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Kinesiophobia in Pre-Operative Patients with Cervical Discopathy and Coexisting Degenerative Changes in Relation to Pain-Related Variables, Psychological State and Sports Activity

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Background: No research group has ever investigated the level of kinesiophobia in a well defined group of preoperative patients treated due to cervical discopathy and degenerative spine disease, confirmed by X-ray and magnetic resonance imaging (MRI) examinations. We aimed to investigate the degree of kinesiophobia and the differences in pain-related and psychosocial characteristics between patients with high and low levels of kinesiophobia, in relation to factors commonly associated with neck pain.





Material/Methods: Sixty-five consecutive patients with cervical discopathy and coexisting degenerative changes were assessed pre-surgically. The mean pain duration was 31.7 SD 34.0 months. Patients completed the Polish versions of the Tampa Scale for Kinesiophobia (TSK-PL) on 2 occasions, and the following once: Neck Disability Index (NDI-PL), State-Trait Anxiety Inventory (STAI-PL), Coping Strategies Questionnaire (CSQ-PL), and the Visual Analogue Scale (VAS-PL).

Results: A high level of kinesiophobia was indicated in 81.5% and 87.7% of patients in first and second completion, respectively. Patients with high and low kinesiophobia differ in regards to the recreation section of NDI-PL ($p=0.012$), gender ($p=0.043$), and sports activity ($p=0.024$). Correlations were identified between TSK-PL and marital status ($p=0.023$) and sports activity ($p=0.024$).

Conclusions: Kinesiophobia levels are higher in patients with chronic cervical pain before surgical treatment. Fear of movement tends to be higher in women and among patients avoiding sports recreation before surgical treatment. Although sports activity and socio-demographic data are predictors of kinesiophobia, psychological, pain-related, and clinical data are not. These findings should be considered when planning rehabilitation after surgical treatment of cervical discopathy and coexisting degenerative changes.

MeSH Keywords: **Anxiety • Neck Pain • Phobic Disorders**

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Background

The influence of anxiety as a psychosocial factor relevant to body pain has been extensively studied [1–5]. In general, anxiety is thought to be associated with pain intensity and pain duration [6,7]. Specifically, chronic pain sufferers with high levels of pain are considered likely to have high levels of anxiety with respect to their condition/symptoms and, in particular, pain-related fear [4,8–12].

Kinesiophobia, a term introduced by Kori et al. in 1990, is defined as “an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury” [13]. Fear of pain may lead to catastrophic interpretations of pain, avoidance, escape, and hypervigilance behaviors. While functional disability can arise as a result of pain-related fear, the severity of pain is also likely to play an important role [14]. The Tampa Scale for Kinesiophobia (TSK) is one of the most frequently used questionnaires to assess the subjective rating of fear of movement and/or (re)injury [15–18].

Most research on fear of movement has been focussed on low back pain, but recently there has been growing interest in kinesiophobia in patients treated for neck pain. The previously analyzed groups of patients were usually receiving treatment for non-specific neck pain in primary health care [19] or seeking physiotherapy treatment at a primary care outpatient rehabilitation clinic due to various neck disorders [20]. It has been suggested that various non-medical factors such as basic education, depression, anxiety, personality, deficits in social support, and infrequent physical exercise are closely linked to recurrent or persistent neck pain in these population [6,21–23]. In some studies in more specifically defined populations, participants reported their neck pain was due to a work-related injury or a motor-vehicle accident [24].

No group has ever reported evaluating the level of kinesiophobia in such a well defined patient population – preoperative patients treated due to cervical discopathy and degenerative spine disease, confirmed in an X-rays and Magnetic Resonance Imaging (MRI) examinations, with coexisting neurological deficits. To our knowledge, little is known about the associations between fear of movement and pain-related disability, trait anxiety, or coping strategies in this specific patient population. Some areas of research, including detailed evaluation of the degenerative cervical spine disease with regard to the TSK scores, require further investigation.

Although the TSK has been translated into different languages, a Polish version of the TSK was unavailable until now [17,25–30]. Thus, firstly, the purpose of the present study was to determine the psychometric properties of the Polish, 17-item version of TSK in a sample of pre-operative patients with neck

pain due to cervical discopathy and coexisting degenerative changes. Secondly, we aimed to investigate the degree of kinesiophobia and to determine if, and to what extent, other factors commonly associated with neck pain (e.g., decreased range of motion, difficulties in car driving, radiating of cervical pain, decreased muscle strength, and disturbed sensations in upper extremities or problems in maintaining balance) are associated with fear of movement or (re)injury. Therefore, the aforementioned factors are the predictors (independent variables) influencing the dependent variable, which was the level of kinesiophobia. We also sought to analyze the differences in pain-related and psychosocial characteristics between patients with high and low levels of kinesiophobia. We investigated the relationship between the level of kinesiophobia (low or high) and pain-related and psychosocial characteristics.

Material and Methods

Study design

The questionnaires collected information regarding socio-demographic data, pain-related variables, and psychological characteristics. Questions asked, for example, how long neck pain had been present in months, and whether neck pain was constantly present or intermittent. The design of the study was approved by the Bioethics Committee of Poznan University of Medical Sciences.

Research procedure

Patients were hospitalized for surgery due to cervical discopathy in the Department of Neurosurgery and Neurotraumatology of Poznan University of Medical Sciences. All physical examinations were performed by the same physician, a neurosurgeon. MRI of the cervical spine was performed in all cases. Anterior cervical discectomy and fusion was done in all study participants. The average length of the hospital stay ranged from 4 days to 12 days, including the day of surgery.

Inclusion and exclusion criteria

Participants were eligible for the study if they were: (1) over 18 years old, (2) had experienced neck pain for at least 3 months, (3) were treated operatively due to cervical discopathy and coexisting degenerative changes, and (4) were fluent in the Polish language. We excluded patients who were pregnant, had cancer, had other neurological diseases or rheumatoid arthritis, were being treated for a terminal disease or psychiatric disorders, or had previous spinal surgery. Comorbidities such as allergy, asthma, hypertension, anemia, arrhythmia, diabetes, angina pectoris, atherosclerosis, hyperthyroidism, and hyperthyroidism were reported in the studied group.

Table 1. Socio-demographic characteristics of study participants.

Characteristics	Mean (SD), range	No. (%)
Gender (M/F)	–	24(36.9)/41(63.1)
Age (years)	49.2 (8.1), 31–66	–
Employment status		
Work full/part-time	–	37 (56.9)
Hours of paid work (weekly)*	36.2 (20.3), 8–120	–
Retirement	–	8 (12.3)
Disability pension	–	12 (18.4)
Unemployed	–	5 (7.7)
Housewife	–	3 (4.6)
Marital status		
Single	–	2 (3.1)
Married	–	51 (78.5)
Widowed	–	1 (1.5)
Divorced	–	11 (16.9)
Educational level		
Elementary	–	3 (4.6)
Vocational	–	27 (41.5)
Secondary	–	26 (40.0)
University	–	9 (13.8)
Place of residence		
Countryside	–	21 (32.3)
City below 25,000 inhabitants	–	16 (24.6)
City between 25,000 and 200,000 inhabitants	–	11 (16.9)
City over 200,000 inhabitants	–	17 (26.2)

* Out of 37 participants working full/part-time.

Data collection

All study participants were recruited consecutively and were assessed preoperatively. After a complete description of the study was given, written informed consent was obtained from all the participants. Participants were assured of anonymity, and that a refusal to participate in the study would not affect further treatment. The design of the study was approved by the Bioethics Committee of Poznan University of Medical Sciences.

After enrollment, patients were asked to complete the questionnaires. The investigator was available throughout the visit if participants required explanation or clarification.

Participants

Seventy-eight consecutive patients, seeking care in the Department of Neurosurgery and Neurotraumatology between June 2009 and September 2010 were eligible for the

study. Two patients were excluded because of cancer and 1 due to psychiatric disorders. A further 10 patients dropped out of the study, and were excluded due to incomplete data.

Finally, there were 65 study participants, of which 24 were men (36.9%) and 41 were women (63.1%). Patients were aged between 31 and 66 years, with a mean age of 49.2 yrs (SD 8.1) (See Table 1 for detailed analysis of socio-demographic data). The range of pain duration was from 3 months to 10 years, and the mean pain duration was 31.7 months (SD 34.0); 41 participants (63.1% of the population) had constant (without remission) neck pain. In 19 of the 65 cases (29.2%) there was a history of overload/injury in the cervical spine. Additional pain-related and clinical data are shown in Table 2 and 3.

Outcome measures

Polish versions of evaluation instruments are listed below.

Table 2. Clinical characteristics of study participants.

Characteristics	Mean (SD), range	No. (%)
Neck pain duration (in months)	31.7 (34.0), 3–120	–
Cervical spine overload/injury	–	19 (29.2)
Symptoms		
Local cervical (neck) pain	–	31 (47.7)
Cervicobrachialgia	–	24 (36.9)
Myelopathy and cervicobrachialgia	–	10 (15.4)
Presence of neurological deficits	–	34 (52.3)
Decreased range of motion in cervical spine	–	45 (69.2)
Decreased muscle strength in upper extremities	--	58 (89.2)
Sensory abnormalities in upper extremities		
Lack of sensory abnormalities	–	2 (3.1)
Decreased sensory	–	33 (50.8)
Sensory disturbance (numbness, tingling)	–	30 (46.1)
Problems in maintaining balance/dizziness	–	42 (64.6)
Collapse	–	15 (23.1)
Constant neck pain	–	41 (63.1)
Physical activity aggravates pain	–	59 (90.8)
Car driving aggravates pain	–	35 (81.4)*
Being in a prone/sitting position aggravates pain	–	51(78.5)/59(90.8)
Bending the head forward aggravates pain	–	39 (60.0)
Tilting the head back aggravates pain	–	42 (64.1)
Deviation of the head to the right/to the left aggravates pain	–	44(67.7)/36(55.4)
Turning the head to the right/left aggravates pain	–	41(63.1)/36(55.4)
Sleep interrupted by pain	–	38 (58.5)
Recreational sport activity before beginning of the disease	–	15 (23.1)
Smoking	–	29 (44.6)
Earlier physical therapy	–	44 (67.7)
Continuous use of opioid	–	8 (12.3)

* Out of 45 participants with driving license.

The *Tampa Scale of Kinesiophobia* is designed by Kori et al. to assess fear of pain and (re)injury due to activity [12,15,16]. It consists of 17 items, each rated on a 4-point Likert-type scale. The TSK was initially used to measure fear of movement related to chronic low back pain, however, it has been used increasingly for pain related to different parts of the body, including the cervical spine [29]. The TSK total score ranges from 17 to 68, with scores greater than 37 indicating a high degree of kinesiophobia [9,29]. An 11-item Tampa Scale for Kinesiophobia (TSK-11) has also been developed [31,32]. In this study we used an adaptation of the 17-item version of the TSK.

The *trait form of the State-Trait Anxiety Inventory (STAI-trait)*. The STAI-trait [33] is comprised of 20 items assessing the extent

to which respondents experience temporally stable levels of anxiety. It contains 4-point Likert items. The range of scores is 20–80, with a higher score indicating greater anxiety [33–35].

Visual analogue pain scale (VAS). Intensity of participants' clinical pain was assessed using a visual analogue scale comprising a vertical line graphic labeled with intensity-denoting adjectives and numbers ranging from 0 ("no pain") to 100 ("worst possible pain") [36].

The *Coping Strategies Questionnaire (CSQ)* consists of 50 questions that evaluate 6 cognitive strategies (diverting attention, reinterpreting pain sensations, ignoring pain sensations, coping self-statements, catastrophizing, and praying/hoping) and

Table 3. Radiological evaluation.

Characteristics	No. (%)
Number of discopathy levels	
1 level	13 (20.0)
2 or more levels	52 (80.0)
Changes of signal intensity in spinal cord	13 (20.0)
Sagittal dimension of vertebral canal on the discopathy level	
>9 mm	27 (41.5)
<9 mm	38 (58.5)
Degenerative changes	
Facet hypertrophy	29 (44.6)
Thickened ligamentum flavum	20 (30.8)
Osteophytes of vertebral bodies	45 (69.2)
Narrowing of the neural foramen	34 (52.3)

1 behavioral strategy (increasing behavioral activities) for coping with pain. Each item is rated from 0 (never do that) to 6 (always do that). Each subscale score can range from 0 to 36. In addition, the 2 effectiveness items are used to rate the overall ability to control and to decrease pain. These items are rated from 0 (no control/not able to decrease pain at all) to 6 (complete control/able to decrease pain completely) [37].

The Neck Disability Index (NDI) assesses neck pain intensity and is composed of the following sections: pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation [38,39]. Each item is scored from 0 (no disability) to 5 (total disability). The maximum possible score is 50, but the sum of the scores obtained is often doubled to give a percentage score out of 100. The interpretation is as follows: 0–20 is normal, 21–40 is mild disability, 41–60 is moderate, 61–80 is severe disability, and 80 or over is complete or exaggerated disability [38–41].

Translation and adaptation procedure

The process of cross-cultural adaptation of TSK for Polish settings was compliant with the guidelines proposed by Beaton et al. [42] and was comprised of a number of stages. In the first stage, 2 translators working independently translated the English version of the TSK into Polish. Polish was the native language of these translators. One of the translators, who had a medical background, was instructed on the whole process of the adaptation. The other translator had no medical background and received no information on the project. In the second stage, these translations were compared and synthesized into a single version by the 2 translators and the authors of the project. In the third stage – the so-called reversed translation – 2 independent translators, who were native speakers of English, translated a

compromised version of the Polish translation into the language of the original document. The translators were not familiar with the original language version. The objective of this stage was to assure equivalence of the 2 versions and to identify possible mistranslations. In the final stage, a committee of translators, an orthopedic surgeon, a statistician, and a psychologist reviewed all the translations to create a pre-final version of the questionnaire. Then 65 patients filled out the TSK-PL (Appendix 1) twice with a 2-day interval, before the surgical treatment.

Considering the course of the translation process, the questionnaire items were translated easily, with some grammar discrepancies appearing because of different linguistic backgrounds. For example, in the TSK-PL, we had to take female and male inflexions into account when translating verbs. Most of subjects understood the translated items well and did not report difficulties during completion.

The following tests on the psychometric properties of the TSK-PL were conducted. To assess the internal consistency of the PL-CPCI-42, Cronbach's alpha was calculated. Cronbach's alpha values were accepted as follows: ≥ 0.80 as excellent, 0.70–0.79 as adequate, and < 0.70 as poor [43]. We analyzed floor and ceiling effects (% of patients with the minimum score and % of patients with the maximum score). Test-retest reliability was calculated using the Intra-Class Correlation (ICC) as an alternative to the Pearson's product moment correlation. Values of ICC above 0.80 were considered as evidence of excellent reliability [44].

The Bland-Altman plot was used [45] as a measure of within-subject variation. The limits of agreement were used to assess the agreement between the TSK-PL scores on the 2 occasions [46,47]. This was created by plotting mean difference in the TSK-PL scores for the 2 occasions against the baseline TSK-PL

Appendix 1.

Skala kinezyfobii Tampa – polska wersja (Tampa Scale for Kinesiophobia – Polish version)

1 – zdecydowanie się nie zgadzam / 2 – nie zgadzam się / 3 – zgadzam się / 4 – zdecydowanie się zgadzam

1.	Boję się, że mogę ulec urazowi, jeśli będę ćwiczył/a.	1	2	3	4
2.	Gdybym próbował/a pokonać ten lęk, mój ból by się nasilił.	1	2	3	4
3.	Moje ciało daje mi znać, że dzieje się ze mną coś niebezpiecznego.	1	2	3	4
4.	Mój ból prawdopodobnie by się zmniejszył, gdybym ćwiczył/a.	1	2	3	4
5.	Ludzie nie traktują mojego stanu zdrowia wystarczająco poważnie.	1	2	3	4
6.	Mój uraz spowodował, że moje ciało będzie narażone na ryzyko do końca życia.	1	2	3	4
7.	Ból zawsze oznacza, że doznałem urazu ciała.	1	2	3	4
8.	To, że coś wzmacnia mój ból, nie znaczy, że jest to niebezpieczne.	1	2	3	4
9.	Boję się, że przez przypadek mogę ulec urazowi.	1	2	3	4
10.	Zachowanie ostrożności, polegającej na tym, iż nie wykonuję żadnych zbędnych ruchów, jest najbezpieczniejszą rzeczą jaką mogę zrobić, aby zapobiec nasileniu się bólu.	1	2	3	4
11.	Nie odczuwałbym/abym takiego bólu, gdyby w moim ciele nie działo się nic potencjalnie niebezpiecznego.	1	2	3	4
12.	Chociaż mój ból jest dokuczliwy, będę czuł/a się lepiej, jeśli będę aktywny/a fizycznie.	1	2	3	4
13.	Ból daje mi znać, kiedy przestać ćwiczyć, aby uniknąć urazu.	1	2	3	4
14.	Naprawdę nie jest bezpieczne, aby osoba w moim stanie zdrowia była aktywna fizycznie.	1	2	3	4
15.	Nie mogę wykonywać wszystkich czynności, które wykonują normalni ludzie, ponieważ łatwo mogę doznać urazu.	1	2	3	4
16.	Nawet jeśli coś sprawia mi dużo bólu, nie sądzę, aby było to naprawdę niebezpieczne.	1	2	3	4
17.	Nikt nie powinien ćwiczyć, jeśli odczuwa ból.	1	2	3	4

scores. We calculated 95% confidence interval around the mean difference and limits of agreement were also plotted [46].

Construct validity refers to the extent to which scores on a particular instrument relate to other measures in a manner that is consistent with theoretically derived hypotheses concerning the concepts that are being measured [48,49]. We hypothesized, similar to the study conducted by French et al. [24], that TSK-PL will be related to other pain-related measures theoretically related to the kinesiophobia construct: catastrophizing (from CSQ), anxiety (from STAI), disability (from NDI-PL), and pain intensity (measured by VAS).

Statistics

Continuous variables are presented as means with SDs in parentheses, range and 95% confidence intervals (95% CI). Categorical variables are presented as percentage and number of units belonging to the same group. The Mann-Whitney test or the Kruskal-Wallis test was used to determine dependency between quantitative and qualitative characteristics.

Spearman's rank correlation coefficient was used for calculating correlations between quantitative variables. Differences between patients with low and high levels of kinesiophobia were tested using the Mann-Whitney test or the Fisher exact test. The level of significance was set at $p < 0.05$.

We used logistic regression analysis to define the degree to which patient characteristics affect the level of kinesiophobia in participants with cervical discopathy and coexisting degenerative changes. Based on the TSK scores interpretation [29], a TSK total score ranging from 17 to 37 points was defined as a "good result". Statistical analysis was done using Statistica.

Results

Psychometric properties of TSK-PL-preliminary validation

The internal consistency (coefficient Alpha) of the TSK-PL was excellent and equaled 0.80 (95% CI 0.72–0.86). Similarly, temporal stability (test-retest reliability) based on the Intraclass

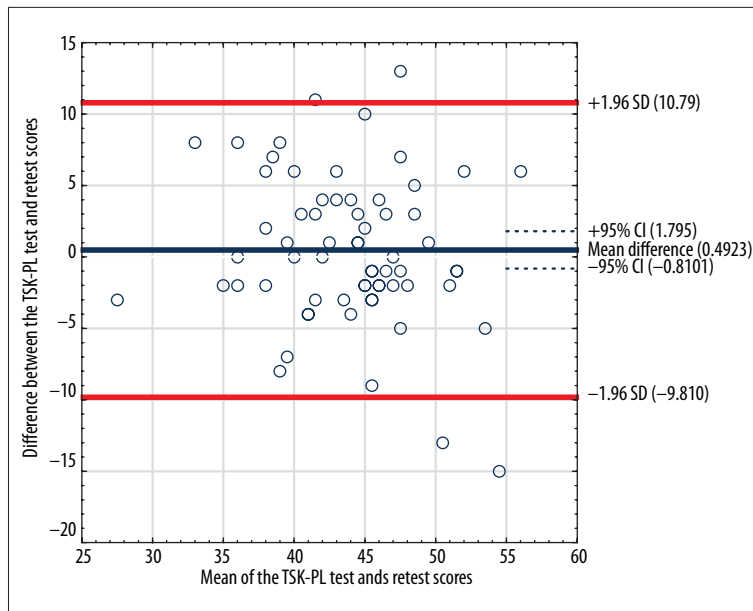


Figure 1. Bland and Altman visual analysis for test-retest agreement of the TSK-PL.

Table 4. Internal consistency, test-retest reliability and construct validity study results.

Cronbach's alpha (95% CI)		Test-retest reliability (ICC)		Construct validity						
				Correlation between TSK-PL and STAI-PL			Correlation between TSK-PL and VAS-PL			
0.80 95% CI from 0.72 to 0.86		0.98 95% CI from 0.97 to 0.99		rS=0.06			rS=0.15			
Construct validity- correlation between TSK-PL and CSQ-PL										
Diverting attention	Reinter- preting pain sensations	Ignoring pain sensations	Coping self- statements	Catastro- phizing	Praying / hoping	Behavioral activities	Item 43	Item 44		
rS=-0.04	rS=-0.04	rS=0.14	rS=0.21	rS=0.17	rS=0.15	rS=0.15	rS=-0.15	rS=-0.19		
Construct validity – correlation between TSK-PL and NDI-PL										
Total score	Pain intensity	Personal care	Lifting	Reading	Head- aches	Concen- tration	Work	Driving	Sleeping	Recreation
rS=0.04	rS=0.09	rS=-0.01	rS=0.01	rS=0.11	rS=0.01	rS=-0.20	rS=-0.03	rS=0.18	rS=-0.18	rS=0.25*

* $p < .05$; CI – Confidence Interval; ICC – Intraclass Correlation Coefficient; TSK-PL – Polish versions of the Tampa Scale for Kinesiophobia; NDI-PL – Neck Disability Index; STAI-trait-PL – State-Trait Anxiety Inventory; CSQ-PL – Coping Strategies Questionnaire; VAS-PL – Visual Analogue Scale.

Correlation Coefficient (ICC) was excellent and equaled 0.98 (95% CI 0.97–0.99).

The Bland-Altman plot was used to graphically represent the agreement between the TSK-PL test and retest scores (Figure 1).

Analysis of construct validity indicated that the TSK-PL was not significantly correlated with the general measures of pain severity (VAS-PL) or other self-report instruments of neck

pain-related disability (NDI-PL total score). Interestingly, taking into account individual sections of the NDI-PL, recreation ($rS=0.25$, $p=0.041$) was weakly associated with the level of kinesiophobia. Furthermore, TSK-PL scores were not significantly correlated with the analyzed coping strategies, measured by CSQ-PL. Contrary to our expectations, associations were not obtained for TSK-PL scores and other measures of anxiety (STAI-trait-PL) (Table 4).

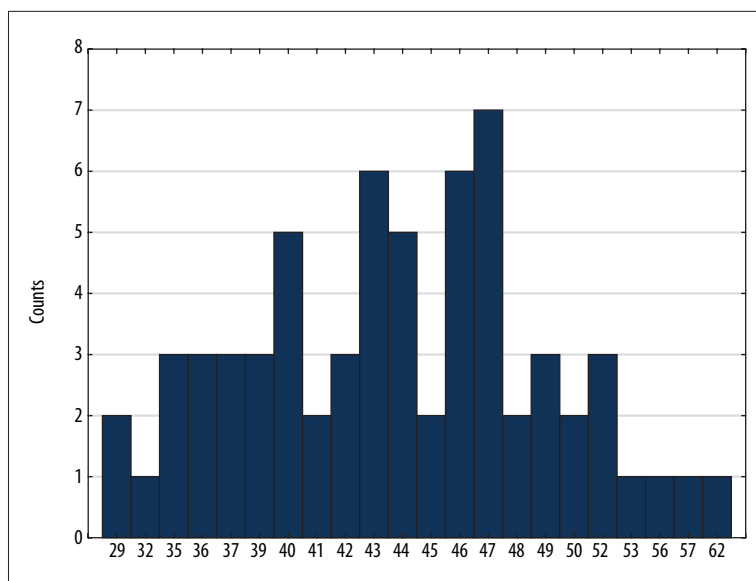


Figure 2. Floor and ceiling effects assessment.

Floor and ceiling effects were not present, since none of the patients scored the minimum (17 pts) or the maximum (68 pts) in the test or retest. Figure 2 presents a histogram of the floor and ceiling effect assessment.

Outcome measures-scores distribution

Means with SDs, range, and 95% CI are presented in Table 5. A TSK total score over 37 points, indicating high level of kinesiophobia, applied to 81.5% of patients (53 participants) in the test and to 87.7% of patients (57 participants) in the retest. In regards to the general results of STAI-trait, 34.5% of patients experienced a low anxiety level, medium anxiety was reported by 44.6% of patients, and high anxiety was experienced by 20% of study participants.

Sub-groups comparisons

Based on the TSK scores interpretation [29], patients were divided into 2 subgroups: with low or high level of kinesiophobia ($n=12$ and $n=53$, respectively). Having analyzed quality of life data, the subgroups do not differ in regards to the VAS-PL, CSQ-PL, or STAI-trait-PL results (Table 6). Interestingly, patients with high and low levels of kinesiophobia differ in regards to the recreation section of the NDI-PL ($p=0.012$, patients with lower level of kinesiophobia display lower NDI-PL results in regard to the recreation section).

Concerning patient characteristics, statistically significant associations between the analyzed subgroups with high and low fear of movement and gender ($p=0.043$) were supported. The frequency of reporting a low level of kinesiophobia was 6 times higher among male patients than female patients. A statistically significant difference between the analyzed subgroups and

recreational sports activity ($p=0.024$) was confirmed. We found that among patients reporting sports recreation, the frequency of reporting a low level of kinesiophobia was over 3 times higher than in patients avoiding this activity.

Correlational analyses by socio-demographic characteristics

We assessed the relations between the socio-demographic characteristics of study participants and TSK-PL. The only statistically significant correlation was identified between marital status and TSK-PL ($p=0.023$). It was revealed that married patients report a higher level of kinesiophobia compared to divorced patients. Age, gender, education level, current employment status, and place of residence were not significantly associated with the TSK-PL (Table 7).

Correlational analyses by pain-related and patient clinical characteristics

Analysis of correlation between pain level and patient characteristics and TSK-PL revealed that the only statistically significant association was identified between recreational sports activity practiced before the beginning of the disease and TSK-PL ($p=0.024$). Patients practicing sports report a lower level of kinesiophobia (Table 8).

The logistic regression analyses

The multivariate model could not be applied due to relatively small sample size ($n=65$) and the small number of patients reporting a low level of kinesiophobia ($n=12$). For a multivariable model (based on all significant variables in univariate model), none of the analyzed variables were significant. That

Table 5. Descriptive statistic of questionnaire results.

Measurements	Mean (SD)		Range (Min–Max)	95% Confidence Intervals	
				From	To
TSK-PL (test)	43.7	(6.3)	29–62	42.1	45.2
TSK-PL (retest)	44.2	(5.5)	26–59	42.8	45.5
VAS-PL	47.3	(19.7)	2–100	42.4	52.2
CSQ-PL					
Diverting attention	2.5	(1.2)	0–5.3	2.2	2.8
Reinterpreting pain sensations	1.7	(1.2)	0–4.5	1.4	2.0
Ignoring pain sensations	2.0	(1.5)	0–7.7	1.6	2.4
Coping self-statements	2.6	(1.5)	0–6.0	2.2	2.9
Catastrophizing	3.2	(1.4)	0–5.7	2.9	3.6
Praying / hoping	3.4	(1.3)	0–6.0	3.1	3.7
Behavioral activities	3.0	(1.3)	0–5.7	2.6	3.3
Item 43	3.5	(1.3)	0–6.0	3.2	3.8
Item 44	2.8	(1.3)	0–6.0	2.5	3.1
STAI-trait-PL	43.7	(8.0)	25–63	41.7	45.7
NDI-PL total score	23.0	(6.7)	5–35	21.3	24.3
Pain intensity	2.3	(0.8)	0–4	2.1	2.5
Personal care	1.3	(0.9)	0–3	1.1	1.6
Lifting	3.0	(1.4)	0–5	2.6	3.3
Reading	2.6	(1.0)	0–5	2.3	2.8
Headaches	2.8	(1.5)	0–5	2.4	3.1
Concentration	1.4	(0.9)	0–4	1.1	1.6
Work	2.4	(1.0)	0–5	2.2	2.7
Driving	2.6	(1.3)	0–5	2.2	3.0
Sleeping	2.6	(1.3)	0–5	2.3	2.9
Recreation	2.8	(1.2)	0–5	2.5	3.1

TSK-PL – Polish versions of the Tampa Scale for Kinesiophobia; NDI-PL – Neck Disability Index; STAI-trait-PL – State-Trait Anxiety Inventory; CSQ-PL – Coping Strategies Questionnaire; VAS-PL – Visual Analogue Scale.

is why we decided to perform the stepwise approach (backward elimination) to find a subset of variables that will make a significant contribution to model. However, due to small sample size, only the univariate model was significant.

The logistic regression model gained as a result of the calculations revealed that only recreational sports activity has a statistically significant ($p=0.021$) influence on the probability of achieving low level of kinesiophobia, as measured by the TSK-PL. Odds ratio calculations suggest that patients engaged in sports activity were 4.88 times more likely to report a low level of kinesiophobia (95% CI, 1.24–19.16).

Discussion

Preliminary research has shown that there is value from a psychometric perspective in using the TSK with neck pain patients [18]. Cleland et al. examined the psychometric properties of the TSK in patients with neck pain at baseline and in a 2-day follow-up. It was reported that the TSK was moderately reliable for neck pain patients [50,51]. The present study supported that the Polish TSK meets the criteria of excellent internal consistency and test-retest reliability in a group of pre-operative patients with cervical discopathy and coexisting degenerative changes; however, construct validity of TSK-PL needs further investigation.

Table 6. Results of cross-group comparisons between patients with low and high levels of kinesiophobia.

Measurements	Patients with low level of kinesiophobia (n=12)		Patients with high level of kinesiophobia (n=53)		p value
	Mean (SD)	Range (Min–Max)	Mean (SD)	Range (Min–Max)	
VAS-PL	47.9 (17.4)	10–70	47.1 (20.6)	2–100	.852
CSQ-PL					
Diverting attention	2.5 (1.2)	0–4.0	2.5 (1.2)	0–5.3	.906
Reinterpreting pain sensations	2.2 (1.4)	0–4.5	1.6 (1.2)	0–4.0	.223
Ignoring pain sensations	2.0 (2.2)	0–7.7	2.0 (1.3)	0–4.5	.532
Coping self-statements	2.5 (1.1)	0.7–4.2	2.6 (1.6)	0–6.0	.000
Catastrophizing	2.6 (1.5)	0–5.0	3.4 (1.3)	0.5–5.7	.070
Praying/hoping	3.1 (1.2)	0–5.0	3.4 (1.3)	0–6.0	.389
Behavioral activities	2.9 (1.4)	0–4.7	3.0 (1.3)	0–5.7	.960
Item 43	4.1 (1.4)	2–6.0	33.0 (1.2)	0–6.0	.118
Item 44	3.0 (1.7)	0–6	2.8 (1.2)	0–6.0	.357
STAI-trait-PL	41.8 (7.8)	27–57	44.1 (8.1)	25–63	.412
NDI-PL total score	22.1 (6.5)	5–30	23.2 (6.8)	7–35	.630
Pain intensity	2.2 (0.6)	1–3	2.3 (0.9)	0–4	.483
Personal care	1.2 (0.7)	0–3	1.4 (0.9)	0–3	.531
Lifting	2.8 (1.5)	0–5	3.0 (1.6)	0–5	.636
Reading	2.5 (0.7)	1–3	2.6 (1.1)	0–5	.490
Headaches	2.8 (1.7)	0–5	2.8 (1.4)	0–5	.910
Concentration	1.8 (0.8)	1–3	1.3 (0.9)	0–4	.113
Work	2.3 (0.8)	1–3	2.4 (1.0)	0–5	.698
Driving	2.3 (0.9)	1–3	2.6 (1.4)	0–5	.341
Sleeping	3.0 (1.5)	0–5	2.5 (1.3)	0–4	.207
Recreation	2.1 (0.8)	0–3	3.0 (1.2)	0–5	.012*

* $p < .05$; TSK-PL – Polish versions of the Tampa Scale for Kinesiophobia; NDI-PL – Neck Disability Index, STAI-trait-PL – State-Trait Anxiety Inventory; CSQ-PL – Coping Strategies Questionnaire; VAS-PL – Visual Analogue Scale.

Table 7. Correlational analysis between TSK-PL scores, socio-demographic data.

TSK-PL	Socio-demographic characteristics					
	Gender	Age (years)	Employment status	Marital status	Educational level	Place of residence
	$p = .100$	$p = -.096$	$p = .873$	$p = .023^*$	$p = .257$	$p = .370$

* $p < .05$; TSK-PL – Polish versions of the Tampa Scale for Kinesiophobia.

Sample size plays an important role in estimating the reliability level of the measurement scale. According to Yurdugül [52], the alpha coefficient is the most widely used measure of internal

consistency for composite scores. However, due to difficulties in data gathering in psychometric studies, the minimum sample size for the sample alpha coefficient has been frequently

Table 8. Correlational analysis between TSK-PL scores and pain-related and clinical data.

Characteristics	rS	p value
Neck pain duration (in months)	0.11	.407
Cervical spine overload/injury	–	.108
Symptoms	–	.445
Presence of neurological deficits	–	.743
Decreased range of motion in cervical spine	–	.439
Decreased muscle strength in upper extremities	–	.487
Sensory abnormalities in upper extremities	–	*
Problems in maintaining balance/dizziness	–	.266
Collapse	–	.761
Constant neck pain	–	.973
Physical activity aggravates pain	–	*
Pain does not improve when in prone position	–	.389
Sleep interrupted by neck pain	–	.464
Recreational sport activity before beginning of the disease	–	.024**
Smoking	–	.326
Earlier physical therapy	–	.230
Continuous use of opioid	–	.899
Number of discopathy levels	–	.857
Changes of signal intensity in spinal cord	--	.337
Sagittal dimension of vertebral canal on the discopathy level	–	.690
Degenerative changes		
Facet hypertrophy	–	.548
Thickened ligamentum flavum	–	.609
Osteophytes of vertebral bodies	–	.235
Narrowing of the neural foramen	–	.650

* Not applicable; ** $p < 0.05$.

debated. There are various suggested minimum sample sizes for the robust estimation of the population alpha coefficient [52].

Javali et al. [53] proposed that efficacies of reliability coefficients are consistent and comparable for $n \geq 50$. For reliability coefficient calculation for any scale with 3–5 points, a sample size of 50 should be sufficient. Ozdamar [54] reported that for reliability analysis, sample size should be > 50 , whereas Ercan et al. [55] found that the sample size is not important for reliability coefficient, but the number of items plays an important role in estimating the population parameter, especially with the omega coefficient.

Thus, in light of the aforementioned results, the sample size of 65 patients is adequate to estimate the internal consistency by means of the alpha coefficient. Furthermore, Nijs and Thielemans [56] in a study examining the reliability of Dutch and French versions of the Tampa kinesiophobia scale, the sample size of native French speakers was $n=48$.

In contrast, Charter [57] claims the general view on this subject is that the sample alpha coefficient obtained from larger samples tends to produce a more accurate estimate of the population alpha coefficient. Kline [58] suggested a minimum sample size of 300, as did Nunnally and Bernstein [44].

Yurdugül [52], in a study of the minimum sample size for Cronbach's alpha coefficient, revealed that if the first eigenvalue is 3.00–6.00, the required minimum $n=100$ will be adequate for an unbiased estimator of the alpha coefficient. To summarize, we believe the sample size of $n=65$ might have influenced the results of internal consistency of the TSK-PL, and this, according to some authors, might constitute a limitation of the current study.

Hudes, in a review regarding TSK and neck pain, identified some areas of research – neck range of motion, strength, and muscle activation with regard to fear of movement and the TSK – that require detailed further investigation [18]. However, our analyses of detailed clinical data and TSK scores, indicated that they are not predictors of intensity of fear of movement, particularly in the analyzed group of chronic neck pain patients.

Considering socio-demographic factors [59,60], it was indicated that physical job-demand characteristics, ergonomic as well as psychological factors such as work-related stress, can be both risk factors and prognostic factors for neck pain. Interestingly, Cook et al. [61] reported that TSK score decreased with age in patients with chronic pain; however, this was not consistent with the results of the present study. Furthermore, the only confirmed association between TSK scores and socio-demographic data applies to marital status and gender.

It was previously shown that TSK correlates not only with other measures of pain-related fear [62], but also with catastrophizing, depression, anxiety, and pain intensity [9,63,64]. However, relationships between the TSK-PL and other psychological factors, or applied coping efforts in particular, were not, contrary to expectations, supported in preoperative patients with cervical pain as a consequence of cervical discopathy and coexisting degenerative changes.

In a prospective study on musculoskeletal pain by Lundberg et al. [12], associations were found between kinesiophobia and pain severity, disability, and psychological characteristics, as measured by the Multidimensional Pain Inventory (MPI), that were not consistent with the presented results, especially in analyzed factors commonly associated with neck pain, such as cervical pain duration and intensity, decreased range of motion, radiating of cervical pain, decreased muscle strength, or disturbed sensations in upper extremities.

A study of Lundberg et al. has explored whether fear of movement in a group of preoperative patients is irrational [65]. These patients have pain caused by an anatomical deficit, in contrast to patients with chronic pain, and pain in the former does not seem irrational. In the presented study on preoperative patients only, the level of fear of movement was considered as high in over 80% of patients.

There is good evidence from cross-sectional and longitudinal studies to suggest that fear of movement and injury, measured by the TSK, is a robust predictor of disability in patients with traumatic neck pain [66]. Interestingly, Archer et al., in a prospective study of patients after spinal surgery for degenerative conditions, found that early (6 weeks) postoperative fear of movement predicted pain intensity, pain interference, disability, and physical health at a 6-month follow-up. They concluded that early postoperative screening for fear of movement and depressive symptoms that do not acutely improve following surgical intervention appears warranted [67]. In light of these results, we consider further investigation of the analyzed group of patients treated due to cervical discopathy and degenerative spine disease in a sufficient follow-up after surgical treatment to be necessary.

Branstorm et al. [29] found no correlations between TSK scores and trauma, whereas Crombez et al. [62] found evidence that patients who reported a sudden traumatic pain scored higher on the TSK compared with patients who reported pain that had started gradually. In the presented study on preoperative patients only, trauma was reported by 29.4% of participants. As previously suggested by Branstorm et al. and Crombez et al. [29,62], our study results did not support any association between cervical spine overload/injury and higher TSK scores.

The present findings have implications for developing improved clinical guidelines for the assessment and management of neck pain. This will further our understanding of the nature of psychosocial determinants of neck pain, as well as fear of movement. We believe it should be emphasized that clinical data are not predictors of intensity of kinesiophobia, particularly in the analyzed group of neck pain patients before surgical treatment. Furthermore, it is essential to underline factors such as gender or recreational sport activity, which in particular influence patients' fears of movement within the cervical spinal region.

Future research needs to extend to other neck pain groups, including those with more severe injuries as well as acute cervical pain patients. To provide additional data for the evaluation of the psychometric properties of the TSK-PL, particularly in regards to construct validity, the Polish version of TSK could be tested in different chronic pain samples.

Furthermore, the modern test theory approach, specifically the partial credit model, could be used to assess internal consistency.

Another limitation of the current study is that the study patients were not followed-up postoperatively. It would be of interest to extend the present study with a sufficient follow-up after surgery. Therefore, further research is warranted to

investigate the role of fear of movement post-operatively as well as the effects of treatment of cervical discopathy and co-existing degenerative changes in the group of patients investigated pre-operatively. Furthermore, we believe research is needed to determine other measurable factors associated with neck pain, which might be associated with fear of movement, such as beliefs about pain control as well as the so-called distress personality (the D personality). We encourage further investigations aimed specifically at determining the role of beliefs about pain control as well as the distress personality, in the course of treatment of cervical discopathy and co-existing degenerative changes. More research into this issue is necessary.

Despite the aforementioned limitations, our results provide clinicians with access to a valid, internally consistent, and temporally stable measure of pain-related fear for Polish patients treated due to neck pain.

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Conclusions

In conclusion, kinesiophobia levels are high in patients with chronic cervical pain before surgical treatment. Fear of movement tends to be higher in women and among patients avoiding sports recreation before surgical treatment. Psychological as well as pain-related and clinical data are not, in contrast to sports activity and socio-demographic data, predictors of kinesiophobia, and this should be taken into consideration when planning rehabilitation after surgical treatment due to cervical discopathy and co-existing degenerative changes.

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