clinical or socio-demographic variables was analyzed using Pearson's Chi-Square test. The statistical comparison between the groups divided according to the cutoff point for cognitive function was performed by the *Mann-Whitney* test for the quantitative clinical variables, and by Pearson's Chi-Square test for the categorical variables. Two-tailed p value of 0.05.

Ethical aspects

This research was approved by the Ethics and Research Committee of the Medical School/ Antônio Pedro University Hospital, under opinion No. 3.089.60, and meets the requirements of Brazilian resolution 466/12 of the National Health Council[20]. This research guarantees the maintenance of the secrecy, confidentiality, and privacy of the research subject's data.

RESULTS

Throughout the study, 79 patients were selected as eligible for the research sample, of whom 40 (50.6%) are female, aged 63.30±11.93 years old (p=0.417), 51 being older adults (64.6%), thus justifying the percentage of retirees: 53.2%. Regarding schooling, 45 (57.0%) have more than 9 (nine) years of study, and retirement was presented as the main source of income for 53.2%. It is observed that, in the patients seen at the clinic specialized in HF, the mean time of disease was 114 (24-168) months (p<0.0001). About the New York Heart Association Functional Class, 19 (24.1%) were in NYHA I, 40 (50.6%) in NYHA II, 18 (22.8%) in NYHA III, and 2 (2.5%) in NYHA IV.

For 62.0%, non-ischemic is evidenced as the probable etiology of the disease. It was observed that, of the total sample, 16.5% are smokers, 84.8% have Systemic Arterial Hypertension, and 36.7 have Diabetes Mellitus. With the Minnesota Quality of Life questionnaires and Beck Depression Inventory, 44.3% answered that they had a poor quality of life, and 36.7% did not have depressive symptoms. In the Mini-Mental State Examination, 60.8% have normal cognition and 39.2% have cognitive loss, as shown in Table 1.

Table 2 shows the categorical variables regarding cognitive loss and normal cognition, where 45.1% of the older adults in the sample (of the 51 older adults, 23 are in this category) and 28.6% of the adults up to 59 years of age (of the 28 adults, 8 are in this category), as well as 52.5% of the female population, have cognitive loss.

Table 3 shows the association of the clinical variables and the cognition scores by the MMSE. There were no statistically significant results.

Table 4 associated the MMSE domains according to the cognition scores. Orientation (p<0.0001), attention and calculation (p<0.0001), evocation (p=0.003), language (p<0.0001), and total score had higher me-

Table 1. Clinical characteristics of the sample (n=79). Niterói, Rio de Janeiro, 2019.

Variables	n=79	p-value
Number of Medications*	6.19±2.83	0.159†
Probable Etiology†		
Ischemic	30(38.0)	
Non-ischemic	49(62.0)	
Ejection Fraction*	54.27±16.44	0.168†
Smoker†	13(16.5)	
Consumes Alcoholic Beverage†	19(24.1)	
Influenza Vaccine†	53(67.1)	
Pneumococcus Vaccine†	15(19.0)	
Comorbidities†		
Systemic Arterial Hypertension	67(84.8)	
Acute Myocardial Infarction	22(27.8)	
Dyslipidemia	17(21.5)	
Diabetes Mellitus	29(36.7)	
Minnesota Quality of Life Questionnaire‡	39(20-61)	
Good quality of life†	28(35.4)	
Moderate quality of life†	16(20.3)	
Poor quality of life†	35(44.3)	
Maintenance of Self-Care*	45.30±16.24	0.165†
Adequate self-care (≥70) †	7(8.9)	
Inappropriate self-care (<70) †	72(91.1)	
Self-care Handling*	57.41±20.67	0.774†
Adequate self-care (≥70)†	11(29.7)	
Inadequate self-care (<70)†	26(70.3)	
Beck Inventory - Depression‡	12(7-20)	
Minimum†	29(36.7)	
Mild to minimum†	27(34.2)	
Moderate to severe†	18(22.8)	
Severe†	5(6.3)	
Mini-Mental State Examination‡	27(24-29)	
Normal cognition	48(60.8)	
Cognitive loss	31(39.2)	

* Mean±standard deviation; † n (%);‡ Median (interquartile amplitude: 25-75);† Shapiro-Wilk

dians of scores in the group with cognition considered normal.

Table 5 associated clinical variables (age, disease duration, number of medications, and ejection fraction), as well as total scores of the quality of life, self-care, and depressive symptoms questionnaires with the cognition scores. There was no difference between the groups with normal cognition and with cognitive loss.

DISCUSSION

This study verified that 39.2% of the patients with HF in a specialized clinic have impaired cognition. Orientation, evocation, language, and attention and calculation showed statistically significant differences when compared to patients without cognitive deficit. In addition, there was a difference between the group of older adults and that of adults regarding cognitive loss. The rest of the variables did not show significant differen-

Table 2. Association of the socio-demographic variables and level of cognition. Niterói, Rio de Janeiro, 2019.

Categorical Variables	Normal cognition (27 or +) (n=XX)	Cognitive loss (up to 26) (n=XX)	p-value
Age[x]			
Older adult (+60)	28(54.9)*	23(45.1)*	0.027[#]
Adult (up to 59)	20(71.4)*	8(28.6)*	
Gender[x]			
Female	19(47.5)*	21(52.5)*	0.231[#]
Male	29(74.4)*	10(25.6)*	
Marital status[x]			
Single	8(42.1)*	11(57.9)*	0.119[†]
Married or with partner	30(69.8)*	13(30.2)*	
Divorced, separated, or widowed	10(58.8)*	7(41.2)*	
New York Heart Association Functional Class[x]			
I-Asymptomatic	12(63.2)*	7(36.8)*	0.722[†]
II-Great efforts	23(56.1)*	18(43.9)*	
III-Small efforts	12(66.7)*	6(33.3)*	
IV-Rest	1(100)*	0	
Schooling[x]			
Low schooling (up to 9 years)	21(61.8)*	13(38.2)*	1.000[#]
High schooling (9 years or more)	27(60.0)*	18(40.0)*	
Income[x]			
With income	42(62.7)*	25(37.3)*	0.612[#]
No Income	6(50.0)*	6(50.0)*	
Living Alone[x]			
Living alone	9(56.2)*	7(43.8)*	0.899[#]
Living with someone	39(61.9)*	24(38.1)*	

ces. A systematic review carried out in the United Kingdom in 2017 aimed to describe the association of heart failure with cognitive impairment. Among the 4,176 patients with HF, 43% (95% confidence interval: 30-55) had some cognitive decline[21].

Cognitive deficits are directly associated with the frailty of the older adults. Usually, these individuals report complaints of forgetfulness and other changes in the cognitive domains. A number of studies show that aging directly interferes with memory; it can also suggest declines in the executive functions and in language[22]. In this study, we can observe that the studied sample presented important deficits in the language domain ($p<0.0001$). A study carried out with 63 older adult patients in the city of Vassouras in Rio de Janeiro aimed to assess the cognition of these individuals. The cognitive domains (**orientation, memory, attention and calculation, praxis, and language)** presented themselves as significantly reduced in the studied sample; the data suggest that the structural conditions and the schooling level are not factors that generally influence the cognitive status of these patients[23]. This is in line with the data in this study, which pre-

Table 3. Association of the clinical variables and level of cognition. Niterói, Rio de Janeiro, 2019.

Categorical variable	Normal cognition (27 or +) (n=48)	Cognitive loss (up to 26) (n=31)	p-value
Probable Etiologyx			
Ischemic	16(53.3)*	14(46.7)*	0.412#
Non-ischemic	32(65.3)*	17(34.7)*	
Smokerx			
Smoker	6(46.2)*	7(53.8)*	0.385#
Non-smoker	42(63.6)*	24(36.4)*	
Consumes Alcoholic Beveragex			
Drinks	8(42.1)*	11(57.9)*	0.101#
Does not drink	40(66.7)*	20(33.3)*	
Influenza Vaccinex			
Vaccinated	32(60.4)*	21(39.2)*	1.000#
Not vaccinated	16(61.5)*	10(38.5)*	
Pneumococcal Vaccinex			
Vaccinated	9(60.0)*	6(40.0)*	1.000#
Not vaccinated	39(60.9)*	25(39.1)*	
Systemic Arterial Hypertensionx			
No	4(33.3)*	8(66.7)*	0.073#
Yes	44(65.7)*	23(34.3)*	
Acute Myocardial Infarctionx			
No	35(61.4)*	22(38.6)*	1.000#
Yes	13(59.1)*	9(40.9)*	
Dyslipidemiax			
No	36(58.1)*	26(41.9)*	0.512#
Yes	12(70.6)*	5(29.5)*	
Diabetes Mellitusx			
No	29(58.0)*	21(42.0)*	0.674#
Yes	19(65.5)*	10(34.5)*	
Minnesota Quality of Life Questionnairex			
Good quality of life	15(53.6)*	13(46.4)*	0.577 †
Moderate quality of life	11(68.8)*	5(31.2)*	
Poor quality of life	22(62.9)*	13(37.1)*	
Maintenance of Self-Carex			
Adequate self-care (≥70)	5(71.4)*	2(28.6)*	0.698‡
Inadequate self-care (<70)	43(59.7)*	29(40.3)*	
Self-Care handlingx			
Adequate self-care (≥70)	7(63.6)*	4(36.4)*	1.000#
Inadequate self-care (<70)	17(65.4)*	9(34.6)*	
Beck Inventory - Depressionx			
Minimum	21(72.4)*	8(27.6)*	
Mild to minimum	14(51.9)*	13(48.1)*	0.431 †
Moderate to severe	10(55.6)*	8(44.4)*	
Severe	3(60.0)*	2(40.0)*	

* n (%); # Continuity Correction; x Chi-square; † Pearson's Chi-square; ‡ Fisher's Exact Test

Table 4. Association between the domains of the MMSE questionnaire and the respective total scores. Niterói, Rio de Janeiro, 2019.

Mini-mental	Normal cognition (27 or +) n=48	Cognitive loss (up to 26) n=31	p-value
Orientation	10(10-10)‡	9(7.50-10)‡	0.000#
Immediate Memory	3(3-3)‡	3(3-3)‡	0.149#
Attention and Calculation	5(5-5)‡	2(0-4.50)‡	0.000#
Evocation	3(2-3) ‡	2(1.50-3)‡	0.003#
Language	9(8-9)‡	7(6.50-8)‡	0.000#
Total	29(28-30)‡	23(22-25)‡	0.000#

‡Median (interquartile amplitude: 25-75); #Mann-Whitney

Table 5. Association between clinical variables, scores of the quality of life, self-care, and depressive symptoms questionnaires and the total scores of the MMSE questionnaire. Niterói, Rio de Janeiro, 2019.

Variables	Normal cognition (27 or +) n=48	Cognitive loss (up to 26) n=31	p-value
Minnesota Quality of Life Questionnaire	42.02±24.208*	39.52±25.313*	0.660†
Maintenance of self-care	47.06±16.417*	42.58±15.850*	0.234 †
Self-care handling	55.67±19.320*	60.62±23.434*	0.495 †
Beck Inventory - Depression	10(7-20)‡	15(9.50-19.50) ‡	0,142#
Age	62.38±11.625	64.74±12.434	0.393 †
HF time	120(24-168) ‡	108(36-132) ‡	0.842#
Number of medications	6.31±2.830	6±2.864	0.635 †
Ejection fraction	52.50±16.006	57.23±17.038	0.240 †

*Mean±standard deviation; ‡Median (interquartile amplitude: 25-75); #Mann-Whitney; † T-test

sented the impaired orientation (p<0.0001), attention and calculation (p<0.0001), evocation (p=0.003), and language (p<0.0001) domains with little interference from schooling and other socio-demographic factors in cognition.

Declines in cognitive functions influence impairments in physical functioning, risk of dependence, reduced autonomy, and emotional and social harm in these patients. Cognitive impairment can impact important issues in the lives of patients with HF, one of which is self-care[24].

Recent international recommendations highlight the importance of identifying patients with a worse prognosis and of integrating them into multidisciplinary management programs such as HF Clinics. The activity of these spaces is structured with patient education, optimization of therapy, psychological support, and easy access to health care[25].

Another comparative data is in relation to age. The configuration of today's society has been changing over the years. A strong characteristic of the world population is advanced age, which is a major challenge for multidisciplinary health teams, as the older adults are more susceptible to various comorbidities, as

well as to degenerative, cardiovascular, and cerebrovascular diseases[13]. This reality can be observed in this study, which showed a mean age of 63.30±11.93 years old.

The aging of the population and the greater survival to diseases, thanks to the advanced techniques of diagnosis and treatment, have been highlighted as some of the causes for the increase in the prevalence of HF in recent years[26], corroborating with this study, which showed a predominant elderly population, with HF and prevalent comorbidities such as systemic arterial hypertension and Diabetes Mellitus. Mild cognitive impairment is a common comorbidity in patients with HF and is associated with structural and functional changes in the brain[27]. Another study published in PubMed in 2016, *Cognitive decline in heart failure*, reports that cognitive impairment is more common in older adult patients who have heart failure.

This study also showed a profile of patients where gender distribution has male predominance, married or in a stable relationship, low levels of schooling and income, and comorbidities such as arterial hypertension, Diabetes Mellitus, and acute myocardial infarction associated with HF. With regard to schooling, the results found in this study are in line with national research studies conducted with patients with HF[28]. It is worth mentioning the high rate of retirees in this study, which may be related to the deficient health conditions related to HF and to the comorbidities presented, since the limitations brought about by the disease may suggest early retirements.

The changes related to the socio-demographic issues in society have resulted in a greater predisposition to the development of chronic non-communicable diseases, especially cardiovascular ones[29].

The analysis of the clinical and socio-demographic conditions and their relationship as a cognitive deficit is very important, considering that the cognitive function is composed of several domains such as memory, attention, executive functions, psychomotor speed, language, and visual-spatial capacity[30], items that influence the life of a human being. It is known that patients with HF suffer from deficiencies in several other important aspects of the cognitive function, including working memory, attention, ability to solve problems, and psychomotor response[31]. Even so, the sample of this study revealed preserved cognition in the majority of the studied population.

Cognitive deficit is associated with harmful health outcomes, deficient quality of life, and psychological disorders[32]. Even so, cognitive deficit did not appear latently in this study, as the literature has shown[33].

It is worth highlighting two conditions that may have interfered with the findings of this study. The first is the instrument used to assess cognition, the MMSE being one of the most widely used screening tests for screening cognitive performance in several studies; but some authors have pointed out that the use of the MMSE to assess cognitive performance in patients with HF is not effective and is not sensitive to indicate cognitive impairments in patients with HF.

Another important issue to be analyzed is the treatment offered to the patients in this sample through the clinic specialized in HF. The activities of these organizations, using

the Coração Valente Heart Failure Clinic as a model, are guided by educational actions, therapeutic improvement, and various supports through the multidisciplinary team composed of nursing, medicine, physiotherapy, nutritionist, psychology, physical educator, support team of information technology, and pedagogy. The usual forms of care are through face-to-face consultations, home visits, telephone consultations, telemonitoring, and an orientation and social group[34].

The grouping of actions and interventions found in the HF clinics shows positive results in the prognosis of the patients, probably greater than those of the individuals who do not receive this type of treatment, making it difficult to quantify the dimension of this care. These factors probably interfered with the cognitive assessment proposed by this study[35].

CONCLUSION

Through the data of this study it was possible to identify the association between the socio-demographic and clinical conditions and the cognition of patients with HF, showing that age is a variable associated with cognition. Therefore, for the practice of the multidisciplinary team, this study shows concepts for the refinement of interventions in order to promote improvements in promoting strategies to face this disease.

In addition, we propose to deepen the research through cohort studies on the socio-demographic and clinical profile of patients with HF and their correlations with cognition in different regions of the country, as well as the implementation of multidisciplinary monitoring programs promoting HF care and clinical control.

The limitation of this research is found in its cross-sectional design, through data from medical records, which makes it impossible to evaluate the variables in a longitudinal way and the casual relationships between them. In addition, the size of this sample shows that these data cannot be generalized, being necessary to conduct new research studies with analyses over time with a larger sample in order to prove or refute the hypotheses raised by this study.

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Received: 11/13/2019

Revised: 05/26/2020

Approved: 06/04/2020