



Artículo de investigación

## Riesgo de caídas e incidencia de delirio en pacientes hospitalizados en el servicio de ortopedia

### Fall risk and incidence of delirium in hospitalized orthopedic patients

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#### RESUMEN

**Introducción:** el riesgo de caídas y de lesiones relacionadas, así como el de presentar delirio, representan un problema de salud pública en constante aumento, en especial en sociedades con una población que envejece. **Objetivo:** el propósito de este estudio fue evaluar el nivel de riesgo de caídas, previo a cirugía de cadera o rodilla, y la frecuencia de desarrollar delirio después de las intervenciones quirúrgicas. **Materiales y métodos:** estudio observacional, analítico de corte transversal en el que se encuestaron pacientes hospitalizados en la Clínica de Cirugía Ortopédica y Traumatología, Novi Sad, Serbia, entre el inicio de diciembre de 2022 y fin de enero de 2023. **Resultados:** del número total de pacientes (N = 106), la mayoría (61.3%) tenían más de 70 años, de los cuales la mayor parte eran de sexo femenino (N = 80 (75.5%). El porcentaje más alto de los que respondieron la encuesta fueron categorizados en nivel II de riesgo de caída (73.6%), mientras que se clasificó como nivel I

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y III a 14 pacientes en cada uno de dichos niveles (13.2%). Los resultados del puntaje 4AT evidenciaron que en la mayoría de los pacientes (N = 50 47.2%) la probabilidad de presentar delirio o deterioro cognitivo fue baja, con posibles deterioro cognitivo en 40 (37.7%) y delirio en 16 (15.1%). *Conclusión:* los pacientes hospitalizados en el servicio de ortopedia de la Clínica de Cirugía Ortopédica y Traumatología del Centro Clínico Universitario de Vojvodina tenían riesgo de caída nivel II, con baja probabilidad de presentar deterioro cognitivo o delirio en el posoperatorio.

*Palabras clave:* riesgo de caídas, delirio, enfermería, pacientes de ortopedia.

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## ABSTRACT

*Introduction:* The fall risk and fall-related injuries, as well as the risk of developing delirium, represent a constantly increasing public health problem, especially in societies with an aging population. *Objective:* This study aimed to assess the level of risk for falls in patients before hip or knee surgery and the frequency of delirium after hip or knee surgery. *Materials & Methods:* The study was conducted as an observational, analytical cross-sectional study by surveying hospitalized patients at the Clinic for Orthopedic Surgery and Traumatology, Novi-Sad, Serbia, between the beginning of December 2022 and the end of January 2023. *Results:* From the total number of patients (N = 106), the majority (61.3%) were over 70 years of age, of which the largest number were female (female = 80 (75.5%)). The highest percentage of respondents had a level II fall risk (73.6%), while level I and level III risks had 14 respondents each (13.2%). The results of the 4AT score showed that the largest number of patients, N = 50 (47.2%), had delirium or cognitive impairment with low probability, with possible cognitive impairment in 40 patients (37.7%), while delirium was possible in 16 patients (15.1%). *Conclusion:* Orthopedic patients hospitalized at the University Clinical Center of Vojvodina had level II fall risk, and the largest number of these patients had a low probability of cognitive impairment or postoperative delirium.

*Key words:* fall risk, delirium, nursing, orthopedic patients.

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## INTRODUCTION

Falls and fall-related injuries represent a growing public health issue due to the increasing life expectancy of individuals and the aging of the global population<sup>1</sup>. A fall is defined as an unplanned event that leads to the unintentional descent of a patient to the ground, floor, or lower level in general, excluding intentional changes in position with the purpose of relying on furniture, walls, or objects in the immediate surroundings.<sup>2</sup>

Falls and fall-related injuries are one of the most commonly reported adverse events in hospital settings. According to the Agency for Healthcare Research and Quality (AHRQ), in the United States, there are 700,000 to 1,000,000 reported patient falls annually during hospitalization.<sup>3</sup> NANDA (North American Nursing Diagnosis Association) includes the fall risk in nursing diagnosis, defined as "a state of increased vulnerability to falling and the occurrence of bodily harm".<sup>4</sup>

About 15–20% of falls result in serious injuries, with or without fractures. Falls without injury are also associated

with negative health impacts, such as loss of function, anxiety, depression, fear of falling, and social withdrawal. Many countries with developed healthcare systems have established fall prevention services.<sup>1</sup>

### Categories of falls in hospital settings

There are three categories of falls in hospital settings: anticipated physiological factors/anticipated physiological falls (unsteady gait, history of falls, and current fall risk); unanticipated physiological factors/unanticipated physiological falls (syncope, seizures, pathological fractures); and environmental factors/accidental falls (external hazards or equipment malfunctions). Additionally, organizational units within healthcare institutions differ in terms of patients, staff, healthcare delivery model, environment, and equipment accessibility, all of which significantly impact patient fall rates.<sup>5</sup> Age-related physiological changes are associated with an increased fall risk. Unaddressed sensory impairments hinder obstacle detection and/or avoidance,

while decreased muscle strength and weakened reflexes have a negative impact on reactivity.<sup>6</sup> In older people, falls are recognized as the leading cause of injuries and hospital admissions worldwide, most commonly due to fall-related injuries.<sup>7</sup> Annually, one-third of older people (65 years and older) experience a fall at least once, with 20% of these falls resulting in injuries. The high prevalence of injuries imposes an additional financial burden on the entire healthcare system.<sup>8</sup>

### **Fall risk factors in older people**

Fall risk factors in older people can be divided into two groups: intrinsic factors and environmental factors. Among intrinsic factors, in addition to older age and gender, many diseases and physical dysfunctions have a significant impact, such as muscle weakness, gait and balance problems, visual impairments, postural hypotension, and a significant number of chronic conditions (osteoporosis, hypertension, diabetes, stroke, cognitive impairment, epilepsy, dementia etc). The use of medications for the treatment of mental disorders, diabetes, and cardiovascular diseases, as well as non-steroidal anti-inflammatory drugs, is also associated with an increased fall risk. Environmental factors most commonly relate to living in an unsafe environment.<sup>7</sup> Orthopedic patients are at a significantly increased fall risk due to musculoskeletal disorders, mobility impairments, and prolonged immobility<sup>9,10</sup>, and delirium is not uncommon among these patients during hospitalization.<sup>11,12</sup>

### **Fall risk factors and the onset of delirium in older people**

Delirium is characterized by an acute and fluctuating impairment of consciousness, accompanied by disturbances in attention, cognition, and perception. Postoperative delirium is a serious complication for older patients as it is associated with functional impairment, prolonged hospitalization, and institutionalization. Early recognition, diagnosis, and treatment of delirium can reduce the length of hospital stays, in-hospital morbidity, and healthcare costs.<sup>13</sup> The prevalence of delirium during hospitalization in these patients is as high as 60%. Older orthopedic patients are at an increased risk of developing delirium, especially after a surgical procedure. Several predisposing factors for the development of delirium in hospitalized patients have been identified. These factors commonly include the patient's age, cognitive impairment, depression, severe illness, confirmed infection, sedative use, sleep disturbances, hospitalization-related fractures, significant physical function impairment, and preadmission institutionalization.<sup>14</sup> A number of risk factors that significantly increase the likelihood of delirium following orthopedic interventions have been identified. They include preoperative affective dysfunction, general anesthesia, intraoperative hypercapnia and hypotension, a surgery duration longer than 3 hours, postoperative pain, postoperative sleep disturbances, and the length of

hospitalization itself. Notably, orthopedic pathology related to the hip joint has the highest incidence of postoperative delirium.<sup>15</sup>

In patients who have undergone hip joint replacement, impaired joint function and muscle weakness can increase the fall risk. These patients may also experience a fear of falling during activities of daily living (ADL).<sup>16</sup>

### **Fear of falling**

The fear of falling is defined as a persistent concern about falling and can lead to self-restriction in performing daily activities. Fear is a predominant risk factor for falls in older individuals, regardless of their history or frequency of falls.<sup>17</sup> Recurrent falls, along with fear, can result in serious psychological trauma known as *post-fall syndrome*, where older adults refuse to move due to the fear of further falls and injuries.<sup>18</sup> Even 65% of older patients who have not experienced a fall and 92% of those who have report experiencing a fear of falling. Fear of falling after a surgical procedure diminishes self-efficacy and one's perception of one's own abilities.<sup>17</sup> In hospital settings, various guidelines are used for fall prevention, which involve systematic identification of patients at high fall risk and a clinical assessment to select an appropriate fall prevention strategy. However, there are significant differences among guidelines, which create confusion regarding the correct approach to fall prevention. Unclear fall prevention guidelines can burden healthcare delivery and potentially increase the risk for patients.<sup>19</sup>

### **Aim of the study**

Based on everything stated, we have concluded that there is a need to assess the fall risk in hospitalized orthopedic patients upon admission to the hospital, as well as the frequency of delirium in patients after surgical procedures. Our aims were to: (i) Assess the fall risk level among hospitalized patients prior to hip or knee surgery; and (ii) Evaluate the incidence of postoperative delirium among patients undergoing hip or knee surgery.

## **MATERIALS AND METHODS**

The study was conducted as an observational, analytical cross-sectional study by surveying hospitalized patients at the Clinic for Orthopedic Surgery and Traumatology of the University Clinical Center of Vojvodina between the beginning of December 2022 and the end of January 2023. The clinic has a capacity of 70 beds and provides care for patients with degenerative musculoskeletal conditions, as well as traumatized patients. A total of 106 patients, with diagnoses of *Gonarthrosis and Coxarthrosis*, both male and female, 50 to 94 years old, participated in the research.

The fall risk assessment was performed upon admission to the Clinic for Orthopedic Surgery and Traumatology, while

the evaluation of potential delirium was conducted 24 hours after the surgical procedure. The study was organized as individual interviews with each patient conducted by the researchers. Medical documentation was used for data related to the ASA status (ASA - American Society of Anesthesiologists) and the type of anesthesia used during the surgical procedure. The American Society of Anesthesiologists (ASA) adopted a classification of patient risk prior to anesthesia in 1963. This classification allows for a numerical assessment of the patient's health (ranging from I to VI) and an evaluation of potential anesthesia-related risk factors.<sup>20</sup>

**Research instruments**

The Fall Risk Assessment Score Sheet<sup>21</sup>, was used as the primary research instrument. Permission to use the instrument was obtained through written correspondence with the author. This instrument was specifically designed to identify the fall risk level in hospitalized patients upon admission to a hospital facility. It consists of 16 items distributed across two domains. The first domain relates to patient characteristics, including age, history of falls, environmental changes, and personality traits. The second domain focuses on assessing the patient's physical condition, including physical fitness, cognitive functions, physical activity, and medication use. Based on the number of identified elements, the fall risk level is assessed, ranging from the lowest (Level I) to the highest risk level (Level III). Level I indicates a score of 0-3, Level II indicates a score of 4-9, and Level III indicates a score of 10 or higher.

Another instrument used in this research was the 4AT - Rapid Clinical Test for Delirium Detection.<sup>22</sup> It was used in the postoperative period, 24 hours after hip/knee surgery. The 4AT has the strongest evidence base for diagnostic accuracy compared to all instruments designed for delirium assessment. The 4AT evaluates the patient's level of consciousness and accuracy of responses to questions about their date of birth, current location, and current

year, indicating orientation to self, others, time, and place. It also assesses attention and any significant changes or fluctuations in wakefulness, cognitive functions, and other mental functions (present in the past two weeks and still evident within the last 24 hours). A score of 0 indicates a low probability of delirium or cognitive impairment (but without exclusion), scores of 1-3 suggest possible cognitive impairment, and a score of 4 or higher indicates possible delirium with or without cognitive impairment. The instrument is freely available for use at [www.the4at.com](http://www.the4at.com).

**Statistical data analysis**

Data analysis was performed using IBM SPSS Statistics 25 software. Within descriptive statistics, absolute and relative frequencies were calculated. For computing differences, the chi-square test was used for qualitative variables. A p value <0.05 was considered statistically significant.

**RESULTS**

**Study participants:** Out of the total number of patients, N=106, the majority of participants (61.3%) were above the age of 70. There were 80 female patients (75.5%) and 26 male patients (24.5%).

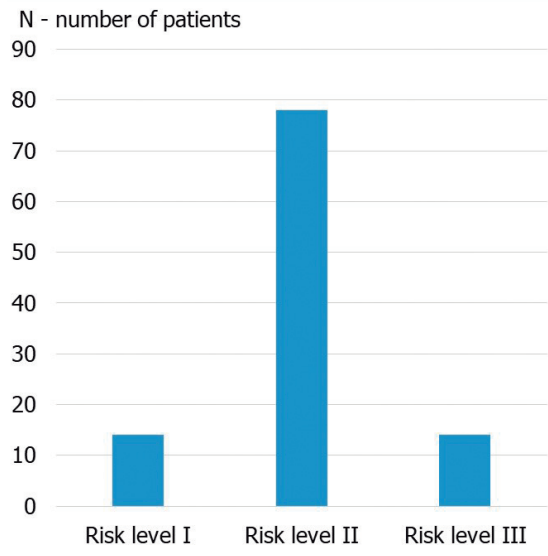
**Table 1** presents general data on the surgical procedure of the participants N=106. Fall risk Level I was present in 14 participants (13.2%), fall risk Level II in 78 participants (73.6%), and fall risk Level III in 14 participants (13.2%) (**figure 1**).

Considering the total 4AT score, the largest number of patients, N = 50 (47.2%), had a low probability of delirium or cognitive impairment; 40 patients (37.7%) had possible cognitive impairment; and delirium was possible in 16 patients (15.1%) (**figure 2**). Out of the total number of patients with possible delirium, 11 patients (10.38%) developed postoperative delirium after hip surgery, of whom 9 were female (81.82%), while 2 were male (18.18%).

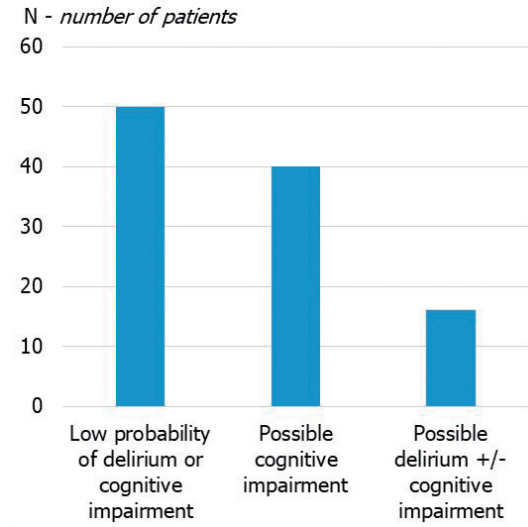
**Table 1.** Data on the surgical procedure (N= 106)

	%	n
<b>Surgical procedure</b>		
Hip	66	70
Knee	34	36
<b>Type of anesthesia</b>		
Regional	44.3	47
General	55.7	59
<b>ASA status</b>		
II	69.8	74
III	30.2	32

Source: the authors.



**Figure 1.** Fall risk level. Source: the authors.



**Figure 2.** Total 4AT score. Source: the authors.

**Table 2.** Differences between groups based on 4AT score results

	Low probability of delirium or cognitive impairment	Possible cognitive impairment	Possible delirium +/- cognitive impairment	$\chi^2$	p
<b>Sex</b>					
Male	15 (30%)	8 (20%)	3 (18%)	1.54	0.463
Female	35 (70%)	32 (80%)	13 (82%)		
<b>Age (years)</b>					
>70	20 (40%)	31 (77.5%)	14 (87.5%)	18.62	<0.0001*
<70	30 (60%)	9 (22.5%)	2 (12.5%)		
<b>Surgical procedure</b>					
Hip	23 (46%)	10 (25%)	3 (18.7%)	6.31	0.043*
Knee	27 (54%)	30 (75%)	13 (81.3%)		
<b>ASA status</b>					
II	45 (90%)	26 (65%)	3 (18.8%)	29.90	<0.0001*
III	5 (10%)	14 (35%)	13 (81.3%)		
<b>Anesthesia</b>					
Regional	32 (64%)	15 (37.5%)	0 (0%)		<0.0001*
General	18 (36%)	25 (62.8%)	16 (100%)	21.33	

Note: Statistically significant differences\*  
Source: the authors.

**Comparison of patients based on their 4AT score**

Subjects whose total 4AT score indicates possible delirium have significantly higher values of the ASA score compared to other subjects ( $\chi^2 = 23.33$ , p 0.0001). Additionally, in this group of patients, there were significantly more individuals who underwent general anesthesia ( $\chi^2 = 14.98$ ,

p 0.0001). They also have a significantly higher fall risk compared to others ( $\chi^2 = 22.28$ , p 0.0001) (table 2, figures 3-5).

Among the statistically significant differences among subjects with different 4AT scores, it stands out that patients with a low probability of delirium or cognitive



impairment are significantly younger than others ( $\chi^2 = 18.15$ ,  $p = 0.0001$ ), more frequently undergo knee surgery ( $\chi^2 = 6.10$ ,  $p = 0.04$ ), have a lower ASA score ( $\chi^2 = 18.32$ ,  $p = 0.0001$ ), more frequently undergo regional anesthesia ( $\chi^2 = 14.82$ ,  $p = 0.0001$ ), and have a lower fall risk ( $\chi^2 = 22.28$ ,  $p = 0.0001$ ). Patients with possible cognitive impairment are statistically significantly older than others ( $\chi^2 = 7.08$ ,  $p = 0.04$ ) (**table 2**).

The majority of patients with fall risk Level II had a low probability of developing delirium or cognitive impairment (**table 3**).

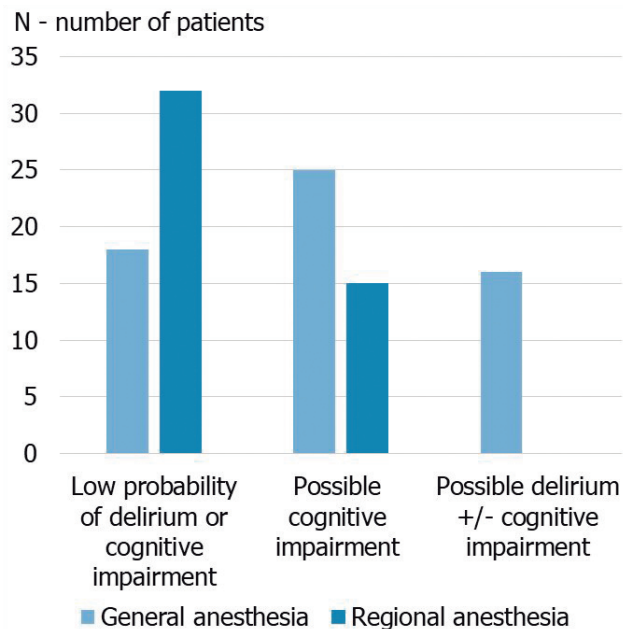
Out of the total number of patients who developed delirium 24 hours after the surgical procedure ( $N = 11$ ), 1 patient had ASA status II (9.09%), and 10 patients had ASA status III (90.91%), of which 9 patients were operated under general anesthesia (90.91%).

**Table 3.** Comparison of 4AT score results in relation to fall risk

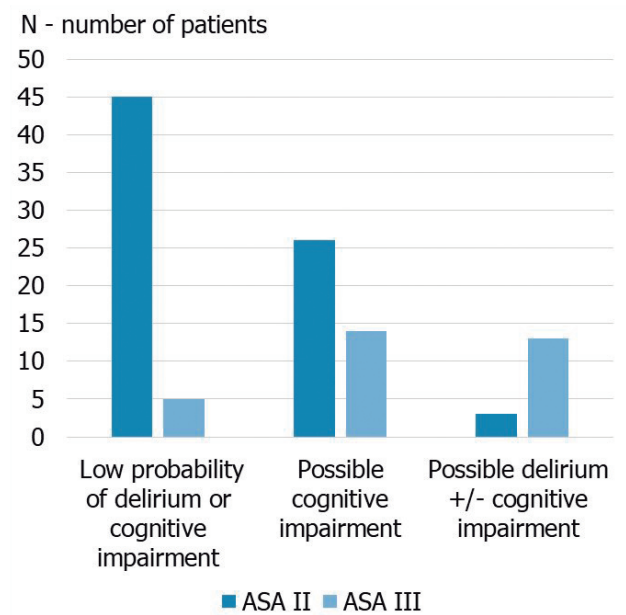
4AT score	Low probability of delirium or cognitive impairment	Possible cognitive impairment	Possible delirium +/- cognitive impairment	$\chi^2$	p
<b>Fall risk</b>					
Risk level I	12 (24%)	2 (5%)	0 (0%)		
Risk level II	37 (74%)	33 (82.5%)	8 (50%)	31.37	<0.0001*
Risk level III	1 (2%)	5 (12.5%)	8 (50%)		

Note: Statistically significant differences\*

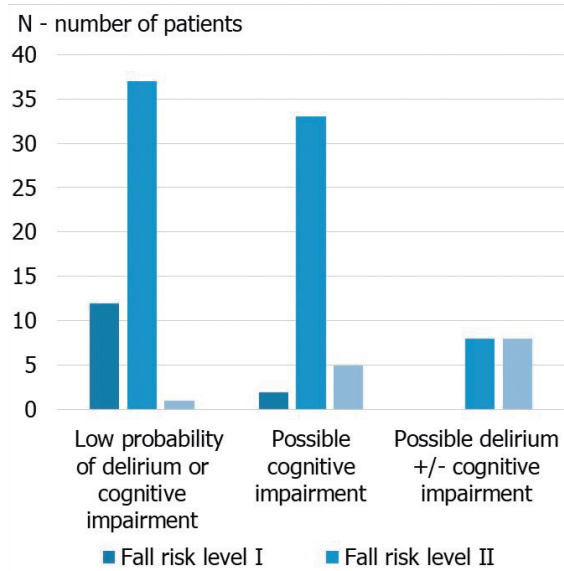
Source: the authors.



**Figure 3.** Difference in anesthesia type between groups based on 4AT score results. Source: the authors.



**Figure 4.** Difference in ASA status between groups based on 4AT score results. Source: the authors.



**Figure 5.** Difference in fall risk between groups based on 4AT score results. Source: the authors.

## DISCUSSION

On stationary orthopedic wards, risk assessment is conducted multiple times during hospitalization. A structured risk assessment for falls is performed upon admission to the hospital, as needed multiple times during hospitalization, and after surgery. The most important aspect is enabling patients to safely perform daily activities. Qualified medical nurses, nurse technicians, occupational therapists, physicians, and physiotherapists play a significant role in the clinical fall risk assessment.<sup>23</sup>

Frail and older patients, often with cognitive impairment following major joint surgery, have been considered burdensome for orthopedic and hospital services. The development of national registries in highly developed European countries, as well as Australia and New Zealand, has changed these attitudes, as reports indicate improved treatment outcomes.<sup>24</sup> The majority of our participants were over 70 years old and predominantly female, which is consistent with literature regarding the age threshold for the occurrence of degenerative joint pathologies.<sup>25,26</sup> Considering that there have been no studies in the available literature that assessed the fall risk in orthopedic patients using the Fall Risk Assessment Score Sheet, developed by Hagino et al.<sup>21</sup>, we are obliged to interpret our own results, which relate to the assessment of fall risk, to the greatest extent possible. In the aforementioned study, the sample consisted of 5,219 patients admitted to the General National Hospital in Kofu from April 2016 to March 2019. The majority of patients in our study had a total score corresponding to level II risk for falls, which is twice as high compared to the study conducted by the authors

of the Fall Risk Assessment Score Sheet. The reason for this may lie in the fact that the authors of the utilized instrument did not exclusively have orthopedic patients in their sample. When it comes to the possibility of delirium occurring in hospitalized orthopedic patients, 15.1% of patients were assessed as having the potential for delirium, which is significantly lower compared to the study, which used data from the National Hip Fracture Database (NHFD) and internal hospital computer systems (Medway, ICE, and Clinic letters).<sup>27</sup> The researchers found that 29.3% of orthopedic patients had possible delirium, with 68 patients (38.9%) developing delirium and having an ASA IV score. 94 patients (22.3%) were without delirium ( $p = 0.05$ ). In our study, the majority of patients had possible cognitive impairment (37.7%) or delirium or cognitive impairment with low probability (47.2%). The fact that we did not have patients with an ASA IV score may be the reason for the lower incidence of delirium in our results. Patients identified with higher 4AT scores, indicating possible delirium, had higher ASA scores compared to other patients, indicating that these patients had other serious systemic illnesses. Additionally, the results show that a higher percentage of patients underwent surgery under general anesthesia. Similar results were published in the study by Rajeev et al.<sup>27</sup> The reason for significant variations in the range of postoperative delirium incidence may lie in inconsistent criteria for diagnosing delirium.

In the study conducted in University Malaya Medical Centre on a sample of 447 patients<sup>28</sup>, 11.2% of patients with postoperative delirium were recorded, slightly lower compared to our sample. The study on a sample of 223 patients (154 in the control group and 69 in the study group—those undergoing hip or knee surgery) undergoing hip or knee surgery at Ramathibodi Hospital in Bangkok reported a significantly lower number of patients (1%) in whom the total 4AT score indicated postoperative delirium.<sup>29</sup> Interestingly, due to this result, the researchers sought the opinion of a psychiatrist specialist to confirm the low rate of delirium in the control group. Also, the majority of participants in their study were female, as was the case in our study.

In the study conducted at Brunico-Bruneck Hospital in Northern Italy<sup>30</sup>, out of 202 orthopedic patients comprising the sample, 7.5% had postoperative delirium, with 73.3% developing delirium within the first 48 hours after surgery. Our results are similar, considering that 11 patients developed delirium 24 hours after the surgical procedure (10.38%). In study conducted on a sample of 61 hospitalized orthopedic patients at Port of Spain General Hospital<sup>31</sup>, 42 underwent surgical procedures and 18 patients (42.8%) exhibited cognitive impairment after surgery, while 9 (21.4%) had delirium. They emphasize that delirium occurs more frequently after general anesthesia (26.7%) compared to regional anesthesia (8.4%). Our results identified slightly fewer participants with possible cognitive impairment and delirium. Additionally, we found that our patients with a

low probability of delirium or cognitive impairment were significantly more likely to undergo surgery under regional anesthesia ( $\chi^2 = 14.82$ ,  $p 0.0001$ ).

### Limitations, strengths of the study and future research

Our study has certain limitations. Firstly, we had access to only one study for comparison regarding the risk assessment tool for falls, namely the study by Hagino et al.<sup>21</sup>, and we did not perform a reassessment of fall risk. Secondly, the limitation relates to the time of delirium onset monitoring, as only a 24-hour period after surgery was considered, during which delirium manifested in 11 patients, but subsequent evaluation of other patients was not conducted. Considering that the highest percentage of our participants is over 70 years old, it is important to highlight that the comprehensive goal of the United Nations Decade of Healthy Ageing (2021–2030) is to improve the quality of life for older individuals on a global level. Healthy aging entails “the functional ability of an individual to be and do what they love and value.” Reducing the incidence of falls and fall-related injuries, preserving functional mobility, and eliminating the fear of falling, along with the design of specific guidelines for fall prevention.

### CONCLUSION

Falls have a significant impact on quality of life, which is a key treatment outcome, especially in older individuals. Additionally, a high percentage of potential delirium among hospitalized patients can be prevented, leading to improved postoperative recovery and the overall quality of healthcare services provided. The results of the research have shown that orthopedic patients hospitalized at the University Clinical Center of Vojvodina have a fall risk level II.

Most hospitalized orthopedic patients had a low probability of cognitive impairment or postoperative delirium, indicating the high quality of healthcare services provided and a significant indicator of patient safety in healthcare institutions performing inpatient care.

### FUNDING INFORMATION

None perceived.

### CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

### DATA AVAILABILITY STATEMENT

The datasets generated during and/or analyzed during the current study are not publicly available due to privacy

and ethical considerations. The data that support the findings of the study are available from the corresponding author on reasonable request.

### ETHICAL APPROVAL

The research has been approved by the Ethics Committee of the University Clinical Center of Vojvodina.

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