

# SELECTED CORRELATES OF THE PHYSICAL HEALTH OF PATIENTS UNDERGOING SPINAL DECOMPRESSION PROCEDURES DUE TO TUMOUR INFILTRATION

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## Summary

**Introduction:** An assessment of selected correlates of the functional status of patients undergoing surgery for spinal metastases from malignant tumours.

**Material and methods:** The study group (115 patients) accounted for 38.33% of all patients with cancer metastases to the axial skeleton treated at a purposively selected specialist institution within the Podkarpackie region. The study lasted 22 months. The first stage of the study was conducted between the first and second day after hospital admission, before surgery, and the second stage 3–4 months after surgery. A diagnostic survey and estimation method was used. Research tools such as the American Spinal Injury Association (ASIA) Impairment Scale, the Katz scale (activities of daily living – ADL), the visual analogue scale, and the Rotterdam symptom checklist were used. Statistical analysis was performed using the STATISTICA 13 package. A significance level of  $\alpha = 0.05$  ( $p < 0.05$ ) was adopted.

**Results:** Neurological dysfunctions before the procedure predisposed to pain ( $p = 0.0436$ ). The level of pain before the procedure was higher in patients with incomplete damage: (ASIA C) and (ASIA D). In terms of physical and mental symptoms and activity level, higher values of measured variables were demonstrated after surgery ( $p < 0.0001$ ). Pain intensity ( $p > 0.05$ ) was not shown to differentiate the performance of basic ADL.

**Conclusions:** Pain is the best-studied symptom experienced by people with musculoskeletal dysfunction in the course of cancer. Reducing pain predisposes to improved functionality, thus improving patients' physical activity, positively determining the subjective assessment of the quality of life.

**Key words:** cancer, bone metastases, self-care, functioning.

## Introduction

The global increase in the incidence of oncological diseases is very clear. It is estimated that in the next 20 years the incidence of cancer will double, and 70% of the incidence will occur in developing countries [1]. Malignant tumours are the second cause of death in Poland. According to data from 2019, the most common cancers in men were prostate (20.6%), lung (16.1%), and colorectal (11.0%). However, in the female population, breast cancer (22.9%), lung cancer (9.9%), endometrial cancer (7.0%), and colorectal cancer (5.9%) predominated. The highest percentage of deaths in men was recorded due to malignant tumours of the lung (30.7%), colon (10.9%), and prostate

(8.0%), and in women due to malignant tumours of the lung (15.3%), breast (13.3%), and colon (11.4%). The increase in the number of cancer cases and deaths in Poland is mainly due to changes in the age structure (an increase in the number of people over 65 years of age), increased exposure to carcinogens, and the prevalence of behaviours conducive to the development of cancer, including, among others, the persistently high level of addiction to alcohol and nicotine [2]. The causes of the increase in mortality also include inadequate nutrition [3], low physical activity [4], lack of awareness of the risk of cancer, and, consequently, society's reluctance to perform screening tests and to report early to a doctor or nurse when noticing possible pathological changes [5].

Bone metastases most often concern the axial skeleton and indicate the advancement of the disease, which translates into an unfavourable prognosis. The most common location of metastatic tumours in the spine is the thoracic-lumbar spine (70%) and the lumbar and sacral spine (20%), and the least common location is the cervical spine (10%) [6]. In many cases, bone pain, neuralgia, and pathological fractures are the first diagnosed symptoms. Despite performing all possible diagnostics, determining the primary focus of cancer is not possible in approximately 10% of patients [7, 8]. The first symptom of a metastasis in the spine is (95%) biological pain. Pain and neurological dysfunction resulting from damage to the axial skeleton impair the ability to function, and cause suffering and an increased risk of death [9, 10]. Metastatic epidural spinal cord compression (MESCC) is a common debilitating complication in 5–14% of patients. Rapidly developing symptoms of MESCC require immediate spinal decompression treatment. Standard treatment procedures are based on corticosteroid therapy, radiotherapy, and surgical methods of spinal decompression. The role of surgery has increased significantly in recent years compared to other methods. Patients may benefit from surgical decompression followed by radiotherapy in terms of functional capacity, pain relief, and life expectancy [9].

The aim of the study was to evaluate selected correlates of the functional status of patients undergoing surgery for malignant tumour metastases to the spine.

## Material and methods

The study included 300 patients with a diagnosed primary tumour in whom imaging tests (MRI, CT, X-ray, scintigraphy) revealed the presence of metastatic tumour invasion of the spine, and who were operated on due to spinal stenosis. The main study included people who met the following criteria: surgery performed on the spine due to the progression of a malignant tumour originally located in another location (laminectomy with posterior stabilization [ $n = 78$ ], corpectomy [ $n = 37$ ] with implantation of a spinal prosthesis), symptoms of neurological dysfunction, voluntary consent to participate in the research, and independence in completing forms. In total 180 people met the inclusion criteria for the study, of whom 65 were excluded due to withdrawal from the study and lack of independence in completing forms, disorders of consciousness, and death.

Finally, 115 subjects who completed 2 stages of the study were submitted for statistical analysis, as follows:

- stage I – the examination was carried out in the first or second day after admission to the hospital, before surgery;
- stage II – the examination was carried out 3–4 months after the surgery at the patient's home or in the clinic as part of follow-up visits.

The study group (115 people) constituted 38.33% of all patients with cancer metastases to the axial skeleton treated in a purposefully selected specialist facility in the Podkarpackie Voivodeship. The research lasted 22 months (December 2016–October 2018). The method of diagnostic survey, estimation, and analysis of medical records was used. Research tools were used to assess the functional status, including an original survey questionnaire (sociodemographic data, data from medical records) and the following clinical scales: the American Spinal Injury Association (ASIA) Impairment scale [11], Katz scale (activities of daily living – ADL) [12], and visual analogue scale (VAS) [13], and the Rotterdam symptom checklist (RSCL). Neurological assessment was performed by the physician examining the patients upon admission and in the clinic, while other assessments were performed by the research nurse. Pain intensity was defined as an independent variable, and in the statistical analysis the obtained measurement results of the adopted scales were compared in relation to pain intensity.

## Characteristics of the respondents

The 2-stage prospective study included 115 people, 47% women and 53% men. There were no differences between the sexes of the respondents ( $p = 0.1446$ ). The age of the respondents ranged from 36 to 86 years, and the mean age versus standard deviation was  $64.12 \pm 10.60$  years. The largest group (61.7%) were respondents aged 61–86 years. More than half of the respondents (57.4%) lived in a city. The majority (79.1%) were married. People (63.9%) with secondary education predominated. Half of the respondents (50.4%) declared that their socioeconomic status was at the level of the national average. Detailed sociodemographic data of the respondents are presented in Table 1.

## Statistical analysis

Statistical analysis was performed using the STATISTICA 13 package.

Quantitative variables were presented in the form of arithmetic mean, standard deviation, minimum, maximum, and median, while qualitative variables were presented as the number and frequency.

Differences between variables were verified using the Mann-Whitney  $U$  test and the Kruskal-Wallis test (for independent variables), the Wilcoxon signed-rank test or the McNemar-Bowker test (for dependent variables), and by calculating Spearman's rho correlation coefficient. The choice of tests was dictated by the lack of normality of the distribution of variables (verified by

the Kolmogorov-Smirnov and Shapiro-Wilk test) or the lack of equality of the studied groups (verified by the  $\chi^2$  consistency test). The one-sample Student's *t*-test was also used. The assumed significance level was  $\alpha = 0.05$  ( $p < 0.05$ ).

The consent of the director of the medical facility and a positive opinion of the Bioethics Committee at the University of Rzeszów were obtained to conduct the research (opinion no. 7/12/2016 of 2016/12/01). Moreover, the guidelines of the Declaration of Helsinki were followed throughout the study [14]. Participants were informed about the purpose of the study and could withdraw at any time without giving a reason.

## Results

### Clinical and functional status of the respondents

The assessment of the clinical and functional status of the respondents included the following: comorbidities, clinical diagnosis, location of metastatic lesions in the

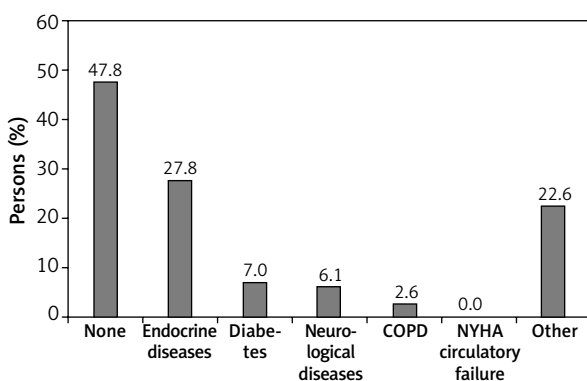


Fig. 1. Coexisting diseases in the study group

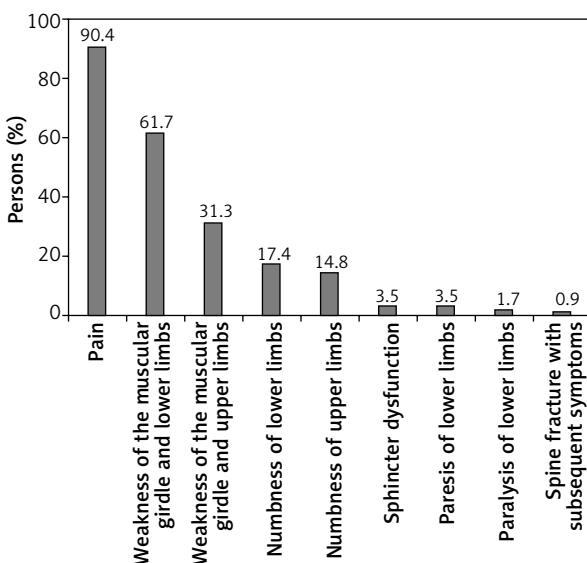


Fig. 2. Qualification of respondents for orthopaedic supplies

spine, assessment of the neurological condition (ASIA), functional assessment of the quality of life (RSCL), and ADL.

More than half of the respondents (52.2%) had, in addition to the diagnosed malignant tumour, confirmed comorbidities, including endocrine diseases, diabetes, neurological diseases, and COPD (Fig. 1).

Clinical diagnoses varied; breast cancer (27.0%) and multiple myeloma (27.7%), and, to a lesser extent, prostate cancer (12.2%), lung cancer (10.4%), and kidney cancer (9.6%).

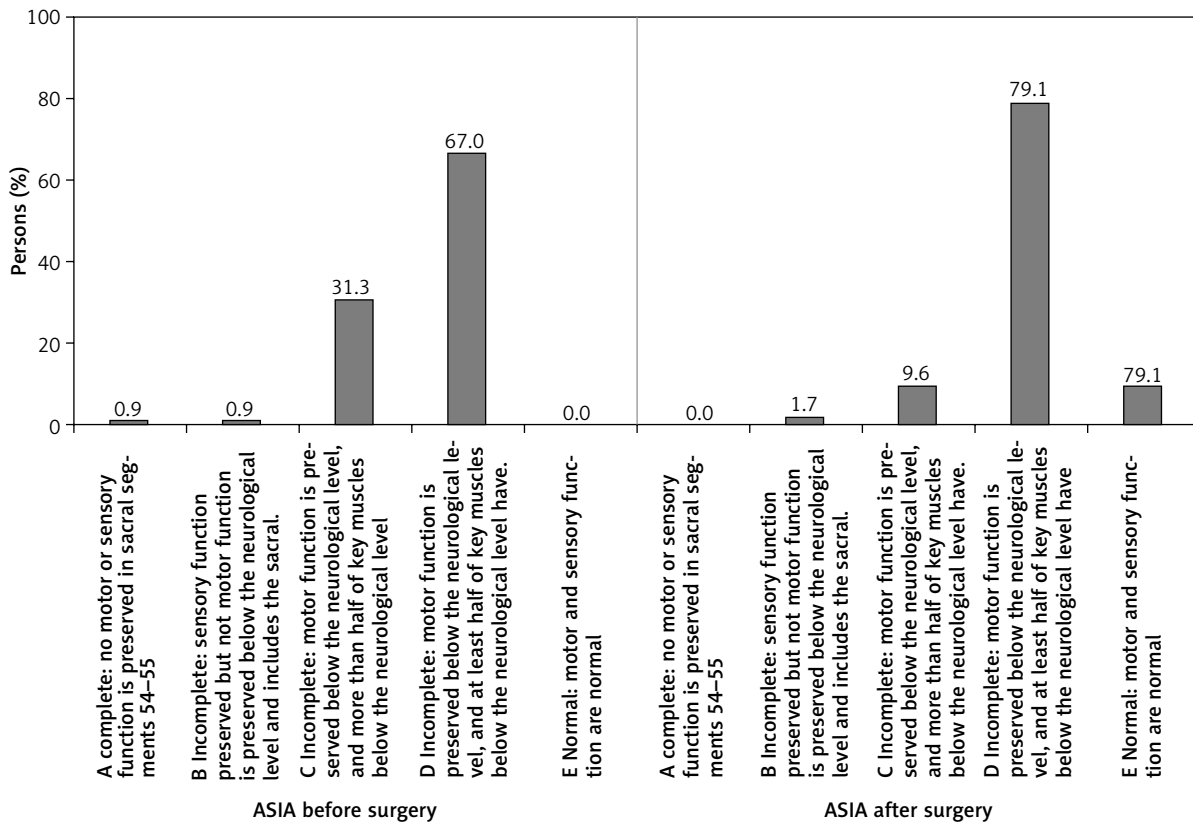
The location of metastatic lesions in the spine mainly concerned the thoracic (58.3%), lumbar (53.9%), sacral (6.1%), and cervical (4.3%) sections. In several cases, the changes concerned 2 locations, so the data obtained do not add up.

### Qualifications for orthopaedic treatment

Patients were qualified for orthopaedic treatment mainly due to pain (90.4%), weakened muscle strength of the girdle and lower limbs (61.7%), and weakened muscle strength of the girdle and upper limbs (31.3%). Detailed data are provided in Figure 2.

Table 1. Sociodemographic characteristics of the respondents

Data categories	n	%
Sex		
Female	54	47.0
Male	61	53.0
Age		
36–60 years	44	38.3
61–86 years	71	61.7
Domicile		
City	66	57.4
Countryside	49	42.6
Marital status		
Married	91	79.1
Widowed	16	13.9
Single	8	7.0
Other	0	0.0
Education		
Primary	4	3.5
Vocational	36	31.3
Secondary	62	53.9
University	13	11.3
Socioeconomic status		
Above the national average	11	9.6
At the national average	58	50.4
Below the national average	46	40.0



ASIA – American Spinal Injury Association Impairment Scale

Fig. 3. Comparison of the clinical assessment of patients before and after surgery on the American Spinal Injury Association Impairment Scale

### Neurological functionality according to the American Spinal Injury Association Impairment Scale

In the preoperative period, incomplete spinal cord damage was confirmed in 99.2% of cases, with the predominant damage at level D (the movement was preserved below the level of damage, and more than half of the key muscles had a strength equal to or greater than 3 on the Lovett scale). Complete spinal cord damage occurred in 0.9% of patients (level A). In the postoperative period, in the study group, normal motor and sensory function was found in 9.6% of the patients (level E), and in 90.4% incomplete spinal cord damage at levels B, C, and D was observed. Data analysis showed a difference in the assessment of spinal cord damage in the study group in the pre- and postoperative period. In the postoperative period, no complete spinal cord damage (level A) was observed in the study group; there was an increase of 0.8% in respondents in level B and of 12.1% in level D (with incomplete damage: with preserved movement below the level of damage and more than half of the key muscles having a strength equal to or greater than 3 on the Lovett scale), there was a 21.7%

decrease in level C, and normal motor and sensory function was found in 9.6% of the patients (level E) compared to the preoperative period (Fig. 3).

Neurological dysfunctions were associated with pain. Negative experiences before surgery on the VAS scale were measured in 111 people (i.e. 96.5% of respondents). Four people were unable to precisely assess their pain due to their health condition and the medications they were taking.

Before the surgery, pain was reported by 87.7% of the respondents, including more than half at the level of 6–8 points. 8.7% of respondents did not report any pain. After surgery, 45.2% of respondents did not feel pain. More than half (54.8%) had pain of 1–5 points. Before the surgery, the average level of pain was felt at  $5.04 \pm 2.07$  points and ranged from 0 to 8 points, while after surgery it was  $1.41 \pm 1.44$  points and ranged from 0 to 5 points. After surgery, there was a significant reduction in the level of pain experienced in the study group compared to the preoperative period (Fig. 4).

The collected data were compared using the Kruskal-Wallis test. The level of pain before surgery was higher in patients with incomplete damage (ASIA C, 5.35 points on the VAS scale) and the ASIA D group

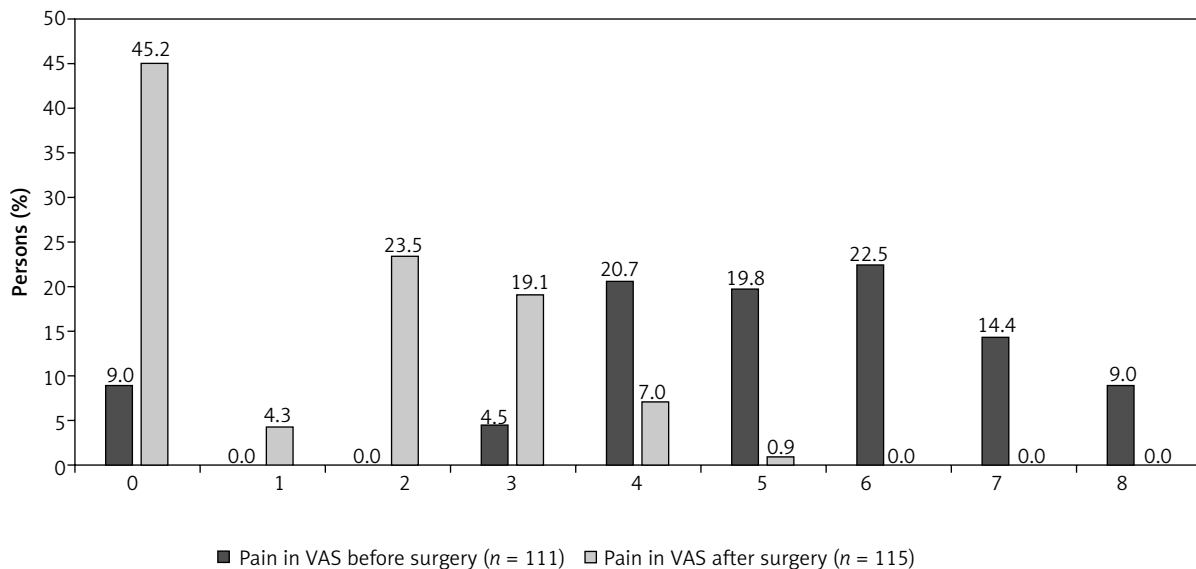


Fig. 4. Comparison of the level of pain experienced by patients before and after surgery on the visual analogue scale

(5.03 points on the VAS scale). In patients assigned to groups A and B according to the ASIA scale, the pain level was zero before the surgery. Neurological dysfunction predisposes to pain  $p = 0.0436$  (Table 2). After the surgery, the pain intensity was higher in group C according to the ASIA scale (2.09 points on the VAS scale), lower in group D (1.43 points), and the lowest in group E (0.82 points). In the case of 2 patients assigned to group B according to the ASIA scale, no pain was noted after the surgery (zero). The differences between the ASIA scale groups and the level of pain after the surgery were not statistically significant ( $p = 0.0863$ ).

#### Assessment of activity in terms of physical and mental symptoms

The Rotterdam symptom checklist (was used to provide an overall assessment of physical, mental, and activity levels. The results on the RSCL scale assessing the quality of life in terms of physical and mental symptoms (negative scales) and activity level (positive scale) were transformed in the range 0–100 points for comparison purposes. Data analysis showed higher values of measured variables after surgery ( $p < 0.0001$ ) in terms of feeling physical symptoms (30.71  $\pm$  11.96 points before surgery vs. 20.91  $\pm$  13.00 points after surgery) and mental symptoms (43.98  $\pm$  14.82 points before surgery vs. 31.35  $\pm$  14.86 points after surgery). The level of activity of the patients also improved ( $p < 0.0001$ ; 36.56  $\pm$  22.43 points to 43.55  $\pm$  20.40 points).

The analysis showed no correlation between pain before the procedure and the results on the RSCL scale before the procedure ( $p > 0.05$ ). However, it was shown

that after the procedure the level of pain correlated negatively with the level of activity scale ( $p = 0.0259$ ), so the higher the pain level, the lower the results on the level of activity scale (Table 3).

Basic everyday activities of the patients in the activities of daily living assessment

Basic activities of daily living in the study group were assessed using the Katz scale (ADL). The highest level of independence in basic daily activities in the preoperative period was achieved by the respondents in the area of eating independently (95.7%) and dressing and undressing (89.6%), lower in terms of bathing (45.2%) and toileting (55.7%) (Table 3). In the preoperative period, 46.1% of the respondents were fully functional. The highest level of independence in basic activities of daily living in the postoperative period was achieved by the respondents in the area of eating independently (97.4%), and dressing and undressing (93%), and it was lower in terms of toileting (63.5%) and bathing (56.5%) (Table 4). The results obtained indicate a slight improvement in self-care capacity.

Before surgery, the level of pain did not differentiate ( $p = 0.5836$ ) the assessment of basic ADL (Table 5). After surgery, it was also not confirmed that the level of pain according to VAS differentiated the ability to perform basic activities as assessed by ADL ( $p = 0.0810$ ) (Table 6).

#### Discussion

Contemporary progress in medical knowledge, early diagnosis, access to preventive tests, and progress in

**Table 2.** Pain intensity and level of spinal damage

Clinical assessment according to the ASIA scale	Mean	SD	Me	Min	Max	n
Pain on the VAS scale (0–10 points) before						
A Complete damage: lack of motor and sensory function below the level of damage, including lack of sensation	0.00		0.00	0	0	1
B Incomplete damage: no motor activity below the level of damage, with preserved sensation	0.00		0.00	0	0	1
C Incomplete damage: movement preserved below the level of damage and more than half of the key muscles	5.35	2.39	6.00	0	8	34
D Incomplete damage: movement preserved below the level of damage and more than half of the key muscles	5.03	1.76	5.00	0	8	75
Total	5.04	2.07	5.00	0	8	111
<i>p</i> -value	0.0436					

ASIA – American Spinal Injury Association Impairment scale, VAS – visual analogue scale Kruskal-Wallis test

**Table 3.** Pain intensity and Rotterdam symptom checklist subscales

Parameters	Physical symptoms scale (before)	Psychiatric symptoms scale (before)	Activity level scale (before)	Subjective assessment of quality of life (before)
Pain on the VAS scale (0–10 points) before the procedure				
<i>rho</i>	–0.108	–0.034	0.087	–0.023
<i>p</i> -value	0.2589	0.7194	0.3653	0.8105
<i>n</i>	111	111	111	111
Pain on the VAS scale (0–10 points) after surgery				
<i>rho</i>	0.129	0.095	–0.208	–0.033
<i>p</i> -value	0.1705	0.3135	0.0259	0.7301
<i>n</i>	115	115	115	115

VAS – visual analogue scale

Spearman's *rho* rank correlation coefficient

**Table 4.** Independence of the patients in performing basic activities of daily living in the pre- and postoperative period

Independence according to activities of daily living	The period before surgery		The period after surgery	
	<i>n</i>	%	<i>n</i>	%
Bathing	52	45.2	65	56.5
Dressing and undressing	103	89.6	107	93.0
Using the toilet	74	64.3	95	82.6
Getting out of bed and sitting on the chair	71	61.7	101	87.8
Eating independently	110	95.7	112	97.4
Controlled urination and stool	64	55.7	73	63.5

**Table 5.** Pain level and activities of daily living in preoperative assessment

Assessment of basic activities of daily living	Mean	SD	Me	Min	Max	<i>n</i>
Pain on the VAS scale (0–10 points) before surgery						
Significantly disabled people	4.14	2.93	5.00	0	8	14
Moderately disabled people	4.93	2.15	5.00	0	8	46
Able-bodied people	5.37	1.64	5.00	0	8	51
Total	5.04	2.07	5.00	0	8	111
<i>p</i> -value	0.5836					

VAS – visual analogue scale Kruskal-Wallis test



**Table 6.** Pain level and activities of daily living in postoperative assessment

Assessment of basic Pain on the VAS scale (0–10 points) after surgery	Mean	SD	Me	Min.	Max.	n
Pain on the VAS scale (0–10 points) after surgery						
Significantly disabled people	1.17	1.47	0.50	0	3	6
Moderately disabled people	1.91	1.51	2.00	0	5	33
Able-bodied people	1.21	1.37	0.00	0	4	76
Total	1.41	1.44	2.00	0	5	115
<i>p</i> -value	0.0810					

VAS – visual analogue scale Kruskal-Wallis test

pharmacology and radiotherapy provide a chance to cure or significantly extend the life of people with cancer [15, 16]. Despite expert observations and epidemiological data, many patients are still diagnosed in an advanced phase of the disease and will require professional care and palliative treatment. Global data indicate that approximately 30 million patients (3% of the world's population) need holistic palliative care [17–19]. Bone metastases are a clinical symptom of cancer advancement and dramatically reduce the patient's quality of life [7, 20]. Damage to the spine caused by metastatic tumours is a source of unrelieved pain, which intensifies mainly at night, initially of biological origin [21, 22]. Pain is the best-studied symptom experienced by people with musculoskeletal dysfunction in the course of cancer. Observational studies show that this is one of many disturbing symptoms that should always be minimized, especially in advanced stages of the disease [23, 24].

In the present study, the most frequently reported negative symptom by patients was pain and neurological dysfunction. It was hypothesized that pain resulting from damage and infiltration of neural structures may cause limitations in physical functioning. Two questionnaires were selected to assess these variables: RSCL and ADL. Variables were assessed twice before surgery and 3–4 months after surgery. A reduction in pain intensity (preoperative mean 5.04 vs. 1.41) was observed after spinal decompression and surgical stabilization of the spine with improved physical and self-care capacity. Pain sensations correlated with the level of damage to neural structures classified as ASIA type damage C (5.35 points on the VAS scale) and D (5.03 points on the VAS scale).

Reducing pain predisposes to improved functionality, thus improving the physical activity of patients and positively determining the subjective quality of life. The results obtained based on the RSCL questionnaire confirm the concept of other researchers. Unfortunately, the hypothesis regarding improved functionality with reduced pain was not confirmed in the assessment of functionality using the ADL scale. It has not been confirmed that the reduction in pain determines the better

functionality of the patients. When making a critical analysis of the conducted research, the functional capabilities of patients with advanced cancer and their point of self-perception should be taken into account. It is assumed that the respondents, when assessing themselves, were too critical of their own capabilities, hence the lack of significant correlation in the case of a positive quantitative assessment. The above observations should be re-examined in a more detailed study.

In tumours metastatic to the spine, despite improvement of the neurological condition, the survival period is short. The authors indicate that 80% of patients die within one year from the occurrence of a spine metastasis. The patient's death is caused by local recurrence of the tumour or generalization and progression of the cancer. Numerous studies have shown that the use of surgical treatment had a positive impact on the life expectancy of patients and improved its quality, both physically and mentally [22–26]. When assessing the patients' condition, the authors did not examine the length of life after the procedure, which may be considered a limitation of the study; 2 patients were excluded from the studied sample who did not survive to the second stage of the study. Analysing the objective assessment of the subjects, a clear conclusion can be drawn that the surgical procedure reduced the symptoms and improved the functioning of the subjects during the 3–4-month follow-up. According to Guzik, the combination of surgical treatment and postoperative radiotherapy opens the possibility of tumour control and local prevention relapse [7, 24]. These observations shed light on the treatment of lesions in the spine, increasing the possibility of minimally invasive procedures leading to improvement of the patient's functionality. A study conducted by Yifei *et al.* in a group of 287 patients with metastatic cancer to the spine, including 191 patients who underwent surgery and 96 treated with radiotherapy, showed that the quality of life improved significantly 6 months after surgery [27]. According to Biega *et al.*, corpectomy, like other surgical techniques, can effectively reduce the pain associated with compression of the nerve trunks. Reducing pain leads to improved functionality of patients and min-

imizes suffering, thus improving the assessment of their quality of life [25].

Until recently, most outcome measures for spinal metastases focused on survival, recurrence, complications, or measures of function and neurologic status. Less attention has been paid to how patients characterize and describe their own health [28]. Our own research sheds new light on the issues related to the possibility of functioning and self-care after spinal surgery for oncological reasons; therefore, they should be treated as preliminary reports, and the obtained results constitute a premise for further research, which should be continued after 6, 12, or 24 months.

## Conclusions

Pain is the best-studied symptom experienced by people with musculoskeletal dysfunction in the course of cancer. Reducing the intensity of pain predisposes to improved functionality, thus improving the physical activity of patients and improving the subjective assessment of the quality of life.

*The authors declare no conflict of interest.*

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