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Analysis of Hospital Safety in Fall Prevention in the Elderly

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Abstract: This study analyzed the risk of falls in the elderly and the safety of the environment in a teaching hospital in Brazil. The Morse Falls Scale was used to stratify the risk of falls in 45 hospitalized elderly individuals, and a checklist was used to analyze the hospital environment. The analysis was based on the chi-square test and multiple regression. The moderate risk of falls was predominant (51.1%). The variable age group (p-value = 0.024) showed statistical evidence of association with the risk of falls. However, the multiple regression analysis showed no difference between the age groups and the risk situation for falls. The hospital wards showed an adequate arrangement of furniture, but some aspects had inadequacies, such as objects in the corridors, non-functional bells in some beds, and inadequacy of the toilet bowls in terms of the recommended height, the absence of non-slip flooring and the support bar in some bathrooms. In conclusion, the moderate risk of falls among the elderly and the adequacy of the hospital environment to technical standards were evident, with the exception of failures in the emergency communication system and sanitary installation.

Keywords: elderly; fall accidents; patient safety

1. Introduction

Population aging is a demographic phenomenon that has been increasing for a few decades worldwide. This trend is also noticeable in Brazil, since the share of people aged 60 or over in the country went from 10.8% to 15.8%, showing an increase of 46.6% [1], demanding new arrangements in the organization of health care networks due to the increased demand for these services [2,3].

During the aging process, changes occur in the body that are intrinsic and extrinsic in nature, that is, influenced by internal and external factors [4]. The predominant damage to health in elderly individuals is traumatic and that related to clinical conditions, directly associated to underlying diseases, such as cardiovascular and metabolic diseases, among others. Moreover, regarding traumatic health problems, falls are the main events [5].

Fall-related health problems in the elderly rank first among the causes of hospitalization, representing approximately 56.1%, and are the third leading cause of death for external reasons in patients over 60 years of age [6]. In the hospital environment, the rates vary from 1.4 to 13 falls for every thousand patients per day, and damage to patients occurs in approximately 30 to 50% of cases, ranging from minor damage, such as abrasions and bruises, to serious damage, such as femur and hip fractures and head trauma. In the most extreme cases, these falls can even lead to the patient's death [7].

According to the World Health Organization (WHO), a fall can be understood as an event characterized by the sudden descent of the body to a level lower than the initial position [8].

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Additionally, patient falls contribute to prolonging the length of hospital stay, resulting in additional care costs and potentially having consequences for the institution's credibility and legal issues [9].

Falls can be influenced by intrinsic factors, such as advanced age, previous history of falls, clinical conditions and drug therapy, or by extrinsic factors related to the environment, such as insufficient lighting, slippery carpets, slippery floors and unexpected obstacles [10].

To promote the safety of patients treated in health units, the Brazilian Ministry of Health, through Ordinance number 2,095 of 2013, approved the "Basic Patient Safety Protocols", which must be applied throughout the Brazilian territory [11]. Among them, the "Fall Prevention Protocol" stands out, which aims to reduce the occurrence of patient falls in care settings and the resulting damage. It is essentially based on the implementation of measures that include patient risk assessment, allowing multidisciplinary care in a safe environment, in addition to promoting patient, family and professional education [12].

There is an agreement between Brazilian regulations and global guidelines for preventing and managing falls in the elderly [13], highlighting the importance of implementing methodologies that analyze the risk of falls through a person-centered approach, taking into account the perceptions of the elderly individual and their interaction with caregivers/companions. Moreover, it is essential to highlight that investment in education aimed at preventing this incident is a low-cost but highly effective strategy.

The nursing staff stands out in hospital care for the elderly and spends more time in direct patient care, being undoubtedly essential in identifying risk factors for falls in hospitalized elderly patients, to direct not only patient-centered care, but also the planning actions to prevent and/or reduce falls [14].

Therefore, given the greater vulnerability of elderly individuals to falls in hospital environments, it is imperative to carry out investigations into the factors that contribute to this adverse event, aiming to improve patient safety. With a focus on preventing falls, it is crucial to identify possible deficiencies in the hospital structure and organization that may predispose the occurrence of these incidents, with the potential to worsen the health of elderly patients. In this context, the present study aimed to analyze the risk of falls in the elderly and the safety of the environment in a teaching hospital in Brazil.

2. Materials and Methods

This is a descriptive study, carried out between November and December 2023, in a teaching hospital in northeastern Brazil. The physical structure for individual and collective use of the following units was analyzed: Surgical Unit (CIR), High Complexity Oncology Unit (UNACON), Internal Medicine Unit (CM) and Internal Medicine/Surgical Clinic Unit (MEDC) as recommended by the NBR 9050/2020 of the Brazilian Association of Technical Standards (ABNT) [15] for analysis of the institution's structure.

The study population consisted of 54 hospitalized elderly individuals, who were assessed for their risk of falls. The following inclusion criteria were used: being elderly and hospitalized in the units of interest of the research, excluding elderly patients who did not communicate verbally, making data collection impossible.

It was not possible to collect data from one patient at UNACON; from three patients in the Internal Medicine Unit; and from five patients in the Internal Medicine/Surgical Clinic Unit. Thus, the study sample comprised 45 elderly patients. Among the reasons for sample losses are patients who were not receptive to dialogue, hearing-impaired and aphasic patients, disoriented patients and patients absent from the bed at the time of data collection.

Three instruments were used for data collection: the Morse Falls Scale [16], the checklist for evaluating the hospital environment for individual use focused on the region of the rooms or wards [15], and the checklist for the physical structure for collective use [17].

The Morse Fall Scale is used to stratify the risk of falling, considering six parameters: history of falls, secondary diagnosis, support for moving/walking, intravenous medication/heparinized catheter, gait and mental state. Each criterion or parameter corresponds to a specific numerical value,

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which when added together results in a score, against which stratification is assigned, being classified as "low", "moderate" and "high" risk of falls [16].

Regarding the analysis of the individual use environment, related to the room or ward, the following safety variables were investigated: presence of bars on the beds, lock on the wheels, bell, auxiliary light, lock on sliding furniture, easy access to belongings, free access to the bathroom, use of non-slip shoes and furniture organized around the bed. The variables of internal circulation and sanitary facilities were considered for the structural analysis of the collective environment.

The data were collected in the rooms/wards of each hospitalization unit, as well as in internal circulation areas and sanitary facilities. They were subsequently typed into Microsoft Excel® spreadsheets, version 16.0, double-checked and exported to the Statistical Package for Social Sciences® (SPSS), version 22.0, for statistical analysis.

The study followed all ethical and legal principles for research with human beings [18]. Approval by the Research Ethics Committee of the University Hospital HU-UFPI was obtained under protocol code 6,462,335, and the participants signed the Free and Informed Consent Form (TCLE).

3. Results

The average age of the participants was 70.4 years, with a predominance of the age group of 60 to 70 years (62.2%). As for the gender, 51.1% were male. In relation to the level of education, there was a predominance of incomplete elementary education, with 55.6% of responses.

Among the main reasons for hospitalization reported by the interviewed elderly individuals, pain (26.7%) and surgical treatment (24.4%) stand out. Regarding the self-reported diseases, high blood pressure was the most common among those investigated, totaling 40% of cases. As for the average length of hospital stay, it was estimated at 16.7 days.

Table 1 shows the responses to the Morse Falls Scale items, which comprise the fall risk assessment. Regarding the history of falls, 88.9% of patients reported not having suffered a fall in the last year. As for the secondary diagnosis, 88.9% were diagnosed with more than one disease.

Table 1. Distribution of elderly individuals according to the Morse Falls Scale evaluation criteria. Teresina, Piauí. 2024.

Morse scale items	N	%
History of falls		
Yes	5	11.1
No	40	88.9
Secondary diagnosis		
Yes	40	88.9
No	5	11.1
Support for moving/walking		
None/bedridden/nurse support	39	86.7
Crutches/Canadian crutches/walker	6	13.3
Intravenous medication		
Yes	27	60
No	18	40
Gait		
Normal/bedridden/wheelchair	26	57.8
Slow gait speed	16	35.6
Needs support	3	6.7
Mental state		
Aware of their capabilities	41	91.1
Overestimates/forgets their limitations	4	8.9

Source: The authors.

In the item "Support for moving/walking", the majority of participants (86.7%) were classified as "none/bedridden/nurse support". Regarding "Intravenous Medication", 60.0% were using intravenous therapy. With regard to gait, it was highlighted that 57.8% of those investigated were

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classified as "Normal/bedridden/wheelchair". The majority of the interviewees were aware of their capabilities (91.1%).

When evaluating the general fall risk classification scale, it was observed that 51.1% of the elderly had a moderate risk of falls, followed by 28.9% with low risk, and 20.0% with high risk.

Table 2 shows the association of patient characteristics according to the Morse Falls Scale risk classification and only the age group variable (p-value = 0.024) showed statistical evidence of association. The moderate risk of falls predominated equally between the sexes, with 33.3% in the age group of 60 to 70 years, in elderly individuals with incomplete elementary education (24.4%) and with up to 30 days of hospitalization (44.4 %).

Table 2. Association between the risk of falls and the participants' characterization. Teresina, Piauí. 2024.

Characteristics	Risk			Total	*p*-Value
	Low N (%)	Moderate N (%)	High N (%)	N (%)	
Sex					0.901
Male	6(13.3)	12(26.7)	5(11.1)	23(51.1)	
Female	7(15.6)	11(24.4)	4(8.9)	22(48.9)	
Age range (years)					0.024
60-70	7(15.6)	15(33.3)	6(13.3)	28 (62.2)	
71-81	2(4.4)	8(17.8)	3(6.7)	13 (28.9)	
≥82	4(8.9)	0(0.0)	0(0.0)	4 (8.9)	
Level of schooling					0.819
Illiterate	4(8.9)	10(22.2)	2(4.4)	16(35.6)	
Incomplete Elementary School	8(17.8)	11(24.4)	6(13.3)	25 (55.6)	
Complete Elementary School	1(2.2)	2(4.4)	1(2.2)	4 (8.9)	
Length of hospital stay					0.258
Up to one month	11(24.4)	20(44.4)	8(17.8)	39(86.7)	
1-2 months	2(4.4)	3(6.7)	0(0.0)	5(11.1)	
>2 months	0(0.0)	0(0.0)	1(2.2)	1(2.2)	

Source: The authors. [1] Chi-square test, with Yates correction, at 5% level.

Regarding the multiple regression analysis, no difference was observed between the groups and the risk situation, as shown in Table 3.

Table 3. Regression association between the risk of falls and the participants' age group. Teresina, Piauí. 2024.

Classification of Morse Falls Scalea		B	df	p-value	OR	OR-95%	
	Age range (years)					Lower limit	Upper limit
Low Risk	Intercept	18.948	1	0.996			
	60-70	-18.794	1	0.996	6.888E+05	0.000	.b
	71-81	-19.353	1	0.996	3.936E-09	0.000	.b
	≥82	0c	0				
Moderate Risk	Intercept	0.938	1	0.166			
	60-70	-0.022	1	0.979	0.978	0.192	4.993
	71-81	0.043	1		1.043	1.043	1.043
	≥82	0c	0				

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Source: The authors. a. The reference category is: high risk. b. A floating point overflow occurred when calculating this statistic. Therefore, its value is set as omitted from the system. c. This parameter is set to zero because it is redundant.

In the analysis of the safety of the hospital environment for individual use, as shown in Table 4, it was observed that in all analyzed environments (rooms/wards), the beds had protective rails and locked wheels, there was an operating individual bedside light, with easy handling, and switches located near the bed.

Table 4. Assessment of individual use environment security variables. Teresina, Piauí. 2024.

Variables	Answer	Total beds assessed	
		N	%
Beds with protective rails	No	0	0
	Yes	145	100
locked wheels	No	0	0
	Yes	145	100
Bedside light	No	0	0
	Yes	145	100
Nearby bell	No	1	0.7
	Yes	144	99.3
Free access to the bathroom	No	2	1.4
	Yes	143	98.6
Sliding furniture without locks	No	0	0
	Sim	145	100
Organized furniture	No	0	0
	Yes	145	100
Easy access to one's belongings	No	0	0
	Yes	145	100
Non-slip footwear	No	145	100
	Yes	0	0

Source: the authors.

It is noteworthy that the item related to the bell was identified in the majority of beds (99.3%), but they were not working in any of them. Regarding the assessment of circulation and organization of the environment, sliding furniture, such as a bedside table, did not have locks (100%), and the elderly had easy access to their belongings (100%) and bathrooms (98.6%). In only 2 (1.4%) beds, the passage was not clear due to the presence of garbage containers.

As for the physical structure for collective use in the four evaluated hospitalization units, they were in compliance with the standard: handrails present on both sides of stairs and ramps, as well as friezes and contrasting signaling on the edges of the stairs, guaranteeing unobstructed access. The corridors and passages had a regular, continuous and durable coating, with continuous leveling and no steps. All doors had a minimum opening of 80 cm and the handles were lever-type. The signaling had contrasting colors, and there were signs indicating the risk of falls, such as before areas undergoing maintenance or being cleaned.

Among the items that did not comply with the technical standards used in the study, the sanitary installations stand out, as despite having support bars on the sides next to the sanitary bowl for transfer, the toilet bowls did not have an adequate height, the floor was not non-slip and there was floor unevenness at the entrance to the bathroom. Furthermore, the fall risk signaling and support bar next to the shower were present in only one of the assessed bathrooms, and not all bathrooms had a shower chair.

4. Discussion

Studies that address the occurrence of falls in the elderly in the context of the hospital environment indicates these events still require greater mobilization of care and management

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strategies to reduce their frequency, especially because the individual factors of senility associated with the fragility of structures hospital physical structures can result in irreparable damage to the physical and psychological health of this population [19,20].

On the one hand, the results showed homogeneity between the sexes for the risk of falls; on the other hand, there is evidence that females are the group most exposed to hospitalization as a result of falls [21]. Considering the characteristics of the teaching hospital where this study was carried out, considered to have regulated admission, it cannot be said that the main reasons for hospitalization were falls; therefore, the similarity of risk between men and women should be better investigated in this context.

The mean age of the participants was similar to that of a systematic review with meta-analysis, in which older adults (70 to 81 years) constituted the group at highest risk of falls [22]. The literature highlights that the risk of falls is associated with age and their occurrence is greater in elderly individuals over 70 years old, due to the advanced decline in physical, sensory and cognitive functions resulting from aging [23].

Low levels of schooling predominated among the participants, highlighting socioeconomic conditions that can influence the health status of the elderly and their families, in addition to access to health information and preventive measures regarding falls [24].

A study carried out in three hospitals in the United States considered that the involvement of patients in understanding and implementing measures aimed at reducing the risk of falls is as important as the monitoring of measures by professionals and the availability of a good infrastructure. With the use of information tools such as printed posters, electronic posters and displays at the head of the bed with fall prevention information, there was an 80% adherence in the assimilation of the content and a consequent reduction in the number of falls [25].

The World guidelines for falls prevention and management for older adults [13] reinforces that involving the elderly is essential for the success in preventing falls; therefore, the elderly person's level of schooling is essential for educational actions to be effective.

The main reasons for hospitalization of elderly people in the analyzed units were pain and surgical treatment, conditions that require attention from the multidisciplinary team in terms of promoting educational measures during the period of hospital stay of the elderly person and their caregiver. Recent studies indicate that more than half of hospitalized patients report moderate to severe pain, regardless of the cause. A survey carried out in a hospital in Sorocaba found an overall prevalence of 41.2% of hospitalizations due to pain [26]. Another study on the prevalence of pain in hospitals in Italy disclosed that 46.6% of the evaluated patients suffered from intense pain, data that are similar to those found in the present study [27].

Regarding the surgical treatment, a survey carried out in a northeastern Brazilian state [28] supports the results of this study, showing that the main causes of hospitalization were surgical procedures. This health scenario results in high hospitalization rates for elderly individuals, prolonging the time spent in hospital beds, which can increase the risk of falls.

Among the diseases that were self-reported by the research participants, high blood pressure was the most common one, considered a risk factor for falls in the elderly. High blood pressure can lead to changes in blood circulation and compromise adequate blood flow to the brain, resulting in dizziness and imbalance, thus contributing to the risk of falls [29].

The average hospital length of stay for the elderly in this study was 16.7 days. Previous studies reported that the average length of stay varied between 7 and 15 days [30,31]. One of the factors that prolongs the hospital length of stay is the delay in receiving definitive treatment. This prolonged length of stay can harm the patients' balance, increasing the risk of falls in the hospital environment [32]

In the analysis of the Morse Falls Scale items, it was observed that 88.9% of those investigated reported not having suffered a fall in the previous year, which is considered a positive factor, given that elderly people who have suffered a fall in the last six months are more prone to occasional falls than those who have not suffered any falls [33].

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However, conditions that increase the occurrence of falls were identified, such as secondary diagnosis (88.9%) and use of intravenous medication (60.0%). The use of medications is considered to increase falls; in addition to being an extrinsic risk factor that occasionally causes psychomotor and physiological changes, it is also an intrinsic factor resulting from the individual's specificities [34].

It is noteworthy that some favorable points were identified regarding the items support for moving and mental state, with the majority of participants demonstrating awareness of their capabilities. However, a significant number of participants showed weakened gait (35.6%) and required support (6.7%), contributing to the incidence of falls due to limitations associated with deficits in balance and locomotion, requiring assistance care to prevent possible damage [33].

Moderate and high risk of falls corresponded to more than half of the elderly individuals investigated in this research (61.1%). These findings corroborate the Brazilian study carried out with 284 elderly people hospitalized in different sectors of a university hospital, in which 79.9% of the participants had a moderate or high risk of falls [33], and the study carried out in China with 153 elderly people hospitalized from 2018 to 2020, in which 88.89% of the participants showed a moderate or high risk of falls [35].

Only the age group variable showed statistical evidence of association with the risk of falls, and when using the high risk of falls as a reference, no difference was observed between the groups, according to the multiple regression analysis. A systematic review with meta-analysis that proposed evaluating 22 factors and their associations with the risk of falls, observed that among the analyzed factors, advanced age considerably increases the risk of falling [22]. A prospective study carried out in the United Kingdom with 3,298 elderly people, in a multivariate analysis of 17 factors, showed that only advanced age was associated with an increased risk of falls for both sexes [36].

Therefore, investigating the factors associated with the risk of falls in the hospitalized elderly population is a measure that positively contributes to the quality of health care, as it allows monitoring the event and developing effective strategies that reduce the occurrence of falls in the hospital environment and ensure patient safety [37].

Falls in the elderly are often attributed to the lack of adequate clinical conditions, an unsafe environment or a combination of these factors [38]. Therefore, when evaluating the hospital environment, it is crucial to consider the organization and physical structure of common areas, such as corridors, to ensure spaces that meet the needs of older adults [24].

Nurses and doctors from an oncology care unit in Kansas (USA) reinforce the relevance of adequate physical and material structure for patient safety and to reduce the risk of falls, such as the availability of wheelchairs in quantities that are proportional to the number of at-risk patients; offering walking belts to assist with the stability of frail elderly people; standardized signaling on walls and floors to inform the risk of falls [38].

Regarding the assessment of the physical structure, both individual and collective, of the studied hospital unit, the majority of facilities comply with the standard [15], which defines the criteria and technical parameters for projects, constructions, installations and adaptations of buildings, furniture, spaces and urban equipment to ensure accessibility. However, there are still some irregularities in the hospital environments as shown in this study, such as non-functioning bells in beds.

By ensuring the presence of essential features such as protective railings, bedside lights, and accessible switches, healthcare facilities can significantly reduce the risk of falls and promote an environment conducive to patient recovery and well-being [39]. These measures demonstrate a commitment to patient safety, providing ideal conditions for multidisciplinary care and the comfort of hospitalized individuals [40]. A study carried out in 12 public hospitals in Malaysia [41] disclosed significant extrinsic factors that led to falls in elderly people, including the absence of a transfer bar by the toilet and a bell.

The analysis of the present research found irregularities in the studied units, which can increase the risk of falls in the elderly, such as standard height toilet bowls, slippery floors and uneven flooring at the entrance to the bathroom. Only one bathroom had fall risk signs and support bars near the shower, and not all bathrooms had a shower chair. In a national study [42] carried out in a hospital

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in southern Brazil, problems related to the physical structure of the institution were found, such as the lack of support bars and water leaks in the bathrooms.

These findings are in line with a study carried out in Australia [43], which identified slippery floors in bathrooms and the presence of water or body substances on these surfaces as the main causes of falls among the elderly. Corroborating these findings, another study [41] identified irregularities also related to bathrooms, with the absence of a support bar in the toilet.

To reduce environmental risks that expose elderly people to fear of falling or the fall itself, researchers have supported the development of technologies such as wireless network sensors, which are attached to the patient and detect the patient leaving the bed. or chair and sends direct signals to the nursing team, so that monitoring and preventive measures can be carried out at the earliest possible moment [44,45].

In Iran, a tiered randomized controlled trial involving 33,856 patients from a university hospital assessed the effectiveness of multiple interventions in reducing fall rates in these patients, such as staff training, adequate lighting, supervision of high-risk patients during transfers, use of mobility devices, placement of a bell and security in bathrooms, placing "fall warning" signs above patient beds, encouraging the appropriate use of glasses, hearing aids and shoes, keeping the side rails elevated, and reassessing patients after each fall. As a result, a decrease in the fall rate was observed from 4 per 1,000 patient-days to 1.34 per 1,000 patient-days [46].

In a case-control study carried out between 2013 and 2019, the costs of inpatient falls and the cost savings associated with the implementation of an evidence-based fall prevention program implemented in 33 medical and surgical units in eight hospitals of two US healthcare systems were analyzed. The software was associated with savings of $22 million at the study sites over the five-year study period and prevented 50 excess deaths [47].

A non-randomized clinical trial developed in 14 medical units in New York, between 2015 and 2018, proposed evaluating a toolkit led by nurses and involving patients and family members in the process of preventing falls during hospitalization. A total of 37,231 patients were evaluated; of these, 17,948 before the intervention and 19,283 after the intervention, and a significant association was verified with the reduction in falls [48].

In Spain, a quasi-experimental study with a non-randomized control group, carried out in 2015, evaluated the effect of an educational intervention led by hospital nurses on the systematic fall risk assessment in reducing the incidence of falls. For this purpose, an intervention group (n=303) and a control group (n=278) were formed. In the analysis, the intervention group was less likely to fall [49].

Therefore, improving the hospital structure can prevent fall events by ensuring that aspects of the hospitalized patient's environment (including flooring, lighting, furniture and accessories, such as hand rails) that can affect the patient's risk of falling are systematically identified and addressed [50]. Structural factors must be added to the multifactorial assessment and interventions, such as professional education, education and counseling for patients and family members, and strategies based on specific measures [19,51–53].

5. Conclusions

In conclusion, the moderate risk of falls in the elderly and the adequacy of the hospital environment to Brazilian technical standards were evident, with the exception of failures in the emergency communication system and sanitary installations. The early identification of environmental factors and the implementation of appropriate preventive measures are essential to reduce the incidence of falls during hospital stay and promote safe care for elderly patients.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org.

Author Contributions: Conceptualization, Leane Carvalho, Letície Lira and Ana Larissa Machado; Data curation, Lairton Oliveira, Annarelly Mendes and Francisco Gilberto Pereira; Formal analysis, Leane Carvalho, Letície Lira and Ana Larissa Machado; Investigation, Leane Carvalho and Letície Lira; Methodology, Leane Carvalho, Letície Lira and Ana Larissa Machado; Resources, Lairton Oliveira, Annarelly Mendes and Francisco

Gilberto Pereira; Supervision, Francisco Gilberto Pereira, Francisca Galiza, Lívia Pereira and Ana Larissa Machado; Writing – original draft, Lairton Oliveira, Annarelly Mendes, Francisco Gilberto Pereira and Ana Larissa Machado; Writing – review & editing, Francisco Gilberto Pereira, Francisca Galiza, Lívia Pereira and Ana Larissa Machado. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: All subjects gave their informed consent for inclusion before they participated in this study.

Data Availability Statement: All studies in our study are included in the Supplementary Materials.

Conflicts of Interest: The authors declare no conflicts of interest.

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