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Review Article

Assessing the use of the frequency, etiology, direction, and severity classification system for shoulder instability in physical therapy research – A scoping review☆

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ABSTRACT

Objective: The aim of this study is to review the implementation of the Frequency, Etiology, Direction, and Severity (FEDS) classification for shoulder instability by the physical therapy scientific community since its publication in 2011.

Methods: A systematic search was conducted on January 10, 2024 in the MEDLINE, EMBASE, SPORTDiscus, Scopus, Web of Science, Cochrane, and SciELO databases, as well as Google Scholar. Studies investigating physical therapy interventions in people with shoulder instability, and reporting selection criteria for shoulder instability were considered eligible. A narrative synthesis was conducted.

Results: Twenty-six studies were included. None reported using the FEDS classification as eligibility criteria for shoulder instability. Only 42% of the studies provided data of all four criteria of the FEDS classification. The most reported criterion was direction (92%), followed by etiology (85%), severity (65%), and frequency (58%). The most common reported descriptor for profiling shoulder instability was "dislocation" (83.3%), followed by "first-time" (66.7%), "anterior" (62.5%), and "traumatic" (59.1%). Regarding other instability classifications, only one study (4%) used the Thomas & Matsen classification, and two (8%) the Stanmore classification.

Conclusions: The FEDS classification system has not been embraced enough by the physical therapy scientific community since its publication in 2011.

1. Introduction

Shoulder instability is a term which includes a wide spectrum of overlapping disorders ranging from complete shoulder joint dislocation to excessive uncontrolled translation of the humeral head (Lewis et al., 2004). Unlike shoulder laxity which is used in the presence of an asymptomatic shoulder hypermobile joint, shoulder instability refers to a loss of joint stability leading to shoulder symptoms such as pain, discomfort, paresthesia, apprehension, and fatigue (Kuhn, 2010). Thus, symptoms of instability are required for making a diagnosis of shoulder instability. However, despite being different entities, there seems to be a close relationship between them. Experts agree that, although shoulder laxity should not be considered a criteria for the diagnosis of shoulder instability, it should be assessed in patients with shoulder instability, because it can be useful to guide their management (Hurley et al., 2022).

In athletes, shoulder joint hypermobility including joint instability has been associated with higher odds of having shoulder injuries (Liaghat et al., 2021). Shoulder instability is a very common clinical condition in young athletes and physically active populations which has a great impact in functional activities and quality of life, (Cameron et al., 2017) but it can also occur in older patients (Paxton et al., 2014). Shoulder instability may occur as a consequence of a traumatic event, repetitive overuse or be inherited (Lewis et al., 2004).

There are currently a great variety of definitions provided by expert opinion for the term shoulder instability (Lewis et al., 2004). A recent study has shown that healthcare professionals do not agree on the clinical factors which are important for diagnosing shoulder instability (Nicolozakes et al., 2021). Whereas orthopaedic surgeons and primary

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care sports medicine physicians gave more importance to physical examination for the diagnosis of shoulder instability, physical therapists and athletic trainers thought that the patient history was the key element for diagnosis (Nicolozakes et al., 2021). In addition to terminology and diagnosis inconsistencies, a universal classification system for shoulder instability is currently lacking. Several methods to classify shoulder instability have been proposed in the literature, such as the Rockwood (Rockwood Jr, 1979), Thomas and Matsen (i.e., TUBS and AMBRI) (Thomas & Matsen 3rd, 1989) Stanmore (i.e., Polar type I, II, III and sub-types), (Lewis et al., 2004) or, Gerber classifications, (Gerber & Nyffeler, 2002) which are mostly based on expert opinion and lack validity and reliability (Kuhn et al., 2011). Based on the most common features used to characterize shoulder instability in the literature, a new classification system namely FEDS, which stands for Frequency (solitary, occasional [2–5 per year], or frequent [>5 per year]), Etiology (traumatic or atraumatic), Direction (anterior, inferior, or posterior) and Severity (dislocation or subluxation), was developed. (Kuhn, 2010; Kuhn et al., 2011). One descriptor from each component is used to describe shoulder instability for an individual patient (e.g., solitary (Frequency), traumatic (Etiology), anterior (Direction) and dislocation (Severity) would be an example of shoulder instability diagnosis). Interestingly, the FEDS classification system gives greater importance for diagnosis to the clinical history than to physical examination, which is used to confirm the primary direction of instability by means of provocative tests (Kuhn et al., 2011). The FEDS system is the only classification system for shoulder instability which has been tested for validity and reliability, with kappa values for inter-rater agreement ranging from 0.44 (etiology domain) to 0.76 (severity domain). (Kuhn et al., 2011).

Since the original publication of the FEDS system in 2011, some epidemiological studies have used this classification system to investigate the prevalence of the different FEDS categories in several shoulder pain populations (Hettrich et al., 2019; Magnuson et al., 2020; Wagstrom et al., 2019). The categories solitary, traumatic, anterior, dislocation and occasional, traumatic, anterior, dislocation seems to be the two most common types of instability based on the FEDS system, (Hettrich et al., 2019; Magnuson et al., 2020; Wagstrom et al., 2019) with some studies finding differences between sex, being OTAD more common in men, and STAS more common in women (Magnuson et al., 2019). Moreover, the FEDS system can be used to provide prognosis on surgical outcomes (Magnuson et al., 2020). The FEDS system was developed in an attempt to establish validated and well-defined diagnostic criteria for classifying shoulder instability in order to reduce confusion in the literature and allow comparability between studies (Kuhn, 2010; Kuhn et al., 2011). In order to find the best way to treat shoulder instability, the condition should be first clearly defined and classified (Kuhn, 2010). Whether this classification system has gained widespread acceptance within the scientific community since its original publication is unknown.

The aim of this scoping review was to evaluate the embracing of the FEDS classification system by the physical therapy scientific community since its publication (i.e., to investigate to what extent the FEDS classification system was considered in selection criteria of experimental research related to shoulder instability). Furthermore, it also aimed to evaluate the reporting of the Thomas & Matsen and Stanmore classifications, and the diagnostic criteria used for shoulder instability.

2. Material and methods

2.1. Design

This was a scoping review reported according to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Supplementary Material 1). (Page et al., 2021) The protocol of the study was registered at PROSPERO (CRD42020193505).

2.2. Literature search

A systematic literature search was conducted on January 10, 2024, in the MEDLINE (Pubmed), EMBASE, SPORTDiscus (EBSCOhost), Scopus, Web of Science, Cochrane, and SciELO databases, as well as Google Scholar, using a combination of descriptors and boolean operators (Supplementary Material 2). Furthermore, references of included studies were also screened for eligibility. Before starting screening, duplicates were removed using Covidence (Veritas Health Innovation Ltd, Melbourne, Australia) and RayyanQ webpage applications (Kellermeyer et al., 2018).

2.3. Screening and study eligibility criteria

The whole screening procedure (title/abstract and full-text) was conducted using the Rayyan webpage application by two independent reviewers (RFM and NRS). All discrepancies were resolved by a third independent reviewer (ELG). The inclusion criteria were: (1) studies completed with the primary purpose of addressing physical therapy interventions for people with shoulder instability, (2) being published since June 2011, and (3) reporting eligibility criteria for shoulder instability. The exclusion criteria were: (1) post-surgery physical therapy intervention studies, and (2) case report studies. Post-surgery studies were excluded because the potential influence of instability classification decision to surgery could bias the results of the systematic review when evaluating the adherence of physical therapy community to the FEDS classification.

Only studies published after June 2011 were included in the systematic review because this was the year of publication of the FEDS classification (Kuhn et al., 2011).

2.4. Data extraction

A standardized data extraction table was elaborated. For each study, the following information was extracted: first author and year of publication, country, study design, sample size and demographic characteristics, diagnostic criteria for shoulder instability, inclusion and exclusion criteria, and criteria for shoulder instability classification. Two independent reviewers (RFM and ELG) extracted data from studies and any discrepancy was resolved by consensus. When no data was present or adequately reported, the authors of the study were contacted.

2.5. Risk-of-bias

Risk-of-bias of randomized controlled trials was analyzed with the Cochrane's risk-of-bias tool 2 (RoB-2), (J. A. C. Sterne et al., 2019) non-randomized studies were analyzed using the Cochrane's ROBINS-I tool, (J. A. Sterne et al., 2016) and non-controlled studies were analyzed with the Study Quality Assessment Tool for Before-After (Pre-Post) Studies With No Control Group of the National Heart, Lung, and Blood Institute (https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools).

Two reviewers assessed independently risk-of-bias (RFM and NRS) and discrepancies were resolved by consensus.

2.6. Statistical analysis

No meta-analysis was planned. The mean and standard deviation (SD) were used to describe quantitative variables, and absolute frequencies and percentages were used for categorical variables. A summary of the results regarding the use of FEDS classification was presented using absolute frequencies and percentages.

3. Results

3.1. Study selection

The literature search retrieved 9812 articles. After duplicates removed 4534 studies were screened, leaving a total of 26 articles included in the review (Fig. 1).

3.2. Study characteristics

The characteristics of the included studies are presented in Table 1.

3.3. Risk of bias

The overall rating of risk-of-bias and study quality for each study is presented in Table 1, and the ratings of each individual item of the risk-of-bias and study quality tools are presented in Supplementary Material 3.

3.4. Results of individual studies and synthesis

3.4.1. Use of the frequency, etiology, direction, and severity classification

There was perfect agreement between the two reviewers who extracted data regarding criteria for shoulder instability, so reliability analyses were not performed.

A summary of the results regarding reporting of descriptors for shoulder instability is presented in Fig. 2.

None of the included studies explicitly reported using FEDS classification for shoulder instability, but all of them reported at least one criterion included in the FEDS classification. The most reported criterion was direction (92%), followed by etiology (85%), severity (65%), and frequency (58%). Nevertheless, only 42% of the studies fulfilled all four criteria of the FEDS classification (Fig. 2).

Within the studies that fulfilled some FEDS criteria, there was a wide variety of reported descriptors for shoulder instability. The most reported frequency descriptor was “first-time” (66.7%), etiology descriptor was “traumatic” (59.1%), direction descriptor was “anterior” (62.5%), and severity descriptor was “dislocation” (83.3%) (Table 2).

3.4.2. Use of other instability classifications

Regarding the explicit reporting of other shoulder instability

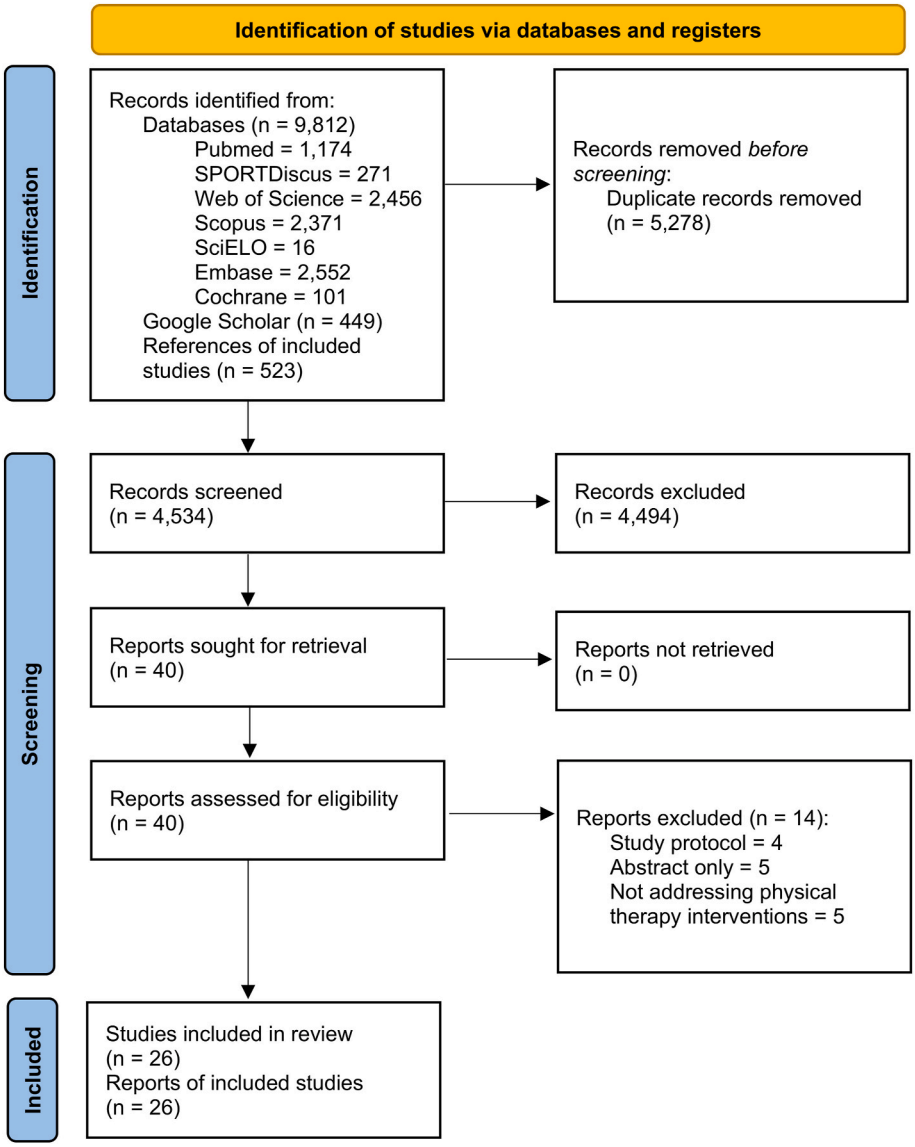

Fig. 1. PRISMA flow diagram.

Table 1
Characteristics of included studies.

Study	Country	Design	Sample size, women (%)	Demographics[a]	RoB/Quality
Shih, 2011; Shih et al., 2011)	Taiwan	Non-randomized	64, 0 (0)	Age: 22 (range, 17–29)	Moderate[b]
Merolla, 2014; Merolla et al., 2015)	Italy	Non-controlled	15, 9 (60)	Age: 19.1 (6.1) Height: 167 (10.7) Weight: 61.1 (14.6) BMI: range, 17-30	Fair[c]
Gigis, 2014; Gigis et al., 2014)	Greece	Non-randomized	65, 24 (36.9)	Age: 16.7 (range, 15–18)	Moderate[b]
Khan, 2014; Khan et al., 2014)	France	Retrospective	49, 14 (28.6)	Age: 23.8 (4.4)	–
Backnall, 2014; Blacknall et al., 2014)	United Kingdom	Case series	19, 10 (52.6)	Age: 16.1 (2.3)	–
Riccio, 2015; Riccio et al., 2015)	Italy	Case series	32, 8 (25)	Age: 27.9 (2.2) BMI: 24.5 (1.8)	–
Bateman, 2015; Bateman et al., 2015)	United Kingdom	Non-controlled	18, 11 (61.1)	Age: 21.2 (range, 12–49)	Fair[c]
Cruz-Ferreira, 2017; Cruz-Ferreira et al., 2017)	Portugal	Non-randomized	51, 8 (15.7)	Age: 26 (9)	Moderate[b]
Gaballah, 2017; Gaballah et al., 2017)	USA	Non-controlled	12, 0 (0)	Age: 18.6 (1.3) Height: 178.4 (3.21) Weight: 74.5 (3.2)	Fair[c]
Watson, 2018; Watson et al., 2018)	Australia	Non-controlled	43, 27 (62.8)	Age: 19.8 (4.9)	Good[c]
Warby, 2018; Warby et al., 2018)	Australia	Randomized controlled trial	41, 33 (80.5)	Age: Watson, 21.8 (6.5) Rockwood, 23 (6.5)	Low[d]
Bateman, 2019; Bateman et al., 2019)	United Kingdom	Non-controlled	66, 43 (65.2)	Age: 21.7 (range, 12–52)	Fair[c]
Woodmass, 2019; Woodmass et al., 2019)	USA	Retrospective	143, 16 (11.2)	Age: 27.9 BMI: 27.1	–
Scott, 2020; Scott et al., 2020)	United Kingdom	Case series	85, 51 (60)	Age: 20 (range, 9–46)	–
Hagesæter, 2020; Hagesæter et al., 2020)	Norway	Feasibility study	7, 3 (42.9)	Age: 31.6 (9.3)	–
Liaghat, 2020; Liaghat et al., 2020)	Denmark	Feasibility study	12, 11 (92.7)	Age: 39.3 (13.9) Height: 168 (7.6) Weight: 73.8 (13.5)	–
Eshoj, 2020; Eshoj et al., 2020)	Denmark	Randomized controlled trial	56, 7 (12.5)	Age: 26 (6.1) Height: 179.6 (8) Weight: 83.4 (16.2)	Low[c]
Pougès, 2021; Pougès et al., 2021)	France	Randomized controlled trial	40, 7 (17.5)	Nonoperative: Age: 21.5 (IQR, 20–22.5) BMI: 22.2 (IQR, 20.5–25.5) Surgical: Age: 22 (IQR, 20.5–22.5) BMI: 22.7 (IQR, 20.9–25.3)	Some concerns[d]
Festbaum, 2022; Festbaum et al., 2022)	Germany	Retrospective	28, 5 (17.9)	Age: 40 (13.7)	–
Ganderton, 2022; Ganderton et al., 2022)	Australia	Non-controlled	24, 16 (66.7)	Age: 23.8 (2.9) Height: 166.8 (7.7) Weight: 64.1 (10.3)	Fair[‡]
Liaghat, 2022; Liaghat et al., 2022)	Denmark	Randomized controlled trial	100, 79 (79)	Age: 37.8 (12.8) Height: 171.9 (9.1) Weight: 80.3 (17.3)	Low[d]
Lee, 2022; Lee et al., 2022)	USA	Retrospective study	115, 14 (12.2)	Age: 28.9 (range, 13–58) BMI: 27.4 (range, 12.3–40.6)	–
Pulido, 2023; Pulido et al., 2023)	Canada	Randomized controlled trial	37, 10 (27)	Age: 19.9 (2.0) Height: 176.2 (9.7) Weight: 89.5 (26.6)	Some concerns[d]
Smartt, 2023; Smartt et al., 2023)	USA	Retrospective study	179, 97 (54.2)	Age: 59.6 (range, 50–71) BMI: 31.3 (7.1)	–
Moroder, 2023; Moroder et al., 2023)	Germany	Randomized controlled trial	49, 27 (55.1)	Age: 20.0 (5.3) BMI: 22.7 (3.4)	Low[d]
Tudini, 2023; Tudini et al., 2023)	USA	Randomized controlled trial	29, 28 (96.6)	Age: 41.2 (16.4) Height: 162.6 (7.4) Weight: 70.6 (20.5)	Some concerns[d]

Abbreviations: USA, United States of America; IQR, interquartile range; RoB, risk of bias, BMI, body mass index.
[a] Data is presented as mean (standard deviation) unless otherwise specified.
[b] Cochrane Risk Of Bias In Non-randomized Studies - of Interventions tool.
[c] Quality assessed with the Study Quality Assessment Tool for Before-After (Pre-Post) Studies with No Control Group (QATBA) of the National Heart, Lung, and Blood Institute.
[d] Cochrane risk-of-bias tool 2.

classification, only one study (Riccio et al., 2015) reported the use of Thomas & Matsen classification (TUBS type), and two (Bateman et al., 2015, 2019) reported the use of Stanmore classification (polar types II and III) (Table 2).

3.4.3. *Diagnostic criteria for shoulder instability*

The inclusion and exclusion criteria reported within included studies is presented in Supplementary Material 4.

Seven studies (Blacknall et al., 2014; Cruz-Ferreira et al., 2017; Ganderton et al., 2022; Merolla et al., 2015; Tudini et al., 2023; Warby et al., 2018; Watson et al., 2018) reported using orthopaedic tests. The following tests were used: sulcus sign, (Blacknall et al., 2014; Cruz--Ferreira et al., 2017; Ganderton et al., 2022; Merolla et al., 2015; Warby et al., 2018; Watson et al., 2018) hyperabduction test, (Merolla et al., 2015) load and shift test, (Merolla et al., 2015) anterior/posterior apprehension tests, (Blacknall et al., 2014; Cruz-Ferreira et al., 2017; Ganderton et al., 2022; Merolla et al., 2015; Tudini et al., 2023; Warby et al., 2018; Watson et al., 2018) posterior shear test (Blacknall et al., 2014), Gagey test (Cruz-Ferreira et al., 2017), Fukuda's jerk test (Cruz-Ferreira et al., 2017), Kim test, (Cruz-Ferreira et al., 2017) and

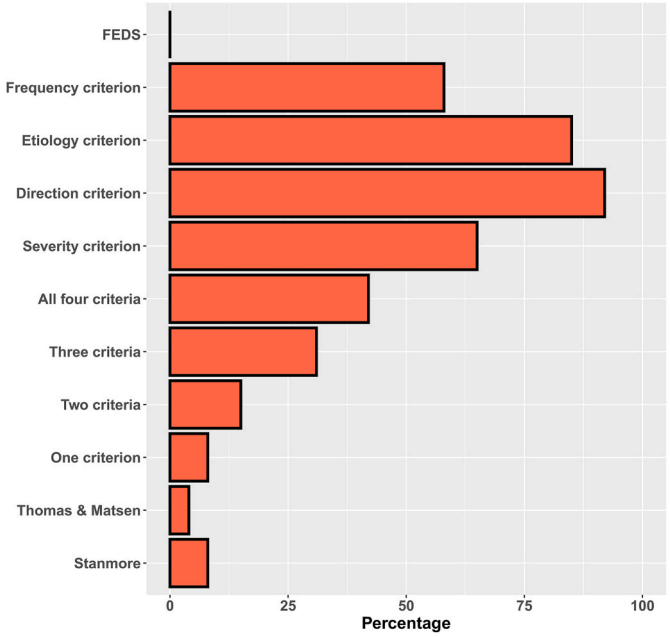

Fig. 2. Bar plot for instability descriptors. Abbreviations: FEDS, frequency, etiology, direction, and severity classification.

anterior/posterior draw tests (Ganderton et al., 2022; Warby et al., 2018; Watson et al., 2018). Regarding diagnostic imaging, it was mostly used as an inclusion criteria for the diagnosis of patients with traumatic shoulder instability (Eshoj et al., 2020; Festbaum et al., 2022; Gigis et al., 2014; Khan et al., 2014; Lee et al., 2022; Moroder et al., 2023; Pougès et al., 2021; Shih et al., 2011). Seven studies used imaging as an exclusion criteria (Eshoj et al., 2020; Festbaum et al., 2022; Lee et al., 2022; Moroder et al., 2023; Pougès et al., 2021; Warby et al., 2018; Watson et al., 2018). The imaging procedures used were radiography (Eshoj et al., 2020; Gigis et al., 2014; Khan et al., 2014; Lee et al., 2022; Pougès et al., 2021; Shih et al., 2011; Woodmass et al., 2019), magnetic resonance imaging, (Festbaum et al., 2022; Lee et al., 2022; Moroder et al., 2023; Warby et al., 2018; Watson et al., 2018) computed tomography arthrography, (Cruz-Ferreira et al., 2017; Festbaum et al., 2022; Lee et al., 2022; Woodmass et al., 2019) and magnetic resonance imaging arthrogram (Lee et al., 2022; Woodmass et al., 2019).

4. Discussion

The aim of this systematic review was to analyze the adherence of experimental research within physical therapy field to the FEDS instability classification. None of the included studies explicitly reported using FEDS classification for shoulder instability, and only 42% of the studies provided data of all four criteria of the FEDS classification (Kuhn et al., 2011). Finally, only two studies (10%), from the same clinical population, reported using the Stanmore classification, (Rockwood Jr, 1979) and only one study (5%) reported using the Thomas & Matsen classification. (Thomas & Matsen 3rd, 1989).

While there is no consensus that the FEDS classification should be used in favor of other methods, it was surprising to find that only 3 out of 20 studies used any formal classification system. The reasons for this are uncertain and may be due to a lack of consensus on which to use, a lack of clinically relevant classifications or simply a lack of awareness within the clinical community. Classification systems are useful if they guide treatment and prognosis. For example, within the Thomas & Matsen classification, TUBS guides towards surgery, whereas AMBRI guides towards rehabilitation. (Thomas & Matsen 3rd, 1989) The Stanmore classification is structured the same way (Type I guides towards surgery, and type III towards rehabilitation), but it also highlights the issues around having such a black and white system, so introduces shades of grey (sometimes decision-making isn't that clear-cut so there are the Type IIs and the sub-classifications) (Lewis et al., 2004). However, the FEDS classification (Kuhn et al., 2011) has 36 possible combinations (Hettrich et al., 2019) and there is no clear algorithm to guide a clinician regarding treatment decisions based upon the classification category. Furthermore, the FEDS classification does not consider multidirectional instability (MDI), because they state it may be difficult to define and has poor agreement (Kuhn et al., 2011). These issues may help to understand why physical therapists seem to not have embraced the FEDS classification since its publication. The most reported criterion was direction (92%), followed by etiology (85%), severity (65%), and frequency (58%). These percentages of reported criteria are similar to the ones obtained by Kuhn et al. (Kuhn et al., 2011) in their systematic literature search conducted for the development of the FEDS classification. It seems that direction (anterior, posterior and/or inferior) and etiology (traumatic or atraumatic) are considered key factors for classifying shoulder instability.

Widely used exercise rehabilitation protocols for shoulder instability, such as the Derby protocol, (Bateman et al., 2015) and the Watson et al. protocols, (Watson, Balster, et al., 2017; Watson, Warby, et al., 2017) clearly emphasize the importance of direction of instability when planning the exercise program for patients. Etiology has also been recognized previously as an important factor when diagnosing shoulder instability. A recently published international Delphi study showed that experts agreed on three subgroups to define posterior shoulder instability based on etiology criteria (traumatic, microtraumatic, and atraumatic) (Sadi et al., 2020). There is a clear distinction in management recommendations for shoulder instability based on its etiology, being the traumatic ones most indicated for surgery, due to high recurrence rates when managed nonoperatively (Hurley et al., 2020; Wasserstein et al., 2016). These recommendations have been supported by multiple experts, such as the BESS/BOA guidelines, (Brownson et al., 2015; Noorani et al., 2019) the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine, (Bak et al., 2010) the Anterior Shoulder Instability International Consensus Group, (Hurley et al., 2022) as well as the above mentioned international Delphi study regarding posterior shoulder instability (Sadi et al., 2020).

Frequency has also been recognized as an important factor for management decision of shoulder instability, (Bak et al., 2010; Hurley et al., 2022; Sadi et al., 2020) such as within the BESS/BOA guideline (Brownson et al., 2015). It is surprising that only 60% of included studies reported data regarding frequency criterion. This criterion was most reported within traumatic instability studies (66.67%) as "first time", whilst only 5 (45.5%) atraumatic instability studies reported data regarding frequency criteria as "recurrent". Only two studies from the same research team (Eshoj et al., 2020; Hagesæter et al., 2020) that cataloged instability as "recurrent", provided adequate data to rate this category according to the FEDS classification (i.e., 2 to 5 times/year (occasional) or $>$ 5 times/year (frequent)) (Kuhn et al., 2011). Furthermore, despite some patient-reported outcome measures often include an item regarding frequency criteria (e.g., Oxford Shoulder Instability Index and Melbourne Instability Shoulder Scale), none of the included studies which used them as outcome measures (Bateman et al., 2015, 2019; Blacknall et al., 2014; Ganderton et al., 2022; Liaghat et al., 2022; Moroder et al., 2023; Pulido et al., 2023; Scott et al., 2020; Tudini et al., 2023; Warby et al., 2018; Watson et al., 2018) reported frequency data within the manuscript.

This lack of reporting data regarding frequency criteria is worrying, as recurrent shoulder instability seems to be a risk factor for recurrence, (Lebus et al., 2015; Magnuson et al., 2020; Verweij et al., 2021) persistent symptoms, (Lebus et al., 2015; Magnuson et al., 2020; Verweij et al., 2021) need for surgery, (Lebus et al., 2015) and failure of surgical treatments, (Magnuson et al., 2020; Verweij et al., 2021) so the effects of interventions could vary widely between subjects with different frequency rates, precluding generalization and reproducibility of the

Table 2
Classifications and descriptors reported for shoulder instability.

Study	FEDS[a]	Frequency	Etiology	Direction	Severity	Thomas & Matsen[a]	Stanmore[a]
Shih, 2011; Shih et al., 2011)	No	First-time	Traumatic	Anterior	Dislocation	No	No
Merolla, 2014; Merolla et al., 2015)	No	NR	2 patients reported trauma or incident associated with beginning of symptoms; the rest was atraumatic	Multidirectional instability capable of voluntary posterior dislocation	Dislocation	No	No
Gigis, 2014; Gigis et al., 2014)	No	First-time	Traumatic	Anterior	Dislocation	No	No
Khan, 2014; Khan et al., 2014)	No	NR	Traumatic	Anterior	Dislocation	No	No
Backnall, 2014; Blacknall et al., 2014)	No	NR	Atraumatic	Posterior	Subluxation	No	No
Riccio, 2015; Riccio et al., 2015)	No	First-time	Traumatic	Anterior	Dislocation	TUBS	No
Bateman, 2015; Bateman et al., 2015)	No	Recurrent	Atraumatic	Anterior, posterior, or multidirectional	NR	No	Types II and III
Cruz-Ferreira, 2017; Cruz-Ferreira et al., 2017)	No	Recurrent	NR	Posterior	Subluxation or dislocation	No	No
Gaballah, 2017; Gaballah et al., 2017)	No	First-time	Traumatic	Anterior	Dislocation	No	No
Watson, 2018; Watson et al., 2018)	No	NR	Atraumatic	Multidirectional	NR	No	No
Warby, 2018; Warby et al., 2018)	No	NR	Atraumatic	Multidirectional	NR	No	No
Bateman, 2019; Bateman et al., 2019)	No	Recurrent	Atraumatic	Anterior, posterior, or multidirectional	NR	No	Types II and III
Woodmass, 2019; Woodmass et al., 2019)	No	NR	NR	Posterior	NR	No	No
Scott, 2020; Scott et al., 2020)	No	NR	Atraumatic	Anterior, posterior, or multidirectional	NR	No	No
Hagesæter, 2020; Hagesæter et al., 2020)	No	First-time or recurrent	Traumatic	Anterior	Dislocation	No	No
Liaghat, 2020; Liaghat et al., 2020)	No	Recurrent	Atraumatic	NR	Dislocation	No	No
Eshoj, 2020; Eshoj et al., 2020)	No	First-time or recurrent	Traumatic	Anterior	Dislocation	No	No
Pougès, 2021; Pougès et al., 2021)	No	First-time	Traumatic	Anterior	Dislocation	No	No
Festbaum, 2022; Festbaum et al., 2022)	No	First-time	Traumatic	Posterior	Dislocation	No	No
Ganderton, 2022; Ganderton et al., 2022)	No	NR	Atraumatic	Anterior, posterior, or multidirectional	Subluxation	No	No
Liaghat, 2022; Liaghat et al., 2022)	No	NR	NR	NR	Subluxation or dislocation	No	No
Lee, 2022; Lee et al., 2022)	No	First-time	Traumatic	Posterior	Dislocation	No	No
Pulido, 2023; Pulido et al., 2023)	No	NR	Traumatic	Anterior	NR	No	No
Smartt, 2023; Smartt et al., 2023)	No	First-time or recurrent	Traumatic or atraumatic	Anterior	Subluxation or dislocation	No	No
Moroder, 2023; Moroder et al., 2023)	No	Recurrent	Atraumatic	Posterior	Subluxation	No	No
Tudini, 2023; Tudini et al., 2023)	No	NR	NR	Anterior	NR	No	No

Abbreviations: FEDS, frequency, etiology, direction, and severity classification; NR, not reported.
[a] Do the authors explicitly report the use of this classification?.

results of published studies.

The severity criterion was also most reported within traumatic instability studies (91.7%) compared to atraumatic ones (54.5%). This could be due to the nature of first-time traumatic instability, in which a clinical history of dislocation is crucial for patient management, because of the requirement of manual reduction by emergency practitioners (Baden et al., 2020). While the FEDS classification defines instability severity just in terms of subluxation/dislocation, (Kuhn et al., 2011) severity is a complex concept which is influenced by many other factors. There can be patients with subluxation and high levels of pain/disability, and other ones which have suffered a dislocation episode but have mild symptoms. This is the reason why patient reported outcome measures were developed for this patient population, in aim to measuring severity, not just in terms of subluxation versus dislocation, but pain and the impact on function, lifestyle, mental health, etc. (Kirkley et al., 1998)

The most commonly reported descriptors within included studies were “first-time”, “traumatic” (with small difference compared to

"atraumatic"), "anterior", and "dislocation". Previously published literature using FEDS classification within surgery research field has found "recurrent" (i.e., occasional and/or frequent), "traumatic", and "anterior", as the most common descriptors, with no clear dominance of one severity descriptor upon another (Hettrich et al., 2019; Magnuson et al., 2020; Wagstrom et al., 2019). These differences between surgical and physical therapy research fields regarding etiology descriptors, might be due to actual recommendations in favor of surgical procedures for traumatic shoulder instability, (Bak et al., 2010; Hurley et al., 2022; Sadi et al., 2020) so physical therapists might tend to investigate more the atraumatic population in comparison to surgeons, because physical therapy is thought to be more indicated for this population.

There was also inadequate reporting regarding diagnostic criteria for shoulder instability within included studies. Only six studies that classified instability as "atraumatic", and one study that classified it as "traumatic", reported using any orthopaedic test for diagnosing direction of instability, (Blacknall et al., 2014; Cruz-Ferreira et al., 2017; Ganderton et al., 2022; Merolla et al., 2015; Warby et al., 2018; Watson et al., 2018) the most common being the sulcus sign (Blacknall et al., 2014; Cruz-Ferreira et al., 2017; Ganderton et al., 2022; Merolla et al., 2015; Warby et al., 2018; Watson et al., 2018) and the anterior/posterior apprehension tests (Blacknall et al., 2014; Cruz-Ferreira et al., 2017; Ganderton et al., 2022; Merolla et al., 2015; Tudini et al., 2023; Warby et al., 2018; Watson et al., 2018). Furthermore, there were also discrepancies between studies in criteria used for considering an orthopaedic test to be positive. Regarding the sulcus sign, three studies did not report criteria used for a positive test, (Cruz-Ferreira et al., 2017; Merolla et al., 2015; Tudini et al., 2023) two used criteria based on laxity, (Blacknall et al., 2014; Watson et al., 2018) one used a criterion of pain or apprehension and/or guarding, (Ganderton et al., 2022) and the last one used a criterion of apprehension, not just pain or signs of laxity (Warby et al., 2018). On the other hand, regarding all other instability tests, three studies did not specify criteria for a positive test, (Blacknall et al., 2014; Cruz-Ferreira et al., 2017; Merolla et al., 2015) two used criteria of pain, apprehension or guarding, (Ganderton et al., 2022; Watson et al., 2018) and the last one used a criterion of apprehension, not just pain or signs of laxity (Warby et al., 2018).

4.1. Limitations

Only physical therapy interventional studies were considered for inclusion, so the results of this systematic review may not apply to observational studies or studies evaluating post-surgical physical therapy treatments. Furthermore, post-surgery studies were excluded due to the potential influence of instability classification decision to surgery, that could bias the results of the systematic review when evaluating the adherence of physical therapy community to the FEDS classification, so it is unknown if our results can be extrapolated to that study population.

4.2. Implications for future research

Future research should include a minimum of information when conducting studies in patients with shoulder instability. First, all categories within the FEDS classification should be specified in order to clearly describe the type of shoulder instability considered in the study. Second, all the inclusion and exclusion criteria used for eligibility of patients with shoulder instability should be reported in detail in order to facilitate reproducibility. Finally, if researchers use special orthopaedic tests to diagnose shoulder instability, they should report the specific operational definitions used to determine whether the tests are "positive" or "negative".

5. Conclusion

We found that despite FEDS by name has not been embraced enough by the physical therapy literature, there is some recognition of the FEDS variables as critical factors for assessing shoulder instability. Therefore, there is a need to improve the reporting regarding instability classification and diagnosis, and to standardize criteria for positive tests in the diagnosis of shoulder instability. An international consensus on which is the most suitable classification may help to solve some of these issues.

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None declared.

CRediT authorship contribution statement

Rubén Fernández-Matías: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. **Enrique Lluch-Girbés:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Writing – original draft, Writing – review & editing. **Marcus Bateman:** Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **Néstor Requejo-Salinas:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare no conflict of interest. Marcus Bateman is the author of the Derby Shoulder Instability Rehabilitation Programme but does not receive any financial benefits from its use.

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Appendix A. Supplementary data

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