Exploring physiotherapist's ability to identify cauda equina syndrome early

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ABSTRACT

الأهداف: الهدف من هذي الدراسه هو استكشاف قدرة أخصائيي العلاج الطبيعي في المملكة العربية السعودية على تحديد متلازمة ذيل الفرس وتحديد الأساليب المستخدمة من قبل أخصائيي العلاج الطبيعي لإدارة المرضى الذين يشتبه في انهم يعانون من متلازمة ذيل الفرس.

المنهجية: استخدمت هذه الدراسة تصميم البحث المقطعي. وشملت أخصائيي العلاج الطبيعي المرخصين العاملين في المملكة العربية السعودية. تم جمع البيانات باستخدام مسح يهدف إلى تقييم قدرة أخصائيي العلاج الطبيعي على التعرف على متلازمة ذيل الفرس مبكرًا، باستخدام 12 عبارة. بناءً على استجابة المشاركين لهذه العبارات، تم تصنيف جميع المستجيبين إلى المجموعات التالية بناءً على قدرتهم على تحديد وإدارة متلازمة ذيل الفرس مبكرًا: الكفاءة (12-10 نقطة)؛ قدرة جيدة (9-7)؛ القدرة العادلة (6-5)؛ وضعف القدرة (أقل من أو تساوي 4). تم اعتبار التوصل إلى الإجماع على العباره عندما وافق أو اختلف أكثر من 70% من المشاركين مع العباره.

النتائج: شملت هذه الدراسة 401 أخصائي علاج طبيعي (متوسط العمر= 29.51 (الانحراف المعياري=5.54))؛ 53.4% نساء. يتمتع معظم المشاركين (63.6%) بكفاءه و بقدرة جيدة على تحديد وإدارة متلازمة ذيل الفرس مبكرًا. تم التوصل إلى إجماع على 8 عبارات [1، 2، 3، 4، 5، 8، 9، 12] من أصل 12. ومن بين هذه العبارات، اتفق معظم المشاركين على انه يجب الاشتباه في إصابة المريض بمتلازمة ذيل الفرس عندما تظهر عليه أعراض صعوبات ذات أصل عصبي (88.3%) و/أو اعتلال الجذور الثنائي (85.5%)؛ ووافق 88.0% منهم على ضرورة طلب التصوير بالرنين المغناطيسي بشكل عاجل عند التعامل مع مريض مصاب بمتلازمة ذيل الفرس. وفي المقابل، لم يتم التوصل إلى توافق في الآراء بشأن 4 عبارات. تدور هذه العبارات حول طرق التواصل مع المرضى الذين يشتبه في إصابتهم بمتلازمة ذيل الفرس، والتعليمات المطلوب تقديمها لهؤلاء المرضى والإدارة المناسبة المقدمة للمرضى.

الخلاصة: يتمتع معظم أخصائيي العلاج الطبيعي بكفاءه و بقدرة جيدة على تحديد وإدارة متلازمة ذيل الفرس مبكرًا. يمكن أن تساعد نتائج الدراسة في إنشاء أو تحسين المعايير والبروتوكولات السريرية المتعلقة بأدوار أخصائيي العلاج الطبيعي في التحديد المبكر لمتلازمة ذيل الفرس.

Objectives: To explore the ability of physiotherapists in Saudi Arabia to identify cauda equina syndrome (CES) in a timely manner, and to identify the methods used by physiotherapists to manage patients with suspected CES.

Methods: This study utilized a cross-sectional research design and was conducted in the period May-October 2023. It included licensed physiotherapists working in Saudi Arabia. The data was collected using a survey that aimed to assess physiotherapists' ability to identify CES early, using 12 statements. Based on the participants response to these statements, all responders were categorized into the following groups based on their ability to identify and manage CES early: proficient (10-12 points); good ability (7-9); fair ability (5-6); and poor ability (<=4). Consensus to a statement was reached when more than 70% of participants agreed or disagreed with the statement.

Results: This study included 401 physiotherapists (mean age=29.51 (SD 5.54); 53.4% female). Most participants (63.6%) have a proficient-good ability to identify and manage CES early, while 36.4% were categorized as having fair-poor ability Consensus for the CES statements was achieved for 8 statements [1, 2, 3, 4, 5, 8, 9, 12] out of 12. Among these statements, most participants agreed that a patient should be suspected to have CES when they exhibited urinary difficulties of neurogenic origin (88.3%) and/or bilateral radiculopathy (85.5%); and 88.0% of them agreed that an MRI should be requested urgently when managing a patient with CES. Conversely, consensus was not achieved on statements, concerning communication with patients, patient instructions, and management decisions for suspected CES cases.

Conclusion: Most physiotherapists had a proficient-good ability to identify and manage CES early. The study's findings can aid in the creation or improvement of clinical standards and protocols pertaining to physiotherapists' roles in the early identification of CES.

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Cauda Equina Syndrome (CES) is a rare and debilitating condition that commonly affects people with low back pain (LBP).[1] Cauda Equina Syndrome is a serious neurological disorder impacting the bundle of nerve roots of the distal end of the spinal cord, referred to as the cauda equina.[2] Moreover, CES requires urgent surgery to prevent potentially serious consequences, including bladder, bowel, and sexual dysfunctions; numbness; muscle weakness; and severe pain.[2,3] The CES can be caused by lumbar or sacral dysfunction owing to compression of the nerve roots or narrowing of the vertebral canals.[4] Moreover, there are several other potential causes of CES, including discogenic injuries, tumors, infection, spondylolysis, spondylolisthesis.[2]

The CES can occur in individuals of all ages, but it is most commonly seen in adults between the ages of 30 and 60 years old.[1] Although CES is a very rare condition, primary care practitioners such as physiotherapists should consider it a possibility when examining and managing patients. Cauda Equina Syndrome is a critical condition that requires prompt identification and management to prevent long-term complications.[5] When examining patients, it is important to remain vigilant regarding key symptoms such as bowel and bladder dysfunction, leg numbness, and weakness, as these could potentially indicate CES. However, diagnosing CES can be challenging owing to its rarity and symptom overlap with other conditions, such as other spinal pathologies, including lumbar disc herniation, spinal stenosis, or even infections. A previous meta-analysis found that timely surgery plays a critical role in achieving positive clinical outcomes for spine decompression procedures in patients with CES,[6] highlighting the urgency of early identification and intervention in cases of suspected CES.

Physiotherapists may express uncertainty in identifying CES early, possibly due to a lack of advanced examination skills. As such, there is a need to enhance physiotherapists' examination capabilities and ability to recognize CES at an early stage. One of the primary reasons contributing to delayed CES diagnosis is the absence of well-defined diagnostic criteria for primary care settings.[7] However, useful facilitation safety assessment tools, such as toolkits and the cauda scale (TCS), are available to guide the management of patients with suspected CES.[8,9] For example, Greenhalgh et al[8] developed a toolkit to facilitate the subjective examination of patients with LBP and decrease the risk of missed diagnosis. This toolkit can help healthcare professionals to identify the early warning signs and symptoms of CES, such as worsening LBP with or without progressive sensory-motor deficit in the lower limbs. This toolkit drew upon the lived experiences of individuals experiencing CES to inform on the content.[8] According to Finucane et al,[10] employing the toolkit for early identification of possible CES can help frontline practitioners to take timely clinical action.

In terms of early management of patients with suspected CES, positive signs and symptoms of CES based on clinical examination (for example, by a physiotherapist) should prompt an urgent referral for further investigations (for example, diagnostic imaging).[11] Further investigations could aid the clinical reasoning of the physiotherapist and prevent the consequences of CES if it is not picked up early enough.[12]

After searching the databases (Pubmed and Google Scholar) using a combination of keywords related to CES, early identification, and physiotherapy, we found only one research which was a qualitative study and aimed to investigate physiotherapists' experiences for managing individuals with suspected CES.[13] The study provides valuable insights into the challenges faced by physiotherapists in managing suspected cases of CES. However, the narrow focus on the experiences of a small sample of physiotherapists limits the ability to draw broader conclusions about the complex issues surrounding the diagnosis and treatment of this condition. The analysis lacks a critical examination of the study's own methodological limitations and the need for further research to validate and expand upon the findings. A more comprehensive and balanced approach would strengthen the paper's contribution to the field. Thus, the objectives of this study were twofold: (i) to explore the ability of physiotherapists to identify CES in a timely manner, and (ii) to identify the methods used by physiotherapists to manage patients with suspected CES.

Methods. *Design.* This study utilized a cross-sectional research design and was reported in accordance with the STROBE ("Strengthening the Reporting of Observational Studies in Epidemiology") guidelines. The study protocol received approval from the Scientific Research Ethics Committee at King Faisal Medical Complex (No. 2022-A-43). All participants completed an online informed consent form before beginning the

questionnaire. The study was conducted in the period May-October 2023.

Participants and sample size. This study included physical therapists licensed by the Saudi Commission for Health Specialties (SCFHS) who were working in Saudi Arabia. The minimum required sample size was set at 373 participants, as calculated using "calculator. net". This calculation set a 5% margin of error and a 95% confidence level, considering the population size of physical therapists in Saudi Arabia (n=12544), as indicated by the SCFHS.

Participants were recruited using a convenience sample strategy that employed a non-random sampling method. The electronic survey was administered and distributed among participants utilizing an online survey platform (Google Forms). The survey was delivered to the target participants via emails and messages through social media. Participants were briefed regarding the study's objectives and method at the beginning of the survey. They were required to provide informed consent at the beginning of the survey before being granted access to complete the survey. Data collection occurred from May 2023 to October 2023.

Survey development. The survey comprised questions related to demographic information (for example, age, gender, workplace, experience, and rank) and those regarding CES diagnosis and identification.

The second section of the survey was developed to explore physiotherapists' ability to identify and diagnose CES early. This section consisted of 12 statements developed from previous research and CES recommendations.[8,14,15] Based on the participants response to these statements, all responders were categorized into the following groups based on their ability to identify and manage CES early: proficient, 10-12 points; good ability, 7-9; fair ability, 5-6; and poor ability, <=4. The full details of the survey and scoring are provided in the appendix. Each statement was considered to reach a consensus when more than 70% of participants agreed/disagreed to the statement. To increase the reliability and quality of responses, some questions were asked in a different manner to confirm that participants had read and answered the questions carefully.

The survey instrument utilized in this study was developed following recommendations from previous research and established CES management guidelines.[8,14,15] To ensure clarity, ease of understanding and comprehensibility of the survey items, a pilot study was conducted with 10 participants before the main data collection phase. Feedback from these piloted participants was utilized to make minor revisions to improve question wording and clarity.

During the pilot phase, participants were also asked to self-rate their proficiency in identifying and managing CES on a five-point Likert scale, ranging from "highly competent" to "no competent". We then qualitatively matched their survey scores with their self-rated proficiency levels. This alignment helped us to adjust and refine the cutoff scores to better correspond with perceived competence levels, ensuring that the categories reflected meaningful distinctions among participants' abilities. Additionally, we consulted with expert physiotherapists and physicians experienced in CES management to further refine the cutoff scores for categorizing participants into "proficient", "good", "fair" and "poor" competence levels.

Although formal analyses of reliability and validity were not conducted at this stage, the survey's content development was grounded in established CES literature, providing a foundation for content validity. Future research using this survey could benefit from further psychometric assessment to substantiate its validation and reliability in assessing CES competence among healthcare providers.

Statistical analysis. All data analyses were performed using the "Statistical Package for the Social Sciences 23.0 (SPSS)" software from IBM company (Chicago Illinois, USA). Descriptive data is shown using frequencies and percentages or means and standard deviations (SD), as appropriate. Differences in demographic characteristics were analyzed using one-way ANOVA or chi-square tests, with participants grouped by their proficiency levels. A p value less than 0.05 was considered significant.

Literature search and gap identification. Following a comprehensive search of relevant databases, including PubMed and Google Scholar, we used a combination of keywords such as "Cauda Equina Syndrome," "early identification," "screening," and "physiotherapy." Despite this extensive search, we did not find any quantitative studies specifically investigating the experiences of physiotherapists in the early management of individuals with suspected CES. This highlights a significant gap in the current literature, underscoring the importance and novelty of our study in addressing this critical area of clinical practice.

Results. The total number of participants was 401 (mean age=29.51 (SD 5.54)). Among this cohort, 53.4% were female, 76.6% had a bachelor's degree, and 42.2% had practiced for 1-5 years. The demographics of the study participants are shown in **Table 1**.

A statistically significant difference was found in educational qualifications across CES management ability levels (*p*=0.006). In the "Proficient" group, the majority held a bachelor's degree as their highest level

of education (63.5%), followed by those with a master's degree (30.8%). However, having a bachelor's degree as the highest level of education was more common when considering those with only "Good" (75.9%) or "Fair" (79.6%) ability.

Of the 401 physiotherapists, 52 (13.0%) were classified as having proficient ability, 203 (50.6%) as good, 108 (26.9%) as fair, and 38 (9.5%) as poor in identifying and managing CES early (**Table 1**). This distribution indicates that while most participants (63.6%) had proficient-good ability, a substantial proportion (36.4%) were categorized as having fair-poor ability.

Most participants (63.6%) had a proficient–good ability to identify and manage CES early, among whom most were female (55.7%), had a bachelor's degree (73.3%), and had practiced between 1-5 years (38.8%). Participant demographics categorized by 'proficient ability', 'good ability', 'fair ability' and 'poor ability' are shown in **Table 1**.

In general, consensus for the CES statements was achieved for 8 (>67%) statements [numbers 1, 2, 3, 4, 5, 8, 9, 12] out of 12. Among these statements that showed consensus among the participants, most agreed that a patient was suspected of having CES when they exhibited urinary difficulties of neurogenic origin (including loss of desire to void, poor stream, needing to strain to empty their bladder, and loss of urinary sensation) (88.3%), and/or when they described their pain as radicular pain on both sides (bilateral radiculopathy, 85.5%). Moreover, most participants agreed that an MRI should be performed with extreme urgency when managing a patient with suspected CES (88.0%).

Conversely, consensus was not achieved for 4 (33%) statements [numbers 6, 7, 10, 11]. These statements revolved around communication with patients with suspected CES, the instructions given to those patients, and the appropriate management provided for patients with CES.

Discussion. Delayed diagnosis of CES can lead to serious complications in patients with suspected CES. However, some physiotherapists may find diagnosing patients with suspected CES challenging.[13] This quantitative study aimed to explore the ability of physiotherapists to identify patients with suspected cauda equina syndrome early, and to identify the methods used by physiotherapists in the management of CES.

The results showed that the majority of physiotherapists have a proficient–good ability to identify and manage CES early. This is a promising discovery, indicating that a considerable proportion

Table 1 - Characteristics of participants.

| Characteristics | All participants (N=401) | Ability to early identify and manage CES (%) | | | | *P*-value [a] |
		"Proficient ability" (N=52)	"Good ability" (N=203)	"Fair ability" (N=108)	"Poor ability" (N=38)	
Age, years (mean (SD))	29.5 (5.5)	29.9 (5.7)	29.6 (5.9)	29.3 (5.2)	29.3 (4.6)	0.945 [b]
Gender (N (%))						0.243
Male	187 (46.6)	36.5%	46.3%	48.1%	57.9%	
Female	214 (53.4)	63.5%	53.7%	51.9%	42.1%	
Highest Academic Education Qualification (N (%))						0.006
Internship year	7 (1.7)	0.0%	2.5%	1.9%	0.0%	
Diploma degree	13 (3.2)	3.8%	1.5%	4.6%	7.9%	
Bachelor's degree	307 (76.6)	63.5%	75.9%	79.6%	89.5%	
Master's degree	64 (16.0)	30.8%	18.2%	9.3%	2.6%	
PhD degree	10 (2.5)	1.9%	2.0%	4.6%	0.0%	
Years of practice (N (%))						0.385
Less than 1 year	88 (21.9)	23.1	25.1	15.7	21.1	
From 1 to 5 years	170 (42.4)	42.3	37.9	51.9	39.5	
From 6 to 10 years	69 (17.2)	11.5	19.7	15.7	15.8	
More than 10 years	74 (18.5)	23.1	17.2	16.7	23.7	

CES - cauda equina syndrome; N- number of participants; SD - standard deviation. [a] *P*-value was assessed using chi square, unless otherwise stated. [b] *P*-value was assessed using One-way ANOVA.

Table 2 - Responses of physiotherapists to the cauda equina syndrome statements.

Statements		
	Yes n (%)	**No** n (%)
Do you use toolkit/guidelines for early identification of cauda equina syndrome?	102 (25.4)	299 (74.6)
	Agree n (%)	**Disagree** n (%)
Full neurological examinations that include sensation when a patient has lower back pain is not important. (Reversed statement)	88 (21.9)	313 (78.1)
Cauda equina syndrome does not have a 'progression pattern'. (Reversed statement)	69 (17.2)	332 (82.8)
Suspected cauda equina syndrome stage is when the patient has urinary difficulties of neurogenic origin.	354 (88.3)	47 (11.7)
	Yes n (%)	**No** n (%)
Do you suspect cauda equina syndrome when patients describe their pain by radicular pain of one side or both sides (Ipsilateral radiculopathy or Bilateral radiculopathy)? [a]	343 (85.5)	58 (14.5)
Do you ask your patient when they have bilateral radiculopathy about any bowel/bladder dysfunctions in detail?	226 (56.4)	175 (43.6)
Do you give your patient with suspected cauda equina syndrome warning signs card ('Safety Netting Card')?	179 (44.6)	222 (55.4)
Do you warn and explain to the patient with suspected cauda equina syndrome the red flags symptoms?	289 (72.1)	112 (27.9)
Do you document the patient's signs and symptoms of cauda equina syndrome including duration, frequency and progression and the time and date of every contact immediately?	289 (72.1)	112 (27.9)
	Agree n (%)	**Disagree** n (%)
Communication and simple language are not important with patients with suspected cauda equina syndrome and could not be vital information from patients regarding early cauda equina syndrome symptoms. (Reversed statement)	149 (37.2)	252 (62.8)
	Correct n (%)	**Incorrect** n (%)
What is the appropriate management of patients with suspected cauda equina syndrome? [b]	146 (36.4)	255 (63.6)
	Agree n (%)	**Disagree** n (%)
The MRI request should state the extreme urgency of investigation and evaluation (or re-evaluation) of the patient with suspected cauda equina syndrome.	353 (88.0)	48 (12.0)

[a]Bilateral radiculopathy=Yes; Ipsilateral radiculopathy=No, [b]Send the patient immediately to MRI and give the patient 'Safety Netting Card' or warn the patient=correct; any other answer=incorrect

of physiotherapists are equipped with the knowledge and abilities required to detect and treat CES early.[16] This may be explained by their education, background, or continued career advancement. Another finding is that female made up a somewhat higher proportion of physiotherapists with a "good ability" (53.7%). This encourages conducting additional research into aspects connected to gender, as some research has indicated that gender may have an impact on patient interactions and communication patterns, which could be important for diagnosing and treating medical illnesses.[17]

In this study, the importance of formal education is revealed by the fact that most physiotherapists (63.5%) who were classified as having a "proficient ability" held a bachelor's degree. A bachelor's degree provides students with critical thinking skills, problem-solving ability, and good communication approaches, which are crucial in the modern complex and evolving healthcare industry. Moreover, this study found that most physiotherapists who have been practicing for 1 to 5 years had a "proficient ability" to identify or manage CES early. This may suggest that this experience is critical for mastering the diagnosis and treatment of disorders such as CES.

In terms of evaluating patients with suspected CES, most participants agreed that an MRI should be requested with extreme urgency when managing patients with suspected CES, as MRI has high validity in detecting CES in patients displaying indicative signs and symptoms.[18-20] Additionally, most participants agreed that patients should be suspected of having CES

when they present with urinary difficulties of neurogenic origin. The urinary problems, such as abnormalities in bladder function, are frequently regarded as a "red flag" symptom.[20-22] Urinary issues are a significant red flag in cases of CES, where the cauda equina nerve roots are compressed. In addition, the clinical expertise of physiotherapists is a major factor in the identification of clinical patterns. They might have been more aware of the symptoms, such as trouble urinating, after seeing patients with CES or disorders comparable to it over time.[23]

One of the primary findings of this study was the lack of consensus among physiotherapists on the crucial information to communicate to patients. Additionally, the study revealed that physiotherapists often provide inappropriate instructions to those with suspected CES. To ensure safe management, it is vital that patients understand what symptoms to monitor for potential worsening. Prior research has suggested that enhancing patient-centered communication, collaborative decision-making, and a robust therapeutic relationship can improve communication. However, physiotherapists' self-perceived deficits in clinical expertise may hinder the adoption of these strategies. The safety netting strategy is recommended for managing ambiguity related to serious pathology and should be utilized and implemented when working with patients suspected of having CES.[7,24] Furthermore, a previous investigation found that physiotherapists endorsed the use of this strategy.[13]

The findings of this study could help to reduce the risk of serious and long-term complications by highlighting the specializations and regions in which physiotherapists thrive and may benefit from focused interventions or training. Our study further sheds light on potential areas for further training, or resources which could help physiotherapists to improve their ability to recognize and manage patients with suspected CES in a timely manner. These results could thus help to shape continuing education programs for professional development, guaranteeing that physiotherapists are prepared to manage patients with intricate neurological disorders.

Better communication between physiotherapists and other medical specialists, including neurologists, neurosurgeons and orthopedic surgeons, is crucial to ensure the effective management of patients with CES. Such communication promotes a team-based method of patient care, particularly when a multidisciplinary effort is necessary. Early identification of CES by physiotherapists can help to improve the effectiveness of the healthcare system as a whole. Simplified patient paths could reduce unnecessary waiting time for diagnosis and treatment, which could lessen the load on emergency services. Training regarding CES diagnosis and management could be organized and provided to enhance the understanding of CES, its accompanying symptoms, and its management, in addition to fostering better communication with patients and other medical professionals. The results of this study could contribute to the development of sensitive, evidence-based, and unambiguous guidelines for clinical questioning regarding symptoms that may seem humiliating but are clinically important.

The study's results have important implications for the development and refinement of clinical standards and protocols related to the early identification and management of CES by physiotherapists, ultimately contributing to enhanced patient care in Saudi Arabia. The high proficiency levels reported among physiotherapists suggest that they are well-positioned to play a crucial role in the timely recognition and treatment of this serious condition. Nevertheless, the lack of consensus on certain aspects of CES management points to areas where further training and standardization of practices could be beneficial. Ongoing education and research can help address these gaps, ensuring physiotherapists are equipped with the knowledge and skills necessary to provide optimal care for patients at risk of CES.

The study's findings emphasize the importance of empowering physiotherapists as key members of the healthcare team in the early identification and management of CES. By leveraging the expertise of these professionals, healthcare systems can enhance their ability to prevent permanent neurological deficits and improve patient outcomes. This study's findings can aid in the creation or improvement of clinical standards and protocols pertaining to physiotherapists' roles in the early detection of CES, which could enhance care uniformity and standardize procedures within the field. Future research should investigate the long-term impact of these clinical standards and protocols on patient outcomes, as well as explore the effectiveness of specific training and education programs for physiotherapists in the early detection and management of CES. Future research using this survey could benefit from further psychometric assessment to substantiate its validation and reliability in assessing CES competence among healthcare providers.

One limitation of this study is the use of convenience sampling to distribute surveys, which can ensure a cost-effective and timely gathering of data but may limit the generalizability of the findings. Future research could consider employing a more rigorous sampling method, such as random sampling, to increase the

generalizability of the findings. Another limitation is relying on self-reported data, which can impact the accuracy of results due to potential bias or errors in participants' responses. To address this limitation, using multiple methods of data collection could triangulate the findings and improve result validity; incorporating qualitative data alongside quantitative measures could provide a more comprehensive understanding of research topics. Finally, the cutoff scores utilized in this study to categorize participants' competence levels were based on expert opinion rather than formal validation. While these cutoffs were informed by insights from experienced physiotherapists and physicians, further research is needed to empirically validate these thresholds to ensure they accurately reflect competence levels in CES identification and management.

Conclusion. The findings of this study found that although a majority of physiotherapists in Saudi Arabia (63.6%) show a proficient-good ability to promptly identify and manage CES, a substantial proportion (36.4%) were classified as having fair or poor ability. This underscores both strengths and areas requiring improvement within the profession. While many physiotherapists appear prepared and well-equipped to effectively recognize and manage CES, there remains a continued need for targeted training and support to improve early identification skills among those with fair or poor competence levels. Improving these competencies broadly is essential for ensuring timely intervention and the prevention of severe neurological consequences.

References

1. Hoeritzauer I, Wood M, Copley PC, Demetriades AK, Woodfield J. What is the incidence of cauda equina syndrome? A systematic review. *J Neurosurg Spine* 2020; 32: 832-841.
2. Fraser S, Roberts L, Murphy E. Cauda equina syndrome: a literature review of its definition and clinical presentation. *Arch Phys Med Rehabil* 2009; 90: 1964-1968.
3. Korse NS, Veldman AB, Peul WC, Vleggeert-Lankamp CLA. The long term outcome of micturition, defecation and sexual function after spinal surgery for cauda equina syndrome. *PLoS One* 2017; 12: e0175987.
4. Lavy C, James A, Wilson-MacDonald J, Fairbank J. Cauda equina syndrome. *BMJ* 2009; 338: b936.
5. Thakur JD, Storey C, Kalakoti P, Ahmed O, Dossani RH, Menger RP, et al. Early intervention in cauda equina syndrome associated with better outcomes: a myth or reality? Insights from the Nationwide Inpatient Sample database (2005-2011). *Spine J* 2017; 17: 1435-1448.
6. Kumar V, Baburaj V, Rajnish RK, Dhatt SS. Outcomes of cauda equina syndrome due to lumbar disc herniation after surgical management and the factors affecting it: a systematic review and meta-analysis of 22 studies with 852 cases. *Eur Spine J* 2022; 31: 353-363.
7. Greenhalgh S, Finucane L, Mercer C, Selfe J. Assessment and management of cauda equina syndrome. *Musculoskelet Sci Pract* 2018; 37: 69-74.
8. Greenhalgh S, Truman C, Webster V, Selfe J. Development of a toolkit for early identification of cauda equina syndrome. *Prim Health Care Res Dev* 2016; 17: 559-567.
9. Todd NV. Quantifying the clinical aspects of the cauda equina syndrome - The Cauda Scale (TCS). *Br J Neurosurg* 2018; 32: 260-263.
10. Finucane LM, Downie A, Mercer C, Greenhalgh SM, Boissonnault WG, Pool-Goudzwaard AL, et al. International Framework for Red Flags for Potential Serious Spinal Pathologies. *J Orthop Sports Phys Ther* 2020; 50: 350-372.
11. Buell KG, Sivasubramaniyam S, Sykes M, Zafar K, Bingham L, Mitra A. Expediting the management of cauda equina syndrome in the emergency department through clinical pathway design. *BMJ Open Qual* 2019; 8: e000597.
12. Sun JC, Xu T, Chen KF, Qian W, Liu K, Shi JG, et al. Assessment of cauda equina syndrome progression pattern to improve diagnosis. *Spine (Phila Pa 1976)* 2014; 39: 596-602.
13. Paling C, Hebron C. Physiotherapists' experiences of managing persons with suspected cauda equina syndrome: Overcoming the challenges. *Musculoskeletal Care* 2021; 19: 28-37.
14. Todd NV. Guidelines for cauda equina syndrome. Red flags and white flags. Systematic review and implications for triage. *Br J Neurosurg* 2017; 31: 336-339.
15. Todd NV, Dickson RA. Standards of care in cauda equina syndrome. *Br J Neurosurg* 2016; 30: 518-522.
16. Leech RL, Selfe J, Ball S, Greenhalgh S, Hogan G, Holway J, et al. A scoping review: Investigating the extent and legal process of cauda equina syndrome claims for UK physiotherapists. *Musculoskelet Sci Pract* 2021; 56: 102458.
17. Aggarwal NK, Pieh MC, Dixon L, Guarnaccia P, Alegria M, Lewis-Fernandez R. Clinician descriptions of communication strategies to improve treatment engagement by racial/ethnic minorities in mental health services: A systematic review. *Patient Educ Couns* 2016; 99: 198-209.
18. Balasubramanian K, Kalsi P, Greenough CG, Kuskoor Seetharam MP. Reliability of clinical assessment in diagnosing cauda equina syndrome. *Br J Neurosurg* 2010; 24: 383-386.
19. Dionne N, Adefolarin A, Kunzelman D, Trehan N, Finucane L, Levesque L, et al. What is the diagnostic accuracy of red flags related to cauda equina syndrome (CES), when compared to Magnetic Resonance Imaging (MRI)? A systematic review. *Musculoskelet Sci Pract* 2019; 42: 125-133.
20. Pronin S, Woodfield J, Hoeritzauer I, Carson A, Stone J, Statham PF, et al. Does a history of lumbar spine surgery predict radiological cauda equina compression in patients undergoing MRI for suspected cauda equina syndrome? *Br J Neurosurg* 2020; 34: 76-79.
21. Greenhalgh S, Truman C, Webster V, Selfe J. An investigation into the patient experience of Cauda Equina Syndrome: A qualitative study. *Physiother Pract Res.* 2015; 36: 23-31.
22. Lavy C, Marks P, Dangas K, Todd N. Cauda equina syndrome-a practical guide to definition and classification. *Int Orthop* 2022; 46: 165-169.
23. Hall R, Jones K. The lived experience of Cauda Equina Syndrome: a qualitative analysis. *Spinal Cord* 2018; 56: 41-45.
24. Greenhalgh S, Finucane LM, Mercer C, Selfe J. Safety netting; best practice in the face of uncertainty. *Musculoskelet Sci Pract* 2020; 48: 102179.