

# Anticholinergic Burden in Hospitalized Older Adults with In-hospital Falls: A Cross-sectional Study

Carga Anticolinérgica em Idosos Hospitalizados com Quedas Intrahospitalares: Um Estudo Transversal

Carga Anticolinérgica en Adultos Mayores Hospitalizados con Caídas Intrahospitalarias: Un Estudio Transversal

## RESUMO

**Objetivo:** Analisar a carga anticolinérgica em idosos hospitalizados que sofreram quedas, relacionando-a a idade, sexo, polifarmácia e tempo de internação. É um dos primeiros estudos a acompanhar a carga em quatro momentos da hospitalização. **Métodos:** Estudo retrospectivo e transversal em hospital universitário do sul do Brasil. Foram revisados prontuários de pacientes  $\geq 60$  anos com quedas entre janeiro/2023 e janeiro/2024. A carga foi calculada pela Escala Brasileira de Atividade Anticolinérgica em quatro momentos: antes da internação, no primeiro dia, um dia antes e no dia da queda. **Resultados:** Identificaram-se 37 quedas em 32 pacientes (mediana: 68 anos; 71,9% homens). Conciliação medicamentosa ocorreu em 90,6% dos casos. Uso prévio de fármacos crônicos foi de 78,1%, e 40,6% tinham polifarmácia. Houve aumento significativo da carga, associado à idade e ao tempo de internação. **Conclusão:** O aumento progressivo da carga reforça a importância da revisão farmacoterapêutica e da desprescrição.

**DESCRIPTORES:** carga anticolinérgica; escala anticolinérgica; idosos; quedas.

## ABSTRACT

**Objective:** To analyze anticholinergic burden in hospitalized older adults with falls, examining associations with age, sex, polypharmacy, and length of stay. This is among the first studies to monitor burden at four points during hospitalization. **Methods:** Retrospective, cross-sectional study at a university hospital in southern Brazil. Records of patients  $\geq 60$  years with in-hospital falls (Jan/2023–Jan/2024) were reviewed. Burden was measured using the Brazilian Anticholinergic Activity Drug Scale at four points: before admission, first day, one day before, and on the fall day. **Results:** Thirty-seven falls occurred in 32 patients (median: 68 years; 71.9% male). Medication reconciliation was documented in 90.6% of cases. Chronic drug use was present in 78.1%, and 40.6% met polypharmacy criteria. Burden increased significantly, associated with age and length of stay. **Conclusion:** The progressive burden growth highlights the need for a review of pharmacotherapy and deprescribing.

**DESCRIPTORS:** anticholinergic burden; anticholinergic scale; older adults; falls.

## RESUMEN

**Objetivo:** Analizar la carga anticolinérgica en adultos mayores hospitalizados con caídas, evaluando su asociación con edad, sexo, polifarmacia y tiempo de internación. Es uno de los primeros estudios en monitorear la carga en cuatro momentos de la hospitalización. **Métodos:** Estudio retrospectivo y transversal en hospital universitario del sur de Brasil. Se revisaron historias clínicas de pacientes  $\geq 60$  años con caídas entre enero/2023 y enero/2024. La carga se calculó con la Escala Brasileña de Actividad Anticolinérgica en cuatro momentos: antes del ingreso, primer día, un día antes y el día de la caída. **Resultados:** Se registraron 37 caídas en 32 pacientes (mediana: 68 años; 71,9% hombres). La conciliación medicamentosa se realizó en 90,6% de los casos. El 78,1% usaba fármacos crónicos y 40,6% tenía polifarmacia. Hubo aumento significativo de la carga, asociado con edad y tiempo de internación. **Conclusión:** El incremento progresivo refuerza la necesidad de revisión farmacoterapéutica y desprescripción.

**DESCRIPTORES:** carga anticolinérgica; escala anticolinérgica; adultos mayores; caídas.

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## INTRODUCTION

The increase in life expectancy of the global population is intrinsically linked to the rise in Chronic Non-Communicable Diseases (NCDs), which, in turn, contributes to the increase in polypharmacy prevalence, commonly defined as the concomitant use of five or more medications<sup>(1)</sup>. Polypharmacy, especially among older adults, significantly raises the risk of adverse events, including the use of Potentially Inappropriate Medications (PIMs), prolonged hospital stays, and declines in both cognitive and motor functions<sup>(2)</sup>.

When combined with polypharmacy, the inherent frailty associated with advanced age increases the risk of falls, which represent the third most reported adverse event to the Brazilian National Health Surveillance Agency (ANVISA). Falls in older adults are associated with significant morbidity and mortality, disproportionately affecting men, who tend to have more extended hospital stays and generate higher public healthcare costs<sup>(3)</sup>.

Evaluating medication prescriptions

in older adults, including identifying PIMs, is crucial to preventing falls. Tools such as the Beers Criteria<sup>(2)</sup> and STOPP/START Criteria<sup>(4)</sup> are important references for identifying PIMs, which include anticholinergic properties.

Anticholinergics are frequently prescribed to older adults, with some studies reporting a prevalence as high<sup>(5,6)</sup>. The use of medications with anticholinergic activity is associated with adverse effects on the central nervous system, such as delirium, hallucinations, cognitive decline, and loss of functional capacity, which can predispose individuals to falls and increase morbidity and mortality<sup>(7,8,9)</sup>. The cumulative effect of such medications is referred to as Anticholinergic Burden (AC), which can be quantified by tools such as the Brazilian Scale of Medications with Anticholinergic Activity (EBMAA)<sup>(10)</sup>.

Although several anticholinergic assessment scales have been proposed, their practical application in the patient's pharmacotherapeutic assessment still needs to be investigated. The EBMAA, for example, has the advantage of covering medications commonly used in Brazil

and is recognized for its ease of use and accuracy<sup>(10)</sup>.

This retrospective observational study aims to analyze the relationship between anticholinergic burden and in-hospital falls among older adults, contributing to clinical practice by providing data on the prevalence and factors associated with AC within a Brazilian hospital setting. Quantifying AC with validated scales can assist in identifying PIM prescriptions with anticholinergic activity and measuring the risk associated with using these drugs. Thus, this study aimed to analyze the AC profile in older adult patients who suffered a fall during hospitalization and relate the risk factors associated with this adverse event.

## METHOD

This study is a retrospective, cross-sectional, observational investigation that employs both quantitative and qualitative approaches. The study was conducted at the University Hospital of Santa Maria (HUSM), Santa Maria, RS, Brazil, after approval by the Ethics Committee (approval number 75753423.5.0000.5346).

Falls that occurred in older adults (age  $\geq 60$  years) as reported in the Health Surveillance and Hospital Care Risk Management System (Sistema de Vigilância em Saúde e Gestão de Riscos Assistenciais Hospitalares, VIGHOSP) between January 1, 2023, and January 31, 2024, were selected. This period was selected due to the launch of the Elderly Care Line at the institution, a program designed to enhance safety and care practices for older adults. The medical records were reviewed via the University Hospital Management Application (AGHUX) to verify the admission history and medication reconciliations. Prescriptions were analyzed at the following times: the day of hospitalization, 24 hours prior to the fall, and on the day of the fall, calculating the AB in each situation, as well as the AB prior to hospitalization when available.

The dependent variable was the AB, determined by the Brazilian Scale of Medications with Anticholinergic Activity (EBMAA)<sup>(10)</sup>. The EBMAA is composed of 273 drugs classified into three levels: 1 (mild anticholinergic activity), 2 (moderate), and 3 (strong). The independent variables were sex, marital status, race, previous use of medications, place of hospitalization, medical specialty, and length of stay. The inclusion criteria included patients aged  $\geq 60$  who experienced a fall during hospitalization. The exclusion criteria were patients aged  $< 60$  years and outpatient falls.

Data were analyzed using GraphPad Prism 5 statistical software (GraphPad Software Inc., San Diego, CA, USA). The normality of the variables was assessed using the Shapiro-Wilk test. Continuous variables with a non-normal distribution were presented as median (interquartile range), while categorical variables were presented as frequencies and percentages. The Mann-Whitney U test was used to compare numerical variables.

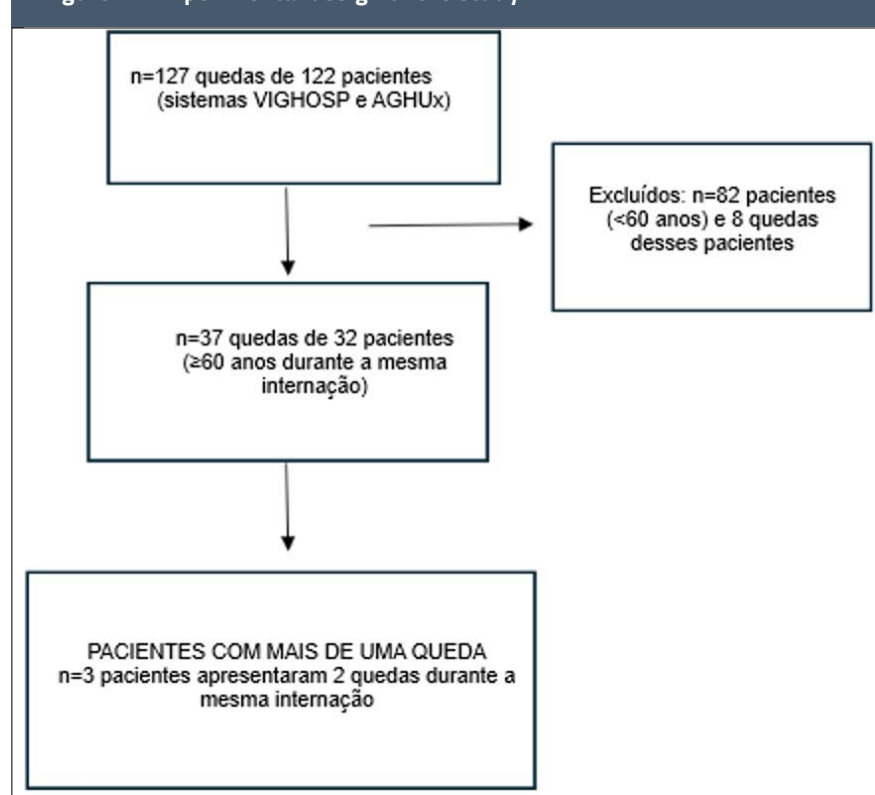
Possible relationships between anticholinergic burden at different time points and non-parametric quantitative and qualitative variables were assessed

using Spearman's correlation and Chi-square tests, respectively. Correlations were classified as weak ( $r$  values between 0.10 and 0.39), moderate ( $r$  values between 0.40 and 0.69), or strong ( $r$  values between 0.70 and 1.00). The level of significance adopted was 5% ( $p < 0.05$ ).

## RESULTS

Initially, 127 in-hospital falls were identified among 122 patients. After applying inclusion and exclusion criteria, 37 falls remained, involving 32 patients; three had two falls, and one had three falls during the same hospitalization period. Figure 1 outlines the study flowchart detailing the inclusion and exclusion criteria applied in the study design.

**Figure 1 – Experimental design of the study.**



Source: Prepared by the author.

Table 1 presents the general, clinical, and demographic characteristics of the patients studied, specifically the older adult individuals who suffered falls ( $n = 32$ ). Thus, 71.9% of the participants were male, and a heterogeneous sample of older adults was observed, with a median age of 68 (range, 66.5-74.5). Medication reconciliation was performed in 90.6% of cases, with 78.1% of patients using at least one medication prior to hospitalization and 40.6% using five or more medications, indicating polypharmacy.

Since all analyzed falls occurred during hospitalization, 43.2% occurred in the Surgical Ward. Among medical specialties, the vascular specialty had the highest number of patients who experienced falls (27%), followed by internal medicine (19%). Notably, 13.5% of the patients died during hospitalization, corresponding to 4 of the 32 patients. One of these patients experienced two falls. The median length of hospital stay was 17 days.

**Table 1 – General, clinical, and demographic characteristics of the patients studied.**

| Variable                                       | n (%)          |
|------------------------------------------------|----------------|
| Sociodemographic Characteristics (n=32)        |                |
| Male sex                                       | 23 (71.9)      |
| Age (years), median (IQR)                      | 68 (66.5-74.5) |
| Race, n (%)                                    |                |
| White                                          | 30 (93.8)      |
| Mixed race                                     | 2 (6.2)        |
| Marital Status, n (%)                          |                |
| Married                                        | 14 (43.7)      |
| Single                                         | 8 (25.0)       |
| Widowed                                        | 6 (18.8)       |
| Other                                          | 4 (12.5)       |
| Previous Medication Use, n (%)                 |                |
| Yes                                            | 7 (21.9)       |
| No                                             |                |
| Polypharmacy                                   | 13 (40.6)      |
| Medication Reconciliation, n (%)               | 29 (90.6)      |
| Hospitalization (n=37 falls)                   |                |
| Location, n (%)                                |                |
| Surgical Clinic                                | 16 (43.2)      |
| Emergency Room                                 | 9 (24.3)       |
| Medical Clinic II                              | 5 (13.5)       |
| Paulo Guedes Unit                              | 3 (8.2)        |
| Medical Clinic I                               | 2 (5.4)        |
| Adult Intensive Care Unit                      | 2 (5.4)        |
| Medical Specialty, n (%)                       |                |
| Vascular                                       | 10 (27.0)      |
| Medical Clinic                                 | 7 (19.0)       |
| Psychiatry                                     | 5 (13.5)       |
| Geriatrics                                     | 3 (8.1)        |
| General Surgery                                | 3 (8.1)        |
| Other <sup>1</sup>                             | 9 (24.3)       |
| Deaths, n (%)                                  |                |
| No                                             | 28 (87.5)      |
| Yes                                            | 4 (12.5)       |
| Length of hospitalization (days), median (IQR) | 17 (9-27)      |

Values are expressed as frequency and percentage or median (interquartile range).

IQR = interquartile range

<sup>1</sup> = Intensive Care Unit, Gastroenterology, Hematology, Oncology, Head and Neck Surgery, Gynecology, Nephrology, Cardiology.

\*37 falls from 32 patients. Source: Prepared by the author.

Fall-related data are shown in Table 2. The most frequent risk factor was advanced age (78.4%), followed by clinical comorbidities (67.6%) and cognitive impairment (48.6%). The median number of risk factors per patient was 2 (IQR: 2–3). Regarding the nature of the falls, 43.2% occurred from standing height, and

56.7% took place in the patient's hospital room. Additionally, 40% of the falls happened within the first three days of admission. The Morse Fall Scale<sup>(11)</sup> is routinely employed at this institution to assess fall risk and implement safety interventions.

However, in 21.6% of the cases, the Morse Scale was not applied, poten-

tially limiting the implementation of preventive measures. Quantitatively, 10.8% of patients experienced more than one fall during hospitalization. The median number of days of hospitalization after the fall was 10 (IQR).

**Table 2 – Data related to the occurrence of falls in elderly patients in a teaching hospital.**

| Variables related to falls                                      | n=37 falls |
|-----------------------------------------------------------------|------------|
| Risk factors for falls, n (%)                                   |            |
| Age                                                             | 29 (78.4)  |
| Diagnosis                                                       | 25 (67.6)  |
| Medication                                                      | 15 (40.5)  |
| Cognitive factor                                                | 18 (48.6)  |
| Number of risk factors, median (IQR)                            | 2 (2–3)    |
| Cognitive, emotional, and social factors, n (%)                 |            |
| Yes                                                             | 21 (56.8)  |
| No                                                              | 16 (43.2)  |
| Characteristics of the fall, n (%)                              |            |
| Same level fall                                                 | 16 (43.2)  |
| From the bed                                                    | 14 (37.8)  |
| During transport                                                | 2 (5.4)    |
| In the bathroom                                                 | 2 (5.4)    |
| Other                                                           | 2 (5.4)    |
| Not reported                                                    | 1 (2.8)    |
| *Location of the fall, n (%) **                                 |            |
| Patient room                                                    | 21 (56.7)  |
| Bathroom                                                        | 12 (32.4)  |
| Hallway                                                         | 6 (16.2)   |
| Occurrence of more than one fall, n (%)                         | 4 (10.8)   |
| Occurrence of fall on the first day of hospitalization, n (%)   | 4 (10.8)   |
| Occurrence of falls within three days of hospitalization, n (%) |            |
| No                                                              | 22 (59.5)  |
| Yes                                                             | 15 (40.5)  |
| Length of hospital stay after the fall (days), median (IQR)     | 10 (4–13)  |

Values are expressed as frequency and percentage, or as median (with interquartile range).

\*Falls may have occurred in more than one location.

Source: Prepared by the author.

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Regarding pharmacological therapy, medication use was assessed at

four times: prior to hospitalization, on the first day of hospitalization, one day before the fall, and the day of the fall (Table 3). Prior to hospitalization, patients used a median of 4 medications (IQR), and 37.0% (10/27) had a pre-admission AB classified as level

3 (high) according to the EBMAA.

On the first day of hospitalization, the median number of prescribed medications increased to 7, and the proportion of patients with AB 3 rose to 62.2% (23/37). One day before and on the day of the fall, the

median number of medications rose to 10 (IQR), and the prevalence of AB 3 reached 75.6% (28/37) on the day of the fall. The most used drug classes with anticholinergic activity prior to admission were antipsychotics, beta-blockers, benzodiazepines, diuretics, anticonvulsants, and anti-

depressants.

On the first day of hospitalization, all patients had opioids prescribed (100%), followed by benzodiazepines (54.1%), antipsychotics (51.3%), and prokinetics (metoclopramide) (43.2%). One day before the fall, opioids remained the most prescribed

class (56.8%), with benzodiazepines (48.6%) and antipsychotics (40.5%) also maintaining high frequency. On the day of the fall, this pattern remained consistent: opioids (51.3%), benzodiazepines (48.6%), and antipsychotics (40.5%).

**Table 3 – Characteristics of the medications used by elderly patients who experienced falls during hospitalization in a teaching hospital.**

| Variables (n=37 falls)       | Prior to hospitalization (%) | First prescription during hospitalization (%) | One day before the fall (%) | Day of the fall (%) |
|------------------------------|------------------------------|-----------------------------------------------|-----------------------------|---------------------|
| Anticholinergic burden n (%) | n=27                         | n=37                                          | n=33                        | n=37                |
| 0 points                     | 9                            | 1                                             | 1                           | 1                   |
| 1-2 points                   | 8                            | 13                                            | 5                           | 8                   |
| ≥ 3 points                   | 10                           | 23                                            | 27                          | 28                  |
| Drug class                   | Prior to hospitalization (%) | First prescription during hospitalization (%) | One day before the fall (%) | Day of the fall (%) |
| Antibiotic                   | -                            | 3 (8.1)                                       | 6 (16.2)                    | 6 (16.2)            |
| Anticholinergic              | 1 (2.7)                      | -                                             | 5 (13.5)                    | 5 (13.5)            |
| Anticonvulsant               | 5 (13.5)                     | 3 (8.1)                                       | -                           | 3 (8.1)             |
| Antidepressant               | 4 (10.8)                     | 3 (8.1)                                       | 3 (8.1)                     | 3 (8.1)             |
| Atypical antidepressant      | 3 (8.1)                      | -                                             | -                           | -                   |
| SSRI antidepressant          | 1 (2.7)                      | -                                             | -                           | -                   |
| Antiemetic                   | -                            | 1 (2.7)                                       | -                           | -                   |
| Antihypertensive             | -                            | -                                             | 3 (8.1)                     | 4 (10.8)            |
| Antihistamine                | 2 (5.4)                      | 4 (10.8)                                      | 2 (5.4)                     | 2 (5.4)             |
| Antipsychotic                | 7 (18.9)                     | 19 (51.3)                                     | 15 (40.5)                   | 15 (40.5)           |
| Beta-blocker                 | 7 (18.9)                     | 4 (10.8)                                      | 7 (18.9)                    | 7 (18.9)            |
| Benzodiazepine               | 5 (13.5)                     | 20 (54.1)                                     | 18 (48.6)                   | 18 (48.6)           |
| Corticosteroid               | -                            | 2 (5.4)                                       | 4 (10.8)                    | 4 (10.8)            |
| Diuretic                     | 5 (13.5)                     | 2 (5.4)                                       | 8 (21.6)                    | 8 (21.6)            |
| Mood stabilizer              | 2 (5.4)                      | -                                             | 1 (2.7)                     | 1 (2.7)             |
| Opioid                       | 1 (2.7)                      | 37 (100)                                      | 21 (56.8)                   | 19 (51.3)           |
| Prokinetic (metoclopramide)  | -                            | 16 (43.2)                                     | 14 (37.8)                   | 14 (37.8)           |
| Not applicable               | 10 (27.0)                    | -                                             | -                           | -                   |
| Number of medications,       | 4.0 (0.7-5.2)                | 7.0 (6.0-10.0)                                | 10.0 (8.0-13.0)             | 10.0 (8.0-12.0)     |

Values expressed as frequency and percentage or median (interquartile range). SSRI = Selective Serotonin Reuptake Inhibitors; IQR = Interquartile Range.

Source: Prepared by the author.

Table 4 presents the relationship between the occurrence of falls and AB levels at different time points, assessed using the Mann-Whitney test. A statis-

tically significant increase in AB was observed from pre-admission to the first day of hospitalization ( $p = 0.0001$ ), indicating a substantial elevation in anticholinergic burden following admission to the hospital. Similarly, among patients who experienced multiple falls, a significant increase in AB was obser-

ved when comparing pre-admission levels to those on the day of the fall ( $p < 0.001$ ). However, there was no statistically significant difference between the AB levels recorded on different days in this latter group.

**Table 4 – Relationship between the occurrence of falls and anticholinergic burden at different time points.**

| Anticholinergic burden on the day of the fall <sup>a</sup> | p-value | r     |
|------------------------------------------------------------|---------|-------|
| Previous anticholinergic burden                            | 0.168   | 0.231 |
| Anticholinergic burden on the first day of hospitalization | 0.006*  | 0.539 |
| Occurrence of more than one fall <sup>b</sup>              | p-value |       |
| Previous anticholinergic burden                            | 0.018*  |       |
| Anticholinergic burden in the first prescription           | 0.010*  |       |
| Anticholinergic burden one day before the fall             | 0.123   |       |
| Anticholinergic burden on the day of the fall              | 0.063   |       |

<sup>a</sup>,Spearman's test. <sup>b</sup>, Chi-square test. Statistical significance at  $p < 0.05$ .

Source: Prepared by the author.

Table 5 examines the relationship between anticholinergic burden at various time points and factors such as age, sex, risk factors, length of hospital stay following the fall, total hospitalization time, medication reconciliation, in-hospital mortality, and whether the fall occurred within 3 days of admission. Table 5 shows no statistically significant associations between AB prior to admission or on the first day of hospitalization and the

observed variables. However, one day before the fall, AB was moderately associated with the presence of risk factors, including age, clinical diagnosis, medication use, and cognitive status ( $p = 0.048$ ,  $r = 0.352$ ), suggesting that a higher AB is linked to the presence of clinical vulnerabilities.

In addition, a significant association was found between prior medication use and AB ( $p = 0.015$ ). On the day of the fall, AB was significantly associated with age ( $p = 0.038$ ,  $r = 0.341$ ), total number of risk factors ( $p$

$= 0.011$ ,  $r = 0.414$ ), length of hospitalization ( $p = 0.020$ ,  $r = 0.381$ ), and falls that occurred within the first three days of admission ( $p = 0.021$ ). These correlation coefficients indicate moderate strength, suggesting a direct relationship between these variables and increased anticholinergic burden during the fall. No statistically significant associations were observed for sex, medication reconciliation, or mortality.

**Table 5 – Relationship between anticholinergic burden at different time points and study variables considering the occurrence of falls.**

| Anticholinergic burden prior to hospitalization (n = 27)            | Valor de p  |
|---------------------------------------------------------------------|-------------|
| Age <sup>a</sup>                                                    | $p = 0.978$ |
| Sex <sup>b</sup>                                                    | $p = 0.509$ |
| Risk factors#                                                       | $p = 0.122$ |
| Length of stay after the fall <sup>a</sup>                          | $p = 0.115$ |
| Total length of stay <sup>a</sup>                                   | $p = 0.278$ |
| Medication reconciliation <sup>ab</sup>                             | $p = 0.244$ |
| Death <sup>b</sup>                                                  | $p = 0.935$ |
| Fall within 3 days after admission <sup>b</sup>                     | $p = 0.076$ |
| Anticholinergic burden at the first inpatient prescription (n = 32) | Valor de p  |
| Age <sup>a</sup>                                                    | $p = 0.526$ |
| Sex <sup>b</sup>                                                    | $p = 0.647$ |
| Risk factors <sup>a</sup>                                           | $p = 0.785$ |
| Previous medication use <sup>b</sup>                                | $p = 0.971$ |
| Length of stay after the fall <sup>a</sup>                          | $p = 0.333$ |
| Total length of stay <sup>a</sup>                                   | $p = 0.308$ |
| Medication reconciliation <sup>ab</sup>                             | $p = 0.722$ |

|                                                         |                     |
|---------------------------------------------------------|---------------------|
| Death <sup>b</sup>                                      | p = 0.293           |
| Fall within 3 days after admission <sup>b</sup>         | p = 0.237           |
| Anticholinergic burden one day before the fall (n = 52) | Valor de p          |
| Age <sup>a</sup>                                        | p = 0.151           |
| Sex <sup>b</sup>                                        | p = 0.185           |
| Risk factors <sup>a</sup>                               | p = 0.048*r = 0.352 |
| Previous medication use <sup>b</sup>                    | p = 0.015*          |
| Length of stay after the fall <sup>a</sup>              | p = 0.333           |
| Total length of stay <sup>a</sup>                       | p = 0.157           |
| Medication reconciliation <sup>ab</sup>                 | p = 0.281           |
| Death <sup>b</sup>                                      | p = 0.769           |
| Fall within 3 days after admission <sup>b</sup>         | p = 0.646           |
| Anticholinergic burden on the day of the fall (n = 32)  | Valor de p          |
| Age <sup>a</sup>                                        | p = 0.038*r = 0.341 |
| Sex <sup>b</sup>                                        | p = 0.897           |
| Risk factors <sup>a</sup>                               | p = 0.011*r = 0.414 |
| Previous medication use <sup>b</sup>                    | p = 0.384           |
| Length of stay after the fall <sup>a</sup>              | p = 0.111           |
| Total length of stay <sup>a</sup>                       | p = 0.020*r = 0.381 |
| Medication reconciliation <sup>ab</sup>                 | p = 0.149           |
| Death <sup>b</sup>                                      | p = 0.317           |
| Fall within 3 days after admission <sup>b</sup>         | p = 0.021*          |

<sup>a</sup> Spearman's test. <sup>b</sup> Chi-square test. Statistical significance at p < 0.05.

# Risk factors: Age, diagnosis, medications, and cognitive factors. Source: Prepared by the author.

## DISCUSSION

This study identified a significant association between AB and the risk of in-hospital falls among older adults. The AB showed a progressive increase during hospitalization: 37% of patients had a high AB (score  $\geq 3$ ) before admission, rising to 62.2% on the first day of hospitalization and reaching 75.6% on the day of the fall. Polypharmacy was observed in 40.6% of cases, with most falls occurring in male patients (71.9%), particularly in the surgical ward (43.2%) and in the vascular specialty (27%).

Falls within the first three days of hospitalization were significantly associated with higher AB levels (p = 0.021), suggesting a rapid pharmaco-

logical impact following hospital admission. The most prescribed anticholinergic drug classes included opioids (100%), benzodiazepines (54.1%), antipsychotics (51.3%), and prokinetics (43.2%). Among the 37 falls analyzed, 23 occurred in patients with an AB  $\geq 3$ . Furthermore, AB was significantly associated with factors such as age (p = 0.038), clinical risk factors (p = 0.011), and length of hospital stay (p = 0.020), indicating that prolonged hospitalization may contribute to increased AB and, consequently, to a heightened risk of falling.

From a methodological standpoint, including a larger sample in future studies could enhance the robustness of the findings and facilitate more refined comparative analyses, such as the inclusion of a control group. Additionally, underreporting bias should be considered, as some falls may have gone unreported during the study period

despite the institution's requirement for mandatory reporting through the VIGIHOSP system.

Nevertheless, AB assessment proved to be a practical and consistent parameter for evaluating fall risk, even when measured prior to admission. Medication reconciliation also emerged as an essential strategy for identifying pre-existing vulnerabilities and monitoring polypharmacy, a known contributor to increased AB. Although reconciliation was performed in 90.6% of cases, and 78.1% of patients were on chronic medications prior to admission, most records lacked detailed information on dosage and administration schedules, which limited further analysis. This limitation is notable, as the literature highlights that the anticholinergic effects of medications are significantly influenced by daily dosage<sup>(7)</sup>.

Polypharmacy was identified in 40.6% of patients, with a median of

four medications used prior to hospitalization. This finding aligns with estimates from a systematic review and meta-analysis by Delara et al.<sup>(12)</sup>, which reported a prevalence of polypharmacy of 37% in older adults. While the conventional definition of polypharmacy involves the use of five or more medications and emphasized a more nuanced concept, defining polypharmacy as the use of one or more potentially inappropriate medications<sup>(2,12)</sup>. This definition aligns with the Beers Criteria<sup>(2)</sup>, highlighting anticholinergic medications as inappropriate for older adults. Complementing this approach, the STOPP/START criteria<sup>(5)</sup> offer a valuable framework for initiating appropriate therapies and deprescribing when necessary.

A substantial increase in anticholinergic medication use was observed from admission onward, with the median number rising from four to seven drugs. These findings suggest a gap in healthcare professionals' awareness of the adverse implications of anticholinergic agents. These drugs are associated with cognitive and functional decline, increased risk of falls, morbidity, mortality, and institutionalization, particularly due to their cumulative effect<sup>(2,8,12)</sup>. Addressing these risks requires continuous medication review, deprescribing, and careful attention to hospital prescribing patterns<sup>(9)</sup>. Notably, in this study, all patients received opioids during hospitalization, and benzodiazepine use increased markedly from 13.5% pre-admission to 54.1% post-admission.

Virnes et al.<sup>(13)</sup> reported a higher incidence of postoperative falls due to the use of sedatives, opioids, and anesthetics. These findings are echoed in the present study, where opioids, benzodiazepines, antipsychotics, antihistamines, and beta-blockers were commonly prescribed. Although most falls occurred in the surgical ward, particularly within the vascular specialty, this may be attributed to a higher patient volume ra-

ther than a specific team-related factor. Nonetheless, a more detailed analysis of perioperative prescribing patterns would be warranted.

Risk factors associated with falls, such as advanced age, comorbidities, cognitive impairment, and medication use, are consistent with those identified in previous studies<sup>(14, 15)</sup>. A central variable in this study, AB, was measured using the EBMAA scale, which categorizes medications by anticholinergic activity as mild (+1), moderate (+2), or strong (+3). Table 3 demonstrates that 37% of patients already had a high AB ( $\geq 3$ ) at baseline, with a steady increase during hospitalization. According to Wong et al.<sup>(6)</sup>, an AB  $\geq 3$  is associated with increased risks of cognitive and functional decline, falls, and mortality, findings also supported by other authors<sup>(5, 6, 16)</sup>.

Following hospital admission, the proportion of patients with AB 3 increased to 62.2% and 75.6% on the day of discharge. Notably, AB reflects the cumulative score of all prescribed anticholinergic medications, meaning that even medications with lower scores can collectively result in a high overall burden. This cumulative effect is well-documented in the literature<sup>(16, 17, 18)</sup>.

On the day of the fall, age, presence of risk factors, duration of hospitalization, and falls occurring within the first three days of admission were all significantly associated with higher AB. These findings are consistent with previous research that identifies these variables as strong predictors of falls in older patients<sup>(4)</sup> and reinforce the importance of including such data in hospital safety monitoring systems, such as VIGIHOSP.

Although falls resulting in death are considered 'never events' (adverse outcomes deemed preventable and unacceptable in healthcare settings), no statistically significant association was found between AB and mortality in this study. These results are consistent with prior findings and may be attribu-

table to the study design or analytical approach<sup>(14)</sup>.

Despite this, the study reinforces the need to monitor inappropriate medication use in older adults. Medica-

tion reconciliation remains a critical strategy for detecting polypharmacy, and the application of validated scales, such as EBMAA, may aid in identifying both baseline and increased AB acquired during hospitalization. Stewart et al.<sup>(18)</sup> emphasize the use of these tools in conjunction with multidisciplinary care teams to guide deprescribing decisions, minimize exposure duration, educate patients, and assess over-the-counter medications, such as antihistamines. Collaborative, multidisciplinary efforts are crucial for optimizing prescriptions and ensuring medication safety in hospitalized older adults.

From a scientific standpoint, further studies with larger sample sizes are needed. However, these results support the need for longitudinal investigations to better understand the long-term clinical and functional consequences of anticholinergic burden in older adults. Research examining institutional and structural variables, such as medication review protocols and integration of AB assessments into fall prevention strategies, may provide valuable insights for improving hospital care.

## CONCLUSION

This study found a statistically significant association between high anticholinergic burden and early in-hospital falls among older adults. These findings highlight the need for rigorous medication review before and during hospitalization to support deprescribing and promote safer prescribing practices. Although the cross-sectional design and absence of a control group preclude causal inference, the results underscore the importance of monitoring anticholinergic burden as a patient safety parameter. Further prospective, controlled studies are warranted

to clarify its impact on fall prevention and guide the development of hospital protocols and deprescribing strategies aimed at reducing preventable adverse events in older inpatients.

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