

## **Limiting Factors on the Rehabilitation Potential in the Elderly Postoperative Period in Orthopedic – Traumatology Patients of Geriatric Profile**

### **Factori Limitativi ai Potențialului de Reabilitare în Perioada Postoperatorie la Pacienții Ortopedici – Traumatologici de Profil Geriatric**

*Denitsa Valentinova VASILEVA*<sup>1</sup>, *Stoyan Dimitrov GRAMATIKOV*<sup>2</sup>

#### **Abstract**

*Introduction:* Falls in the elderly are public health problem, with injuries in people over the age of 75 at increased risk of death. Various aspects and consequences of surgical intervention in the elderly often lead to a temporary limitation of the rehabilitation potential of patients and a delay in their functional recovery, at the same time as an increase in hospital stay. *Aim:* The aim of the study is to determine the most common clinical factors limiting the rehabilitation potential of orthopedic - traumatological patients of geriatric profile in the early postoperative period. *Material and methods:* A total of 8087 patients for surgical treatment. In the period 2017 - 2021, a total of 8087 patients for surgical treatment passed through the base of the Clinic of Orthopedics and Traumatology at the University Hospital - Kaneff. Of these, 4973 (61.49%) aged 65-85. Distribution by age: 65 – 70 years: 22% (n=1121), 70 – 75 years: 30% (n=1476), 75 – 80 years: 27% (n=1328), 80 – 85 years: 21% (n=1048). By location of the trauma: with fractures of the upper limb and spine 57.45% (n = 2857) and with fractures of the pelvis and lower limbs - 42.25% (n = 2116). *Results:* Those who lay more than 2 days preoperatively (2-5) were 16.37% (n = 273), postoperative blood transfusions were 13.97% (n = 233), with established postoperative cardiac disorders were 22.55% (n = 376), in perioperative delirium the average (2 - 8 days) was 9.47% (n = 158), with elevated body temperature postoperatively above 37.5 - 39.83% (n = 664). *Discussion:* Prognostic factors for the final result are the time for the perioperative period, the length of hospital stay and postoperative complications. Delayed surgery is associated with a higher risk of complications and increased mortality. Postoperative complications, in turn, increase both short-term and long-term mortality. Prolonged preoperative bed, perioperative blood loss, perioperative delirium and elevated body temperature (hyperthermia) are also factors influencing the outcome of the surgery. *Conclusion:* The results of the study show that that the main limiting factors on the rehabilitation potential of orthopedic-trauma patients of geriatric profile are perioperative delirium, long preoperative bed rest and cardiovascular postoperative complication.

---

Accepted for publication on 08.02.2022; Published online on 10.02.2022;

For citation: Vasileva, D.V.; Gramatikov, S.D. (2022). Limiting Factors on the Rehabilitation Potential in the Elderly Postoperative Period in Orthopedic – Traumatology Patients of Geriatric Profile. *Revista Română de Kinetoterapie*. 28(48),17-26

<sup>1</sup> Corresponding author; Department of Public Health and Health Care, University of Ruse “Angel Kanchev”, Bulgaria; ddecheva@uni-ruse.bg

<sup>2</sup> Clinic of Orthopedic and Traumatology Surgery, University Hospital for Active Treatment “Kaneff”, Ruse, Bulgaria

**Keywords:** *geriatric, rehabilitation, limiting factors*

## **Rezumat**

*Introducere:* Căderile la vârstnici reprezintă o problemă de sănătate publică, cu leziuni la persoanele peste 75 de ani, având risc crescut de deces. Diverse aspecte și consecințe ale intervenției chirurgicale la vârstnici conduc adesea la o limitare temporară a potențialului de reabilitare a pacienților și la o întârziere a recuperării funcționale a acestora, concomitent cu o creștere a zilelor de spitalizare. *Scop:* Scopul studiului este de a determina cei mai frecvenți factori clinici care limitează potențialul de reabilitare al pacienților ortopedici - traumatologici de profil geriatric în perioada postoperatorie precoce. *Material și metode:* În perioada 2017 - 2021, prin baza Clinicii de Ortopedie și Traumatologie de la Spitalul Universitar – Kaneff au trecut în total 8087 de pacienți pentru tratament chirurgical dintre care 4973 (61,49%) cu vârstă de 65-85 de ani. Distribuția după vârstă a fost: 65 – 70 ani: 22% (n=1121), 70 – 75 ani: 30% (n=1476), 75 – 80 ani: 27% (n=1328), 80 – 85 ani: 21% (n=1048). Distribuția subiecților după localizarea traumatismului a fost: cu fracturi ale membrului superior și ale coloanei vertebrale 57,45% (n = 2857) și cu fracturi ale bazinului și membrelor inferioare - 42,25% (n = 2116). *Rezultate:* Cei care au stat la pat mai mult de 2 zile preoperator (2-5) au fost de 16,37% (n = 273), transfuziile de sânge postoperatorii au fost de 13,97% (n = 233), cu tulburări cardiace postoperatorii stabilite au fost de 22,55% (n = 376), în delirul perioperator media (2 - 8 zile) a fost de 9,47% (n = 158), cu temperatura corporală crescută postoperator peste 37,5 - 39,83% (n = 664). *Discuție:* Factorii de prognostic pentru rezultatul final sunt timpul pentru perioada perioperatorie, durata spitalizării și complicațiile postoperatorii. Intervenția chirurgicală întârziată este asociată cu un risc mai mare de complicații și cu o mortalitate crescută. Complicațiile postoperatorii, la rândul lor, cresc mortalitatea atât pe termen scurt, cât și pe termen lung. Statul la pat prelungit preoperator, pierderea de sânge perioperatorie, delirul perioperator și temperatura corporală crescută (hipertermia) sunt, de asemenea, factori care influențează rezultatul intervenției chirurgicale. *Concluzie:* Rezultatele studiului arată că principalii factori limitanți ai potențialului de reabilitare al pacienților ortopedici - traumatizați de profil geriatric sunt delirul perioperator, repausul preoperator prelungit la pat și complicațiile cardiovasculare postoperatorii.

**Cuvinte cheie:** *geriatrie, reabilitare, factori limitativi*

## **Introduction**

Falls in the elderly are common, with injuries in people over the age of 75 at increased risk of death [1]. According to the literature, 33% of people over the age of 65 suffer falls [2]. The traumatic moment superimposed on osteoporotic bone structures almost always leads to a fracture [3]. The increased incidence of fractures of the femoral neck, vertebrae and forearms is attributed to osteoporosis in people over 50 years of age [4]. In a large percentage of cases,

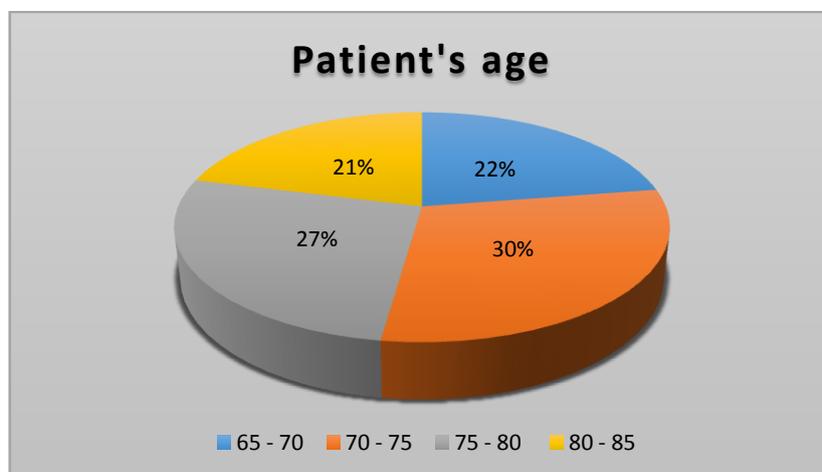
surgical treatment is the first choice as an option for faster and more reliable functional recovery, despite the existing peri- and postoperative risk for patients. The largest number of surgeries are those after a fracture of the lower limbs. Very often they are accompanied by severe injuries, prolonged treatment and a long recovery time [5]. However, various aspects and consequences of surgical intervention in the elderly often lead to a temporary limitation of the rehabilitation potential of patients and a delay in their functional recovery, at the same time as an increase in hospital stay. Rehabilitation potential is determined based on a combination of cognitive functions, medical status, motivation, social support and economic resources of the patient [6]. Among the literature we studied in the database of SCOPUS, Web of Science and ELSEVIER (search period 2011 - 2021) we found data on postoperative factors that increase the risk of mortality and prolongation of hospital stay, but we did not find studied and systematized clinical factors, limiting the rehabilitation potential of patients with geriatric profile with orthopedic - traumatological operations in the early postoperative period.

The aim of the present study is to determine the most common clinical factors limiting the rehabilitation potential of orthopedic - traumatological patients of geriatric profile in the early postoperative period.

### **Material and methods**

During the period 2017 - 2021, a total of 8087 patients for surgical treatment passed through the base of the Clinic of Orthopedics and Traumatology at the University Hospital - Kaneff. Of these, 4973 (61.49%) aged 65-85, of which 2652 women (53.32%) and 2321 men (46.67%) by sex. Distribution by years: 65 – 70 years: 22% (n=1121), 70 – 75 years: 30% (n=1476), 75 – 80 years: 27% (n=1328), 80 – 85 years: 21% (n=1048). (figure1)

By location of the trauma: with fractures of the upper limb and spine 57.45% (n = 2857) and with fractures of the pelvis and lower limbs - 42.25% (n = 2116). Patients were followed from admission to the orthopedics and traumatology clinic until their discharge.



*Figure 1. - Patient's age distribution*

From this patient contingent we differentiated the most common postoperative restrictions that prevent the implementation of rehabilitation measures. A total of 35.31% (n = 1756) of patients aged 65 to 85 years (mean 74.8 years) were observed. Of these, 87.24% (n = 1532) had fractures of the lower limb or pelvis and 12.76% (n = 244) had fractures of the upper limb. Those who lay more than 2 days preoperatively (2-5) were 16.37% (n = 273), postoperative blood transfusions were 13.97% (n = 233), with established postoperative cardiac disorders were 22.55% (n = 376), in perioperative delirium the average (2 - 8 days) was 9.47% (n = 158), with elevated body temperature postoperatively above 37.5 - 39.83% (n = 664). (figure 2)

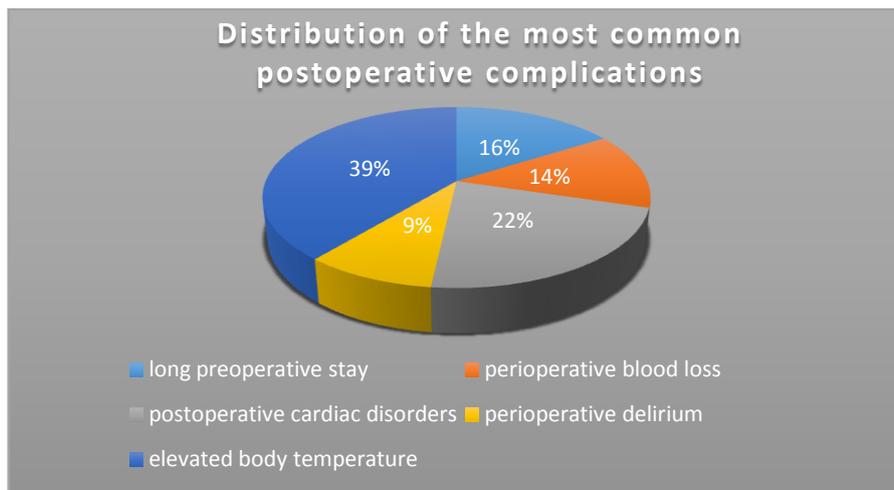


Figure 2. - Distribution of the most common postoperative complications

Postoperative complications such as hypostatic pneumonia (n = 6), deep vein thrombosis (n = 3) and others were also encountered, but their frequency was rare and therefore not included in the study. Deceased patients were also excluded (n = 5). Patients who lays more than 2 days preoperatively, with postoperative blood transfusion, with established postoperative cardiac disorders, in perioperative delirium and with elevated body temperature postoperatively above 37.5 were included in experimental group (n = 1705). The control group consisted of patients operated within 12 hours of their reception and did not show postoperative complications (n = 528).

### Statistical Analysis

For statistical analysis SPSS 15.0 was used. Values are presented as means and standard deviation (SD).

### Results

The hospital stay in the orthopedics and traumatology clinic of the examined patients was on average 11 days (+/- 3). During this time, their rehabilitation program included breathing exercises, passive exercises, active movements, gradual verticalization performed twice a day in good general condition of the patients and the lack of immediate contraindications for the use of physiotherapy. Blood pressure, pulse rate and body temperature were measured twice - before

and after the physiotherapy procedure (PT). The obtained data of the patients from the studied contingent were again compared with the patients from the control group, operated on up to 12 hours after their admission and did not show peri- or postoperative complications until their discharge from the clinic. (table 1)

*Table 1 - Average values and standart deviation of blood pressure, puls rate and body temperature*

Group	Index	Blood pressure (mm/Hg)		Puls (min)		Body temperature (degrees)	
		before PT	after PT	before PT	after PT	before PT	after PT
<b>Experimental</b>	pre-operative stay more 2 days (n=273)	127±7/ 72±8	143±15/ 84±12	65±8	72±9	36.2±0.7	36.7±0.2
	blood transfusion (n=233)	122±10/ 68±8	145±12/ 87±10	60±9	85±11	36.4±0.3	36.8±0.5
	cardiovascular complications (n=376)	138±11/ 73±13	153±9/ 89±11	68±10	92±13	36.1±0.4	36.7±0.3
	perioperative delirium (n=158)	127±9/ 79±8	141±12/ 81±9	65±8	89±6	36.0±0.5	36.6±0.3
	high body temperature >37,5° (n=664)	136±6/ 76±5	139±8/ 83±9	68±4	76±9	37.8±0.2	38.8±0.1
	<b>Control</b>	without complications (n=528)	124±8/ 65±10	132±12/ 75±9	62±8	75±9	36.4±0.3

The mean values of the measured indicators of blood pressure, pulse rate and body temperature show sensitivity to varying degrees in different groups of patients. Changes in blood pressure values before and after the rehabilitation procedure are most pronounced as expected in patients with cardiovascular complications, and with the lowest dynamics of the indicators are in those with fever. However, compared to the mean values of patients who did not show postoperative complications, in all other groups there were more serious differences in the values of systolic and diastolic blood pressure before and after exercise. In the case of the pulse rate indicator, the reasonably changes in the mean values in the different groups of patients are analogous to those observed in the measurement of blood pressure. The results obtained in this way show that in patients from the groups with postoperative complications, the standard rehabilitation measures have a more stressful effect on the cardiovascular system. At the mean values of the body temperature indicator dynamics is observed only in the patients from the group with fever, as the mean values rise by 1 degree and lead to a state of general fatigue of the patients, rapid fatigue and exhaustion of the rehabilitation potential. In addition, fever increases the preconditions for the development of subsequent local postoperative infection.

Pre-operatively and at the end of their hospital stay, the patients were assessed by the Barthel's

test for the degree of functional independence, as a reliable test for assessment in adult patients with fractures [7]. The results were compared between the experimental and control groups pre- and postoperatively. (table 2), (table 3)

*Table 2. –Preoperative Barthel’s score patients results in control and experimental groups*

Index	pre-operative experimental group score <i>mean values and SD</i> (n=1705)	pre-operative control group score <i>mean values and SD</i> (n=528)	p ≤ 0,05
<b>Total Barthel score</b>	96,5±2.03	95,7±3.11	p = 0.000
<b>feeding</b>	9.18±0.53	9.21±0.18	p = 0.001
<b>bathing</b>	4.28±0.51	3.87±1.24	p = 0.000
<b>grooming</b>	3.94±1.10	4.01±0.62	p = 0.000
<b>dressing</b>	9.26±0.18	9.19±0.25	p = 0.001
<b>bowels</b>	8.75±1.25	8.18±1.01	p = 0.000
<b>bladder</b>	9.02±0.85	8.56±1.03	p = 0.001
<b>toilet use</b>	9.23±0.66	9.41±0.28	p = 0.001
<b>transfers</b>	12.56±2.51	11.89±3.02	p = 0.000
<b>mobility</b>	13.04±1.56	12.85±1.28	p = 0.000
<b>stairs</b>	9.25±0.41	8.98±1.02	p = 0.001

The data obtained from the preoperative testing shows similar values both in the overall result and in the individual components of the Barthel test. Patients in both groups showed a high level of self – care and functional independence. The similar results give grounds to claim that the two groups of patients are comparable and the results obtained from postoperative testing will be reliable.

*Table 3. – Postoperative Barthel’s score patients results in control and experimental group at the end of the hospital stay*

Index	postoperative experimental group score <i>mean values and SD</i> (n=1705)	postoperative control group score <i>mean values and SD</i> (n=528)	p ≤ 0,05
<b>Total Barthel score</b>	43.09± 10.32	75.14±11.95	p = 0.001
<b>feeding</b>	6.13±2.13	9.36±2.35	p = 0.005
<b>bathing</b>	1.39±1.02	4.21±1.42	p = 0.001
<b>grooming</b>	3.30±1.51	4.23±1.79	p = 0.000
<b>dressing</b>	2.98±1.18	4.65±2.05	p = 0.001
<b>bowels</b>	7.16±2.42	8.67±2.53	p = 0.001
<b>bladder</b>	6.99±2.18	9.21±1.85	p = 0.003
<b>toilet use</b>	4.79±1.36	8.76±1.22	p = 0.001
<b>transfers</b>	5.34±2.47	9.26±0.56	p = 0.000
<b>mobility</b>	3.91±1.75	10.58±3.24	p = 0.000
<b>stairs</b>	1.09±0.81	6.21±1.76	p = 0.001

Postoperative testing shows significant differences in the overall result and the individual components between the two groups. In order to be more precise in the analysis of the reasons for this, we examined in detail the obtained average values for each subgroup in the experimental group. (table 4)

Table 4. –Detail Barthel's results in experimental group

Index	pre-operative stay more 2 days mean values and SD (n=273)	blood transfusion mean values and SD (n=233)	cardiovascular complications mean values and SD (n=376)	perioperative delirium mean values and SD (n=158)	high body temperature > 37,5° mean values and SD (n=664)
<b>Total Barthel score</b>	40.55±3.25	49.24±1.05	42.58±2.82	24.22±2.36	58.85±4.21
<b>feeding</b>	6.22±1.05	7.24±1.02	6.12±1.2	2.52±1.1	8.56±1.5
<b>bathing</b>	0.06±0.01	2.46±0.5	0.52±0.21	0.05±0.7	3.85±0.8
<b>grooming</b>	3.17±1.2	3.25±1.02	3.50±1.1	2.83±1.1	3.76±1.2
<b>dressng</b>	2.15±1.02	3.15±1.8	3.74±0.9	1.56±1.2	4.28±0.9
<b>bowels</b>	7.61±1.0	7.86±1.9	7.52±2.2	4.62±0.6	8.21±1.6
<b>bladder</b>	6.85±1.05	7.21±2.01	7.36±1.8	5.18±1.1	8.36±1.1
<b>toilet use</b>	4.53±0.8	5.16±1.5	4.86±1.2	3.24±0.4	6.18±1.6
<b>transfers</b>	5.18±1.4	6.39±1.02	5.24±0.6	2.63±1.3	7.24±1.2
<b>mobility</b>	4.28±1.9	4.96±1.4	3.52±2.1	1.54±0.2	5.27±2.3
<b>stairs</b>	0.5±0.2	1.56±1.1	0.2±0.1	0.05±0.01	3.14±1.5

After the observations and the Barthel test, it is clear that the most limited rehabilitation potential is observed in patients with perioperative delirium, followed by patients who lay postoperatively for 2 or more days and those with postoperative cardio-vascular complications. Slightly more limited is the rehabilitation potential in patients who underwent blood transfusion and the highest rehabilitation potential of the studied contingent is observed in patients with elevated postoperative body temperature above 37.5.

## Discussion

Basic risk factors for mortality in patients with hip fractures in special are chronic obstructive pulmonary disease, heart failure, dementia and malignancies. Prognostic factors for the final result are the time for the perioperative period, the length of hospital stay and postoperative complications. Preoperative comorbidities are significant risk factors for postoperative complications [8, 9]. Delayed surgery is associated with a higher risk of complications and increased mortality. Postoperative complications, in turn, increase both short-term and long-term mortality [10, 11].

Prolonged preoperative bed rest leads to hypokinesia, muscular hypotrophy, congestion in the cardiopulmonary system, risk of hypostatic pneumonia, orthostatic reaction in subsequent late

attempt at verticalization, a serious prerequisite for disruption of trophism of certain soft tissue areas and related wounds. The long period of bed rest of the patients preoperatively leads to general atony of the patient and significantly delays the terms for mobilization, verticalization, self-care and functional recovery. In addition, delaying surgery by up to 48 hours increased the risk of mortality in patients with proximal femur fractures by 7% to 15.8% [12].

Perioperative blood loss leads to a breakdown in hemodynamics, expressed to varying degrees in each patient. Given the geriatric profile of patients and related comorbidities such as hypertension, chronic congestive heart failure, valvular prosthetics, stents, shunts, etc., along with chronic obstructive pulmonary changes, the large blood loss during surgery puts the compensatory test seriously of the cardiopulmonary system of patients in the early postoperative period. As a result, the values of blood pressure and pulse rate in the first days after surgery are highly variable, which severely limits the rehabilitation capabilities of the rehabilitation procedure in these patients. Another major factor that has a direct impact on the effectiveness of rehabilitation measures is the value of hemoglobin [13].

Perioperative delirium is common in orthopedic patients - 5% to 67%, especially in patients with pelvic fractures - up to 73%. Delirium is a complex multiplier phenomenon affecting the central nervous system [14]. It is manifested by a hyperactive or hypoactive form. The object of drug treatment is most often the hyperactive form. Delirium is diagnosed in conditions associated with the presence of a sudden, acute change in the patient's behavior, which shows a tendency to fluctuate from minutes to hours during the day; changes in the way of thinking, attention, consciousness, orientation, perceptions and memory; changes in psychomotor skills; disturbances in the waking cycle - sleep; there is concrete evidence that mental changes are due to an acute somatic illness, the intake or abrupt cessation of medications and substances (e.g. alcohol), or a combination of both [15]. There is no convincing evidence for the treatment of delirium [16, 17]. Carrying out a physiotherapy procedure without the active participation and assistance of a conscious patient is ineffective and inexpedient. Very often the psychotic component in patients in a state of delirium hinders rehabilitation activities, and inadequate or aggressive behavior reduces the possibility of conducting a physiotherapy procedure to zero. All this leads to an increase in the days of hospital stay and a delay in functional recovery after surgery [18].

Elevated body temperature (hyperthermia) is a result from abnormal temperature regulation [19]. Elevated body temperature above 37.5 degrees of unknown origin is among the general contraindications for physiotherapy. The reason for this is that the activation of the muscles and the movement of the body or parts of it accelerate the local and general blood flow, which leads to hyperemia and an increase in local and general body temperature. As a result, in the presence of an already increased one, the expected result is for an even greater increase in values. In addition, the unexplained origin gives an indication of local or general infection of bacterial or viral type. Accelerated blood flow and an active muscle pump contribute to the rapid spread of the infection, which would significantly complicate its control and lead to deterioration of the general condition of the patient. On the other hand, the use of active cooling therapy is also not

recommended in patients without sedation with moderate temperature, as it does not reduce the core temperature, but increases the rate of metabolism, activates the autonomic nervous system and provokes thermal discomfort [20].

## **Conclusion**

Based on the results of the study, we can conclude that the main limiting factors on the rehabilitation potential of orthopedic - traumatological patients of geriatric profile are perioperative delirium, long preoperative bed rest and cardiovascular postoperative complications. The large perioperative blood loss, as well as to some extent the postoperative fever, also have a negative impact on the rehabilitation potential. All these complications limit the rehabilitation potential of patients, and this leads to a delay in functional recovery, limit the degree of independence and delay the return to daily life.

## **References**

- [1] Hashmi, A.; Ibrahim-Zada, I.; Rhee, P.; Aziz, H.; Fain, M.J.; Friese, R.S.; Joseph, B. (2014). Predictors of mortality in geriatric trauma patients: a systematic review and meta-analysis; *Journal of Trauma Acute Care Surgery*, 76(3):894-901. DOI: 10.1097/TA.0b013e3182ab0763.
- [2] Pasquetti, P.; Apicella, L.; Mangone, G. (2014). Pathogenesis and treatment of falls in elderly; *Clin Cases Miner Bone Metab*, Sep-Dec; 11(3): 222–225. PMID: 25568657 PMID: PMC4269147
- [3] Partridge, J.S.L.; Harari, D.; Martin, F.C.; Dhesi, J.K. (2014). The impact of pre-operative comprehensive geriatric assessment on postoperative outcomes in older patients undergoing scheduled surgery: a systematic review; *Anaesthesia, Special Issue: Anaesthesia for Elderly*, January, 69 Suppl (1):8-16. DOI: 10.1111/anae.12494
- [4] Stefanova, I.; Mindova, S.; Karaganova, I. (2016). The importance of physical therapy on the prevention of osteoporosis; *Proceedings of University of Ruse*, 55(8.1):90 – 94.
- [5] De Andrade Fonseca, M.; Cordeiro Matias, A.G.; de Lourdes de Freitas Gomes, M.; Matos, A.M. (2019). Impact of Lower Limb Fractures on the Quality of Life. *Ortopedia, Traumatologia, Rehabilitacja*; Feb; 21(1):33-40. DOI: 10.5604/01.3001.0013.1078
- [6] Mayoral, A.; Ibarz, E.; Gracia, L.; Mateo, J.; Herrera, A. (2019). The use of Barthel index for the assessment of the functional recovery after osteoporotic hip fracture: One year follow-up; *PLoS One*; 14(2): e0212000. DOI: 10.1371/journal.pone.0212000
- [7] Mosqueda, L. (1993). Assessment of Rehabilitation Potential; *Clinics in Geriatric Medicine*; 9(4): 689-703. PMID: 8281499
- [8] Shimizu, A. et al. (2022). Hospital Frailty Risk Score predicts adverse events in older patients with hip fractures after surgery: Analysis of a nationwide inpatient database in Japan; *Archives of Gerontology and Geriatrics*, Volume 98, January–February, 98:104552. DOI: 10.1016/j.archger.2021.104552
- [9] Hasan, O.; Barkat, R.; Rabbani, A.; Rabbani, U.; Mahmood, F.; Noordin, S. (2020). Charlson

- comorbidity index predicts postoperative complications in surgically treated hip fracture patients in a tertiary care hospital: Retrospective cohort of 1045 patients; *International Journal of Surgery* (London, England), 82:116-120. DOI: 10.1016/j.ijssu.2020.08.017
- [10] Menzies, I.B.; Mendelson, D.A.; Kates, S.L.; Friedman, S.M. (2012). The impact of comorbidity on perioperative outcomes of hip fractures in a geriatric fracture model; *Geriatric Orthopaedic Surgery & Rehabilitation*, 3:129-134. DOI: 10.1177/2151458512463392
- [11] De Luise, C.; Brimacombe, M.; Pedersen, L.; Sørensen, H.T. (2008). Comorbidity and mortality following hip fracture: a population-based cohort study. *Aging ClinExp Res.* 20(5):412–418. DOI: 10.1007/BF03325146.
- [12] Siegmeth, A.W.; Gurusamy, K.; Parker, M.J. (2005). Delay to surgery prolongs hospital stay in patients with fractures of the proximal femur; *The Journal of Bone and Joint Surgery. British*, Aug;87(8):1123-6. DOI: 10.1302/0301-620X.87B8.16357.
- [13] Diamond, P.; Conaway, M.R.; Mody, S.; Bhirangi, K. (2006). Influence of Hemoglobin Levels on Inpatient Rehabilitation Outcomes after Total Knee Arthroplasty; *The Journal of Arthroplasty*; 21 (5): 636-641. DOI: 10.1016/j.arth.2005.09.006.
- [14] Sherbanov, O.; Nedeva, T. (2017). Perioperative delirium in orthopaedic ward - risk factors, ethyology, parhogenesis; *ВЕСТНИК СОБРЕМЕНННОЙ НАУКИ*, 3 – 1(27): 127 – 136.
- [15] Nedeva, T.; Sherbanov, O. (2013). The risk factors identification for a perioperative delirium in orthopaedic and traumatologic patients; *Proceedings of the Union of Scientists – Rouse*, Book 4, Medicine and Ecology, 3,:30 – 39.
- [16] Mosk, C.A.; Mus, M.; Vroemen, J.P.; van der Ploeg, T.; Vos D.I.; Leon, H.J.; van der Laan, E. (2017). Dementia and delirium, the outcomes in elderly hip fractures patients; *Clin. Interv. Aging.* 12: 421–430. DOI: 10.2147/CIA.S115945
- [17] Schrijver, E.J.; de Graaf, K.; de Vries, O.J.; Maier, A.B.; Nanayakkara, P.W. (2016). Efficacy and safety of haloperidol for in-hospital delirium prevention and treatment: a systematic review of current evidence; *European Journal of Internal Medicine*, 27:14–23. DOI: 10.1016/j.ejim.2015.10.012
- [18] Chróinín, D.; Francis, N.; Wong, P.; Kim, Y.D.; Nham, S.; D'Amours, S. (2021). Older trauma patients are at high risk of delirium, especially those with underlying dementia or baseline frailty; *Trauma Surg Acute Care Open.*, Apr 27;6(1):e000639. DOI:10.1136/tsaco-2020-000639
- [19] Gomez, C.R. (2014). Chapter 62 - Disorders of body temperature; *Handbook of Clinical Neurology*, Volume 120: 947-957.
- [20] Lenhardt, R.; Negishi, S.; Sessler, D.; Vuong, K.; Bastanmehr, H.; Kim, J.; Bjorksten, A. (1999). The effects of physical treatment on induced fever in humans; *American Journal of Medicine*, May;106(5):550-5. DOI: 10.1016/s0002-9343(99)00068-6