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Real world data collection and cluster analysis in patients with sciatica due to lumbar disc herniation☆

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ABSTRACT

Objective: The aim of this study was to identify and describe clusters of patients with similar characteristics presenting with sciatica caused by a lumbar disc herniation in secondary care.
Methods: Forty-six percent (n = 163) of the eligible patients (n = 352) completed all questionnaires and were included in a hierarchical cluster analysis. The analysis was based on baseline characteristics for pain, pain awareness and catastrophizing, disability and quality of life (QOL). Clusters were compared for the use of pain medication, employment status and allocated treatment.
Results: Three significant clusters were identified.
Cluster 2 (n = 49), coined the painfulness cluster, reported the lowest baseline characteristics for pain (>5) and disability together with a higher health-related QOL. Patients in cluster 3, labeled the painfulness and suffering cluster, had relatively high pain scores for back and leg pain (>6), high pain awareness and catastrophizing, i.e. suffering, but relatively limited disability and maintained QOL. Cluster 1 (n = 71), the painfulness-suffering and disability cluster, was characterized by the most severe back and leg pain (>7), high pain awareness and catastrophizing with the lowest QOL and highest disability. Patients in cluster 1 underwent significantly more surgery and used the most extensive pain medication (WHO III).
Conclusion: This research gives insight in the complex population with sciatica and is of added value to the recent, sparsely existing literature on relevant patient subgroups in the low back and leg pain population. The data suggest that VAS scores < 6 do not lead to suffering and VAS scores < 7 not to disability.

1. Introduction

Lumbar disc herniation is the most frequent cause of sciatica. The pain pattern is characterized by pain which radiates below the knee in the dermatome of an irritated or compressed nerve root [1]. Internationally, different prevalence (1.2–43%) and incidence (0.005–5%) figures are reported [2–4]. In general, sciatica has a favorable clinical course with conservative measures. Nevertheless, 10–30% of patients, mostly with more severe initial symptoms, have persistent pain after one year [5–8]. Sciatica and degenerative spine pathology in general have a large economic impact on society. It contributes to direct medical costs from medical interventions, hospitalization and medication. An even larger part is related to indirect costs related to production losses within the socio-economic sector [9,10].

Randomised Controlled Trails (RCTs) indicate a faster symptom reduction after microdiscectomy although there is no significant difference after more than one year of follow-up [6,8,11,12]. Although systematic reviews and meta-analysis have reported the effectiveness of non-opioid medical management, epidural injections and disc surgery, there is no consensus on the timing and indication for surgery in cases of uncomplicated sciatica (no motor deficits, cauda equina syndrome) [7, 9, 13–15]. In addition, available RCTs on the subject have been

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criticized because of the lack of representation for the diverse patient populations with sciatica that generally presents to secondary care providers on a daily basis [16]. There is an extensive range of treatments, but some patients may respond more favorably to certain treatments. Furthermore, a proportion of patients will experience persisting sciatica, with a risk for chronic back or leg pain due to central sensitization [17–19].

The Belgian Health Care Knowledge Center (KCE) recently composed a care plan on the approach of radiculopathy. Initially uncomplicated sciatica is treated conservatively in primary care for 5–6 weeks. If the pain persists, referral to secondary care can be considered. In this clinical pathway, decisions are mainly based on pain scores (VAS). In the secondary care setting, the KCE recommends assessing disability (Oswestry Disability Index), life quality (EQ5D), working status and the use of pain medication [20]. Besides, pain is more than a marker of actual or potential tissue damage [21]. It is a multidimensional entity affecting the patient's life, influencing mental health, disability and quality of life (QOL) [22,23]. However, these patient-reported outcomes are not part of the variables influencing the treatment choices.

The INDIANA survey shows a considerable variation in decision-making in surgeons for degenerative lumbar spinal pathology including disc herniation. Decisions tend to be based on gut feeling and the surgeons' experience [24]. Since it is not yet clear which patient benefits most from which therapy, recent research focuses on identifying patient characteristics at baseline to identify subgroup amongst patients. Several homogenic groups with different clinical courses have been identified. These results could guide future decision making in the treatment of spinal pathology [25–28].

The aim of this study is to identify clusters of patients with similar characteristics presenting with sciatica caused by a, MRI confirmed, lumbar disc herniation in secondary care. Cluster analysis is based on baseline characteristics for pain, pain awareness and catastrophizing, disability and quality of life. Clusters are described and compared for the use of pain medication, employment and allocated treatment.

2. Methods

2.1. Study design and population

This real world data collection for this descriptive study is part of a prospective, multicentre, longitudinal and observational cohort study. Patients were recruited during routine clinic appointments at the Spine Units of three hospitals in eastern Belgium. The study population consists of patients with sciatica due to a lumbar disc herniation, confirmed by imaging and referred to secondary care. Patients were included if they met the following criteria: (a) 18 years or older, (b) sciatica with objective nerve compression signs (positive SLR) and/or neurological deficits (muscle weakness or sensory disturbance) and (c) lumbar disc herniation confirmed with imaging (MRI) explaining the symptoms. Exclusion criteria were prior spinal surgery at the symptomatic level, spondylolisthesis, spinal stenosis, infection, malignancy, pregnancy, cauda equina syndrome or progressive neurological deficits. Data were collected from March 2018 until February 2020.

2.2. Data collection

Patients were informed and requested to participate in the prospective cohort study at their first visit at the Spine Unit. The BackApp ®, a patient-based software program designed for this study, was used for data collection. Patients filled in the baseline questionnaires and signed the informed consent electronically using a tablet in the waiting room prior to their appointment.

General patient characteristics consist of age, gender, employment and medical history. Questionnaires on pain, disability and quality of life were included. Pain scores were measured with a visual analog scale from 0 ('no pain') to 10 ('maximal pain') for back and leg pain separately. The pain-catastrophizing scale (PCS) was used to evaluate the catastrophizing impact of the experienced pain. The scale is obtained by rating 13 statements about pain experiences between 0 ('not at all') and 4 ('always') [29]. Next, the pain vigilance and awareness questionnaire (PVAQ) is a 16 items questionnaire that measures the preoccupation with pain. The PVAQ is associated with pain-related fear and perceived pain severity [30]. The Oswestry Disability Index was used to indicate the sciatica related disability. The ODI is a valid and vigorous questionnaire often used in spinal pathology research [31]. The health-related quality of life was measured using the EuroQol 5 dimensions questionnaire (EQ-5D) validated for Belgium [32].

The consenting participants underwent a clinical assessment by the physician after filling in the questionnaires. The nine different physicians were able to consult the responses during the patients' visits. Information on the use of pain medication (WHO class and/or neuropathic pain drugs) and the allocated treatment was added to the patients' files. WHO class I represents non-opioid pain medication (acetaminophen and NSAIDs). WHO class II consist of weak opioids (e.x. tramadol), plus non-opioid and adjuvant medication. Strong opioids are categorized under WHO class III. WHO class I is represented in all phases of pain management. All patients received information on sciatica and the general course of the condition. Treatment assignment was based on informed decision making and independent of the cluster analysis performed for this study. The surgical intervention in this study was a microdiscectomy. The conservative treatments consisted of advice without changing pharmacological treatment, changing pharmacological treatment, physiotherapy, transforaminal epidural steroid injections (TFESI), Pulse Radio Frequency (pRF) therapy or a combination. Patient data is stored in electronical Case Report Forms (eCRFs) and encoded using a unique study identification number GUID (Global Unique Identifier). An external IT specialist was responsible for processing and depersonalizing the data for further analysis.

The primary outcome in this study is to identify patient clusters amongst patients with sciatica due to lumbar disc herniation. Secondarily, the identified clusters are compared on baseline characteristics, age, gender, employment, pain medication use and allocated treatment. The study was approved by the ethical committee in every study center and is conducted in accordance to the Declaration of Helsinki.

2.3. Statistical analyses

All statistical analyses have been performed with IBM SPSS Statistics version 26 for Mac.

The five variables on pain (VAS, PCS, PVAQ), disability (ODI) and quality (EQ-5D) of life were used in a hierarchical cluster analysis to identify meaningful groups within the study population. The included parameters were first standardized using z-scores to counteract differences in scales. The analysis was conducted based on Ward's method and the squared Euclidian distance. The optimal number of clusters was determined using the linkage coefficients and the graphical representation of the cluster analysis, the dendrogram [33]. Patient that did not complete all five questionnaires were excluded from the cluster analysis.

An ANOVA was conducted to compare the characteristics across the number of identified clusters for continuous variables. The Pearson's Chi squared test was used for categorical variables. In addition to the baseline characteristics, clusters were compared for the use of pain medication and allocated treatment. Results were considered statistically significant if $p < 0,05$. Post hoc tests (Tukey/Bonferroni) were conducted to further explore the differences between the clusters and correct for multiple comparisons.

Canonical correlations, a measure for associations between two sets of variables, were used to explore correlation between pain, pain perception and the functional disability variables. ROC curves for VAS back and leg scores for suffering and disability were computed. Consequently, cut-offs for VAS scores were determined for pain perception and/or disability.

3. Results

3.1. The study sample

In total, 352 patients met the inclusion criteria. Forty-six percent (n = 163, 46%) of patients answered all five questionnaires mandatory for the cluster analysis. Table 1 summarizes the baseline characteristics of the total sample and the sample included in de cluster analysis. Further analyses were exclusively conducted on the cluster sample.

The mean age was 48.8 (range 20–80) years and 39.2% of patients (n = 64) were female. Fifty-five percent (n = 90) of the cluster sample was not working at inclusion. The majority of patients (41,1%) indicated the pain as the reason for not working, followed by retirement (35.6%) and pre-existing disability (15.6%). Sixty patients (36.8%) presented in secondary care with acute sciatica (<6 weeks), 76 (46.6%) with sub-acute complains (6 weeks- 3 months) and 25 (15.3%) were experiencing sciatica for more than 3 months.

3.2. Cluster analysis

Hierarchical cluster analysis suggested three definite clusters based on the Ward's method and the dendrogram. The cluster characteristics are displayed in Table 2.

Patients in cluster 1 (n = 77, 47%) had severe back and leg pain with a mean VAS of 7.41 (± 2.16) and 7.81 (± 1.55) respectively. They indicated a notable low QOL of 0.24 (± 0.19) with a PVAQ of 50.79 (± 9.64) and PCS of 30.62 (± 11.06). The disability index (ODI) of 26.86 or 53.72% corresponds to severe disability due to the sciatica.

Cluster 2 (n = 49, 30%) is characterized by a rather moderate VAS score for back (5.44 ± 2.57) and leg pain (5.33 ± 2.30) together with a low PVAQ (35,96 ± 8.71) and PCS (12.41 ± 5.92). This cluster indicated the highest QOL with an EQ5D score of 0.73 (± 0.14) and the lowest disability (14.08 ± 6.67).

In cluster 3 (n = 37, 23%) the VAS pain scores indicated severe back (6.69 ± 1.21) and leg (7.11 ± 1.45) pain together with a high PVAQ (51,00 ± 8.35) and PCS (28.11 ± 6.68). The QOL was largely preserved (0.70 ± 0.14). The disability index (16.05 or 32,1%) correlates with moderate disability.

3.3. Cluster comparison

The multivariate ANOVA analysis, illustrated in Fig. 1, indicated that the cluster effect can be explained by the significant effect of all five variables included in de cluster analyses ($p < 0.001$).

Univariate ANOVA showed a significant difference between the three clusters for the cluster variables ($p < 0.001$), employment status ($p = 0.019$), the use of pain medication ($p < 0.001$) and the allocated treatment (<0.001). The clusters did not differ in the reasons for not working, the duration of the sciatica or the different conservative treatment options.

The VAS scores for back and leg pain are higher in cluster 1 and 3 compared to cluster 2 ($p < 0.001$ and $p = 0.005$). Additionally, VAS scores in cluster 1 were higher than in cluster 3 ($p = 0.0315$). Further, both the PVAQ and the PCS are higher in cluster 1 and 3 compared to cluster 2 ($p < 0.001$) but did not differ from each other ($p = 0.993$ and $p = 0.293$). The QOL based on the EQ5D was the lowest in cluster 1 compared to cluster 2 and 3 ($p < 0.001$). There is no difference in EQ5D between cluster 2 and 3 ($p = 0.77$). Lastly, patients in cluster 1 were more disabled than those in cluster 2 and 3 ($p < 0.001$), without a difference between cluster 2 and 3 ($p = 0.40$).

Table 1
patient characteristics of the total sample (n = 352) and the cluster sample who completed all questionnaires (n = 163).

Patient characteristics	Total sample (n = 352)	Cluster sample (n = 163)
Age (years), mean (± SD)	49 (± 13.8)	48.8 (± 14.1)
Gender (F), n (%)	173 (49.1%)	64 (39.2%)
Not working, n (%)	202 (57.4%)	90 (55.2%)
Pain as reason, n (%)	87 (43.1%)	37 (41.1%)
Retired, n (%)	60 (29.7%)	32 (35.6%)
Disabled, n (%)	35 (17.3%)	14 (15.6%)
Stopped, n (%)	7 (3.5%)	3 (3.3%)
Unemployed, n (%)	3 (1.5%)	2 (2.2%)
Housewife, n (%)	10 (4.9%)	2 (2.2%)
Duration		
Acute (<6 weeks), n (%)	95 (27%)	60 (36.8%)
Subacute (6weeks-3 months), n (%)	199 (56.5%)	76 (46.6%)
Chronic (> 3 months), n (%)	55 (15.6%)	25 (15.3%)
VAS back, mean (± SD)	6.32 (± 2.29)	6.65 (± 2.28)
VAS leg, mean (± SD)	6.41 (± 2.33)	6.90 (± 2.08)
PVAQ, mean (± SD)	45.70 (± 11.81)	46.38 (± 11.34)
PCS, mean (± SD)	24.10 (± 12.00)	24.58 (± 11.95)
EQ5D, mean (± SD)	0.51 (± 0.34)	0.49 (± 0.29)
ODI, mean (± SD)	19.30 (± 9.81)	20.56 (± 9.20)

Table 2
characteristics of the three clusters based on the hierarchical clustering.

Patient characteristics	Cluster 1 (n = 77)	Cluster 2 (n = 49)	Cluster 3 (n = 37)	p-value
Age (years), mean (± SD)	48.44 (± 13.69)	48.80 (± 14.59)	49.62 (± 14.83)	0.92
Gender (F), n (%)	31 (40.4%)	18 (36.7%)	15 (40.5%)	0.91
Not working, n (%)	51 (66.2%)	22 (44.9%)	16 (43.2%)	**0.019**
Pain as reason, n (%)	26 (51%)	6 (27.3%)	5 (31.3)	0.27
Retired, n (%)	15 (29.4%)	9 (40.9%)	8 (50%)	0.27
Disabled, n (%)	8 (15.7%)	3 (13.6%)	3 (18.7%)	0.27
Stopped, n (%)	2 (3.9%)	1 (4.5%)	0 (0%)	0.27
Unemployed, n (%)	1 (2%)	1 (4.5%)	0 (0%)	0.27
Housewife, n (%)	0 (0%)	2 (9.1%)	0 (0%)	0.27
Duration				
Acute (<6 weeks), n (%)	30 (40%)	21 (42.9%)	9 (24.3%)	0.24
Subacute (6weeks-3 months), n (%)	31 (41.3%)	22 (44.9%)	23 (62.2%)	0.24
Chronic (> 3 months), n (%)	14 (18.7%)	6 (12.2%)	5 (13.5%)	0.24
VAS back, mean (± SD)	7.40 (± 2.2)	5.43 (± 2.57)	6.69 (± 1.21)	**< 0.001**
VAS leg, mean (± SD)	7.81 (± 1.55)	5.33 (± 2.30)	7.11 (± 1.45)	**< 0.001**
PVAQ, mean (± SD)	50.79 (± 9.64)	35.96 (± 8.71)	51.00 (± 8.35)	**< 0.001**
PCS, mean (± SD)	30.62 (± 11.06)	12.41 (± 5.92)	28.11 (± 6.69)	**< 0.001**
EQ5D, mean (± SD)	0.24 (± 0.19)	0.73 (± 0.14)	0.70 (± 0.14)	**< 0.001**
ODI, mean (± SD)	26.86 (± 7.78)	14.08 (± 6.67)	16.05 (± 5.55)	**< 0.001**
Pain reliever use	73 (94.8%)	34 (69.4%)	34 (91.9%)	
WHO I	23 (31.5%)	25 (71.4%)	16 (47.1%)	**< 0.001**
WHO II	42 (57.5%)	8 (23.5%)	18 (52.9%)	**< 0.001**
WHO III	8 (11)	1 (2.9%)	0 (0%)	**< 0.001**
Neuropathic pain drugs	0 (0%)	1 (2%)	0 (0%)	
Treatment (conservative), n (%)	40 (51.9%)	44 (89.8%)	29 (78.4%)	**< 0.001**
Pharmacological	0 (0%)	1 (2.3%)	1 (3.4%)	0.08
Advice(*)	3 (7.5%)	13 (29.5%)	4 (13.8%)	0.08
TFESI	34 (85%)	29 (65.9%)	22 (75.9%)	0.08
Physiotherapy/ reactivation	1 (2.5%)	1 (2.3%)	2 (6.9%)	0.08
Physiotherapy and TFESI	2 (5%)	0 (0%)	0 (0%)	0.08

VAS: visual analog scale; PVAQ: Pain Vigilance and Awareness Questionnaire; PCS: Pain Catastrophizing Scale; EQ5D: EuroQol-5D Quality of Life questionnaire; ODI: Oswestry Disability Index; WHO: World Health Organization; TFESI: Transforaminal Epidural Steroid Injection. (*) advice without changing drug treatment with or without new imaging.

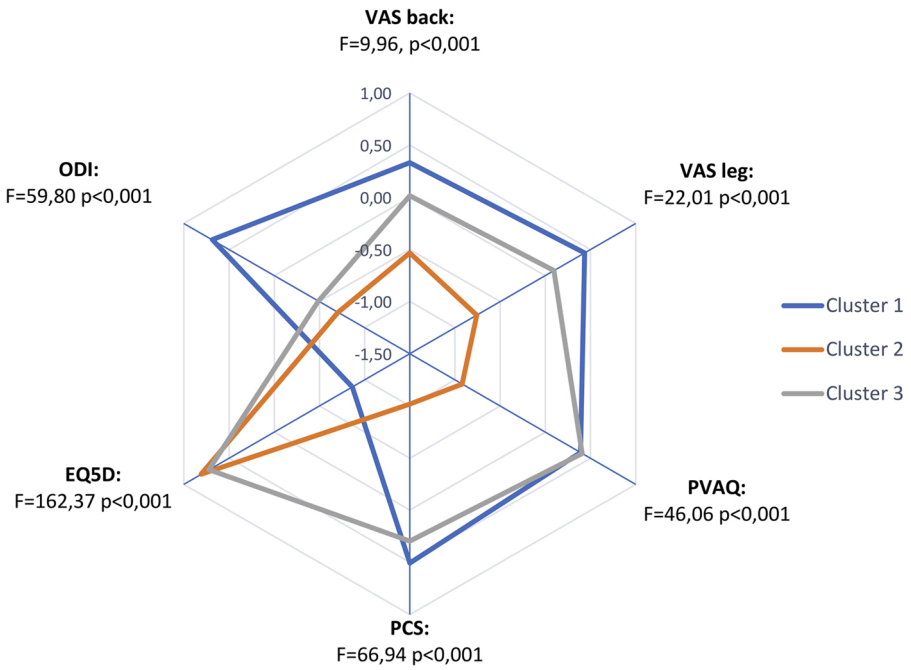

Fig. 1. Multivariate ANOVA of the cluster analysis.

In cluster 1 more patients were not working at inclusion compared to cluster 2 ($p < 0.001$) and cluster 3 ($p < 0.001$). The use of pain medication differed significantly between the clusters for all three WHO pain medication classes. Cluster 1 and 3 used more WHO class II medication than cluster 2 ($p < 0.001$). Cluster 2 used more WHO class I medication than cluster 1 ($p < 0.001$). The WHO class III medication (opioids) was used more in cluster 1 than in cluster 2 and 3 ($p < 0.001$). Patients from cluster 1 had more surgical treatments (microdiscectomy) compared to cluster 2 or 3 ($p < 0.001$ and $p = 0.004$). In cluster 2, more conservative treatments were implemented than in cluster 1 ($p < 0.001$), but not compared with cluster 3 ($p = 0.69$).

3.3.1. *Correlation analysis*

The VAS leg and back scores can be classified as *painfulness* variables. There was a weak correlation between the VAS leg and back scores ($r = 0{,}49$, $p < 0001$). In this dataset leg pain was not always associated with a comparable severity of back pain. Next, PCS and PVAQ, representing the cognitive component of pain, were labeled as the *suffering* variables. These variables had a moderate correlation of 0,68 ($p < 0001$). Lastly, there was a comparable moderate correlation between the EQ5D and ODI variables ($r = -0{,}63$, $p < 0001$). These functional consequences of pain, represented by the EQ5D and ODI, were defined as *disability* variables.

Canonical correlations show a significant, but weak correlation between the painfulness and suffering variables of 0427 ($p < 0001$). The most accurate cut-offs for VAS leg and back scores for patient to be more likely to be allocated to a cluster with suffering are 6,13 and 6,22 respectively. Next, there was a weak correlation between painfulness and disability of 0,43 ($p < 0001$). The cut-offs for VAS leg and back scores for disability are 7,50 and 6,99 respectively. Table 3 shows the accompanying sensitivity and specificity of the cut-off values.

Finally, the suffering variables and disability variables are moderately correlated with a canonical correlation of 0,59 ($p < 0001$).

Table 3
Sensitivity and specificity for cut-offs for VAS scores.

Variables	Cut-off	Sensitivity	Specificity
Suffering[a]			
VAS leg	6,13	82%	64%
VAS back	6,22	75%	70%
Disability[a]			
VAS leg	7,50	80%	70%
VAS back	6,99	74%	66%

[a] suffering variables PVAQ/PCS, disability variables ODI/EQ5D

4. Discussion

In this study three significant patient clusters were identified in patients with sciatica due to a lumbar disc herniation presenting in secondary care. The aim was to collect real-world data from patients who present to secondary care providers on a daily basis. It is the first study to include pain awareness, perception and catastrophizing, quality of life and disability together in the cluster analysis. These variables were assessed by well-known, practical questionnaires in a digital application before a visit at the Spine Unit. This research gives insight in the complex population presenting with sciatica in secondary care and is an added value to the recent, sparsely existing literature on relevant patient subgroups in the low back and leg pain population.

The identified patient clusters were labeled based on the different pain patterns and the different neurological pain pathways. Patients in cluster 2 reported the lowest pain scores, pain awareness and catastrophizing and low disability together with a higher health-related quality of life. In this cluster the majority of patients used WHO class I pain medication and were treated conservatively. Cluster 2 is the painfulness cluster. They suffer from quantified pain, neurologically correlated to the lateral spinothalamic tract, with preserved quality of life. There was no/not yet evidence of an emotional, cognitive or autonomic reaction to the pain. However, this emotional and cognitive component, correlated to the medial pain pathway influencing different brain areas [34], was present in cluster 1 and 3. Patients in cluster 3 had relatively high pain scores for back and leg pain, high pain awareness and catastrophizing, comparable with cluster 1, but with significant lower disability and higher quality of life. Cluster 3 is labeled as the painfulness and suffering cluster. In addition to the sensory aspect of pain, these patients suffer from the qualitative/cognitive component of pain.

The first cluster was characterized by the most severe back and leg pain, disability, high pain awareness and catastrophizing combined with the lowest health related quality of life. In cluster 1, the patients'

functionality was compromised by the sciatica. The disability in this cluster afflicts their quality of life. These patients are classified as the painfulness with suffering and disability cluster. In this cluster significantly more patients were not working at inclusion. One could hypothesize that patients evolve from a suffering stage to a chronic problem with functional impairment and reduced QoL. The cut-off VAS leg and back scores for disability are also higher than those for suffering, making the initial VAS score an important scale. This also emphasizes the importance of assessing and monitoring functionality in patients with sciatica. Maintaining or treating this functionality is important for spine physicians to preserve or improve life quality and eventually get patients back to work.

In recent years new research has identified clinically relevant clusters of patients presenting with low back pain [35–37] and backpain related leg pain [25, 26, 28, 38–40]. Although several classification systems have been published, very few have focused and include patient reported outcomes [38,41]. In addition, there has not been any consensus in the literature on how to specifically define sciatica. Next, the seriously diverse population in daily practice asks for the identification of homogeneous groups [27,42]. Konstantinou et al. developed an algorithm for patients with sciatica in primary care. If these algorithms could be introduced in the healthcare system, patients can be helped faster and ideally return to work [28].

Stynes et al. identified five clusters using latent class analysis in patients with back related leg pain in primary care and described their clinical course over one year. Clusters were labeled as referred leg pain, mild, moderate and severe sciatica and atypical sciatica. Comparable to the present study, severity of back and leg pain were the main items distinguishing the clusters [26]. These findings were confirmed by Stynes et al. in 2019 with a second latent class analysis in patients with confirmed lumbar disc herniation. Here four clusters were identified, labeled mild, moderate, severe and a cluster with mild back and severe leg pain. The cluster labeled severe, moderate and mild resemble cluster 1, 3 and 2 respectively. The patient population with chronic pain ranged from 60% to 69%, considerably higher than our study sample with 12–19%. As in the present study, the majority of patient that underwent surgery were in the clusters with the most severe pain intensity [25]. Both studies did not include variables on the psychological component of pain, disability or quality of life in the cluster analysis.

Comparable studies have been conducted to identify homogeneous subgroups in patients with chronic low back pain and chronic pain in general [43]. Langenmaier et al. described three different profiles for chronic back pain ranging from very distressed patients who were hardly able to participate in daily social activities to groups of patients who were experiencing severe pain and high level of distress with preserved daily activities. Their three-cluster solution stresses the importance of assessing the psychological impact of (chronic) pain problems [44].

In cluster 1, significantly more patients underwent spinal surgery for their lumbar disc herniation. Although this cluster had the highest pain scores, patients in cluster three, in which pain scores were only slightly lower, had less surgical treatments. One could hypothesize that pain experience, measured with the PVAQ and PCS, together with the perceived disability convinced spine surgeons to consider surgery. The Indication for Spinal Surgery survey (INDIANA) determined that only about 25% of surgeons indicated that their decisions were solely based on scientific evidence. Besides, professional experience (in years) was positively correlated with the choice to switch to surgery [24].

The first limitation of this study is the risk of participation bias. Although 352 patients were included in the study, only 163 (46%) completed all questionnaires and were included in the cluster analysis. We don't know the reason for not completing these questionnaires. Moreover, this reason might be a characteristic of one or more masked clusters. Next, the cluster analysis is only based on the six different questionnaires. The inclusion of more variables could influence the (number of) identified clusters. However, the questionnaires used in this study were selected because they are well-known and practical to use in daily practice. Besides, the Belgian Health Care Knowlegde Center (KCE) advises to register patient reported outcomes in secondary care, including VAS scores, Oswestry Disability Index, EQ5D, employment status and the use of pain medication [20].

5. Conclusion

There is no such thing as an 'average' patient with sciatica, as is confirmed by this study. Three patient clusters were identified using well-known, practical questionnaires based on pain, pain experience, disability and quality of life. We recommend the use of these questionnaires for patients with sciatica to have a multidimensional evaluation of the sensory and cognitive component of pain. The patient's disability has shown to be an important variable to preserve life quality.

These data suggest that a VAS scores < 6 do not lead to suffering and a VAS scores < 7 not to disability.

Future research should assess the outcomes of different treatment options amongst the different patient clusters to determine which patient benefits most from which specific treatment. Better patient selection could shorten the circulation of patients in the healthcare system and reduce healthcare costs.

CRediT authorship contribution statement

Vincent Raymaekers: Conceptualization, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Sven Bamps:** Data curation, Investigation, Project administration, Supervision, Validation, Writing – review & editing. **Wim Duyvendak:** Data curation, Investigation, Project administration, Supervision, Validation, Writing – review & editing. **Eric Put:** Data curation, Investigation, Project administration, Supervision, Validation, Writing – review & editing. **Gert Roosen:** Data curation, Investigation, Project administration, Supervision, Validation, Writing – review & editing. **Steven Vanvolsem:** Data curation, Investigation, Project administration, Supervision, Validation, Writing – review & editing. **Maarten Wissels:** Data curation, Investigation, Project administration, Supervision, Validation, Writing – review & editing. **Sven Vanneste:** Formal analysis, Investigation, Methodology, Visualization, Writing – original draft. **Dirk De Ridder:** Formal analysis, Investigation, Methodology, Visualization, Writing – original draft. mark plazier: Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing, Conceptualization, Data curation, Project administration, Resources, Supervision, Validation.

Conflict of interest

The authors declare no conflict of interest.

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