---

**Article:**
Varley, Danielle, Sweetman, Jennifer orcid.org/0000-0003-1969-4586, Brabyn, Sally orcid.org/0000-0001-5381-003X et al. (2 more authors) (2023) The clinical management of Functional Neurological Disorder (FND):A scoping review of the literature. Journal of Psychosomatic Research. 111121. ISSN 0022-3999

https://doi.org/10.1016/j.jpsychores.2022.111121

---

Journal of Psychosomatic Research 165 (2023) 111121

Contents lists available at ScienceDirect

Journal of Psychosomatic Research

journal homepage: www.elsevier.com/locate/jpsychores

Review article

# The clinical management of functional neurological disorder: A scoping review of the literature

Danielle Varley [a,*], Jennifer Sweetman [a], Sally Brabyn [a], Dimitris Lagos [b], Christina van der Feltz-Cornelis [a,b,c,d]

[a] Department of Health Sciences, University of York, York YO10 5DD, UK
[b] Hull York Medical School, University of York, York YO10 5DD, UK
[c] York Biomedical Research Institute, University of York, York YO10 5DD, UK
[d] Institute of Health Informatics, University College London, London NW1 2DA, UK

ARTICLE INFO

*Keywords:*
Scoping review
FND
Clinical management
Conversion disorder
Diagnosis
Therapeutics

ABSTRACT

*Objective:* To date, there have been no reviews bringing together evidence on the clinical management of functional neurological disorder (FND) and patients', caregivers', and healthcare workers' experiences. This review provides an overview of the literature focused on the clinical management of FND.

*Methods:* Four databases were searched, and a consultation exercise was conducted to retrieve relevant records dated from September 2010 to September 2020. Articles documenting diagnostic methods, treatments or interventions, or the experiences and perspectives of patients and healthcare workers in the clinical management of FND were included.

*Results:* In total, 2756 records were retrieved, with 162 included in this review. The diagnostic methods reported predominantly included positive clinical signs, v-EEG and EEG. Psychological treatments and medication were the most reported treatments. Mixed findings of the effectiveness of CBT were found. Haloperidol, physiotherapy and scripted diagnosis were found to be effective in reducing FND symptoms. Several facilitators and barriers for patients accessing treatment for FND were reported.

*Conclusion:* The literature describing the clinical management for FND has increased considerably in recent times. A wide variety of diagnostic tools and treatments and interventions were found, with more focus being placed on tests that confirm a diagnosis than 'rule-out' tests. The main treatment type found in this review was medication. This review revealed that there is a lack of high-quality evidence and reflects the need for official clinical guidelines for FND, providing healthcare workers and patients the support needed to navigate the process to diagnose and manage FND.

## 1. Introduction

Functional neurological disorder (FND) is a condition where an individual experiences altered motor or sensory symptoms or deficits that cannot be explained by another neurological or medical disorder [1]. FND encompasses functional movement disorders (FMD), paralysis, blindness, and non-epileptic seizures (PNES), [2]. Recently, the term 'functional seizures' (FS) has emerged as a new term. For this review, we have referred to non-epileptic seizures as PNES as it was the most commonly used term when the search strategy was developed and utilised. There are a broad range of FND symptoms which typically present with sudden onset [3], range from mild to severe, and cause clinically-significant distress or impairment [1].

Diagnosing FND is challenging for healthcare workers and patients. Historically, diagnostic tests were completed to 'rule-out' other organic possibilities and based on neurological examination or imaging techniques. This is likely to be frustrating for patients who undergo tests that may not lead to a diagnosis. As a reaction to this, "rule-in" approaches (where a specific test is used to support a diagnosis) are sought to diagnose FND [4].

Similarly, treatment options are limited, with only a handful of treatments being studied for effectiveness using randomised controlled trial (RCT) methodology. Patients may feel dissatisfied by the available treatments or may struggle with the notion that a 'cure' has not been

* Corresponding author.
*E-mail address:* Danielle.varley@york.ac.uk (D. Varley).

https://doi.org/10.1016/j.jpsychores.2022.111121
Received 22 June 2022; Received in revised form 13 December 2022; Accepted 13 December 2022
Available online 17 December 2022

found. Thus, a review of available treatments and their effectiveness is timely.

Over the past 10 years, many FND studies focused have been published. These publications have explored potential diagnostic tools and treatments for FND but only a few have focused on the experiences and perspectives of FND patients and healthcare workers on the clinical management of FND. To date, no study has reviewed FND diagnostic tools and treatments alongside experiences of accessing services. Therefore, this knowledge gap needs addressing. A methodology often used to explore knowledge gaps is the scoping review [5,6]. This scoping review aims to explore the literature and summarise the typical diagnosis and treatments and the experiences of patients and healthcare workers on the clinical management of FND.

## 2. Method

### 2.1. Study design

This scoping review was informed by Arksey and O'Malley [7] and recent refinements by the Joanna Briggs Institute (JBI; [5]). Reporting was informed by the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews [6] and the review protocol was registered with the Open Science Framework [8].

### 2.2. Review question

The review's main question was: 'How is Functional Neurological Disorder managed clinically?'

### 2.3. Literature searches

A comprehensive search strategy was developed (Appendix A). Database searches, hand searching, reference checking, and consulting with experts were conducted. Searches were conducted from 15.09.2020–17.09.2020 in four databases: Medline and Medline in Process, PsycINFO, Cochrane Database of Systematic Reviews, and Google Scholar. An attempt was made to contact authors of publications that could not be obtained.

Following Arksey and O'Malley's [7] recommendations, a consultation exercise was conducted. Patients, caregivers, experts, and FND networks were contacted to contribute to the review by providing references to potentially relevant records. The consultation exercise identified 58 records.

### 2.4. Eligibility criteria

Population/participants, Concept and Context (PCC) were followed for this scoping review as it is a less restrictive alternative than the standard PICO (population, intervention(s), comparator(s), outcome(s)) framework to identify the review's main concept, being the core idea that is being examined by the review. Outcomes were included in the Concept section [9].

#### 2.4.1. Population

Records focusing on participants/patients aged 18 years and older with a diagnosis, undergoing the diagnostic process, or receiving/received treatment with one of the following conditions were eligible for inclusion:

- Conversion disorder (CD)
- Dissociative neurological disorder
- Dissociative neurological symptoms
- Functional cognitive symptoms
- Functional movement disorder
- Functional neurological disorder
- Functional neurological symptom disorder
- Psychogenic non-epileptic seizures (PNES) or functional seizures (FS)
- Neurological conversion symptoms

#### 2.4.2. Concept

Records providing a detailed overview and/or evaluating patient involvement, shared decision making, or diagnostic processes or treatment of FND were considered for inclusion.

#### 2.4.3. Outcomes

The outcomes for this review were:

- Diagnostic tests used
- Sensitivity and specificity
- Treatments used
- Treatment effects
- Health service provision of treatments
- Clinical management of FND

#### 2.4.4. Context

The context of this review was:

- The clinical management of FND provided by health services (including primary and secondary care).
- Income of country (low, medium, and high)
- Geographic location

All study designs were eligible for inclusion.

Relevant records must have been published within the past ten years prior to the start of the review. Records not written in English were translated where possible.

#### 2.4.5. Criteria for excluding studies (not covered in the inclusion criteria)

Records were excluded if data for different disorders were not separated. In addition, records that did not follow the diagnostic and statistical manual of mental disorders' (DSM; DSM IV or V, depending on the record's publication date) definition of FND or related disorders were excluded.

### 2.5. Study selection

Two stages (title and abstract, then full paper) of record sifting occurred. Records in both stages were assessed by independent reviewers (DV, JS, SB, JR, JP). For the title and abstract stage, both reviewers reviewed 30% of the records ($n = 709$) and in the full paper sifting stage, 10% of the records were assessed ($n = 72$) by both (Cohen's kappa calculations were 0.805 and 0.834, respectively [10]). The main reviewer (DV) assessed the remaining records. Disagreements were resolved via discussion or through a third reviewer (CFC).

Once the two sifting stages were completed, the data were then charted.

### 2.6. Data charting

Data charting involves sifting and grouping relevant data into key themes relating to the review's aims and objectives [7]. It was planned that data would be charted and checked for accuracy by two independent reviewers [8]. However, due to unforeseen issues, the data charting was completed by the main reviewer (DV) and monitored by CFC and DL.

A data charting form was developed and used to guide the data charting process to ensure consistency.

The following data were charted:

- Author(s) and year of publication
- Type of publication

- Study aims

### 2.7. Key findings

- Study methodology
- Outcome measure(s)
- Guideline type and summary
- Intervention/treatment type
- Disorder of interest
- Summary of patient involvement in decision process
- Participant/patient characteristics
- Setting (including country and type of service
- Study methods
- Study results
- Diagnostic method(s)
- Study usefulness

### 2.8. Data synthesis

The charted data were collated and summarised. To minimise reporting bias, a template to record study characteristics and findings was developed and used. A hierarchy of research designs and evidence [11] was used to report the relevant data.

## 3. Results

Searches of the four databases identified 2698 records and 58 were retrieved through additional searches (handsearching, reference checking, and via the consultation exercise). There were 627 duplicate records; 1420 records were excluded at the initial screening and a further 549 excluded following full-text screening. A total of 162 records were included. Fig. 1 depicts the PRISMA flow diagram.

The literature on the clinical management of FND has increased considerably in recent times. Among the included studies ($n$ = 162), 69% ($n$ = 110) were published within the past five years (2016–2020).

Most studies reporting the setting ($n$ = 87) were conducted in North America (29%) and Europe (48%). predominately the UK and the USA. Following the World Bank definition of high-, upper-middle, lower-middle, and low-income countries [12], 86% of the included studies reporting geographical setting were conducted in high-income countries, 7% in upper-middle-income countries, and 7% in lower-middle-income countries.

For the remainder of the results section, levels 6 and 7 evidence [11] will not be reported. A breakdown of the data included in these records ($n$ = 38) is reported in Appendix B.

Thirty-one studies reported diagnostic methods, 45 reported FND treatments and interventions, and 25 focused on patient and healthcare worker perspectives on the clinical management of FND. Twenty-three studies reported on more than one of these (e.g., diagnostic method and treatments). Three records were clinical guidelines.

Data have been separated by research focus. Included reviews are reported in Appendix C and are reported separately to ensure individual study findings are not duplicated throughout the results. A summary of the data charting for the included studies is in Tables 1-3, Figs. 2 and 3 for a depiction of the main diagnostic methods and treatments reported in this review.

### 3.1. Diagnostic methods

#### 3.1.1. Positive clinical signs

Positive clinical signs were reported in five studies. One study [13] investigated the drift-without-pronation sign and observed it in 100% of FND participants but in only 7.1% of organic patients (100% sensitivity, 93% specificity). Similar findings were reported for Hoover's sign [14], the sign is a very specific (100%) and moderately sensitive (63%) test for patients with unilateral leg weakness. Lastly, Daum and colleagues [15] investigated the reliability of positive signs and found that six positive signs (giveway weakness, drift without pronation, co-contraction, splitting the midline, splitting of vibration sense, and Hoover's sign) were specific to FND and were classified as 'highly reliable signs' [15].

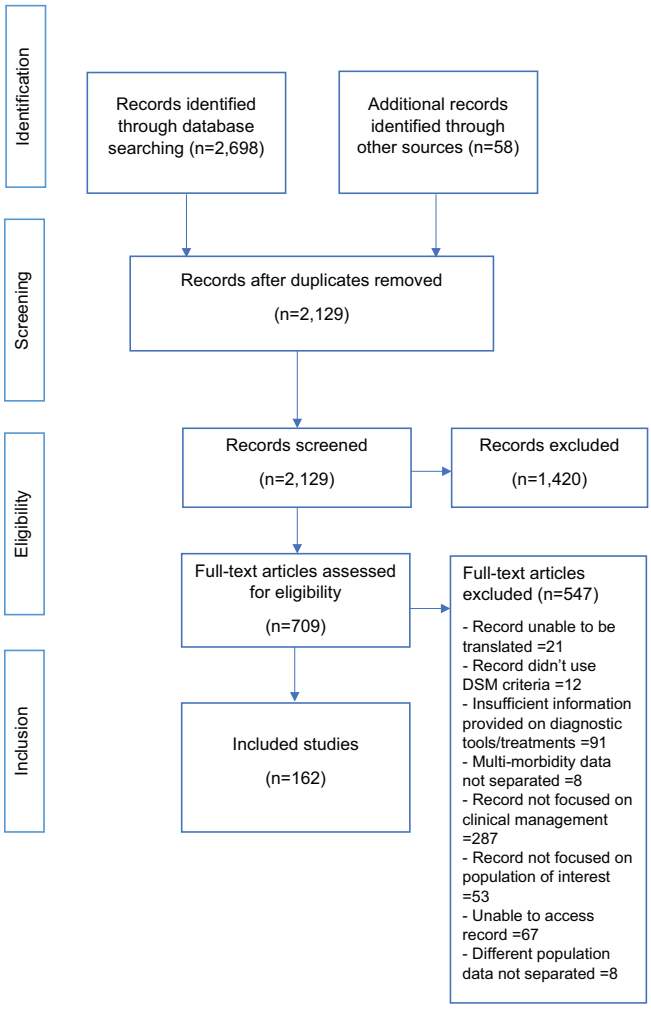


**Fig. 1.** PRISMA diagram.
DSM=Diagnostic and Statistical Manual of Mental Disorders.

#### 3.1.2. Neurological examinations

Several neurological tests were reported, with electroencephalogram (EEG) and video-electroencephalogram (v-EEG) being the most studied ($n$ = 8). It was found that v-EEG and EEG assessments were able to discriminate between PNES and epilepsy [16,17], with one study reporting that v-EEG alongside suggestive seizure provocation significantly contributes to a correct PNES diagnosis [18]. A further study [19] found positive results when using functional magnetic resonance imaging (fRMI) to diagnose FND, reporting specificity, sensitivity, and accuracy over 68% ($p$ = 0.004).

#### 3.1.3. Eyewitness reports, observations, and interviews

Biberon and colleagues [20] investigated whether conversational analysis (CA) is able to differentiate between PNES and epilepsy and found that CA had a high correct prediction rate (84% and 88%, respectively). Another study [21] studied the accuracy of healthcare worker observations for differentiating PNES and epilepsy using videotaped events, and found that only 55.4% correct diagnoses were made, and neither psychiatric nor general medical workers were confident in reaching a diagnosis. Lastly, Syed and colleagues assessed eye-witness

**Table 1**
Summary of data charting for the included studies focused on diagnostic methods.

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Diagnostic method | Main findings |
|---|---|---|---|---|---|---|---|
| Level 4 evidence | | | | | | | |
| [20] | France; neurology department | Blinded prospective study | Evaluate linguistic analysis in the differential diagnosis between PNES and epilepsy | PNES | Total sample size = 32<br>PNES patients ($n$ = 13):<br>Gender: F = 13, M = 0<br>Age, mean: 32.7<br>Epilepsy patients ($n$ = 19):<br>Gender: F = 9, M = 10<br>Age, mean: 43.2 | A semi-structured -patient interview was used and assessed using conversational analysis | There is diagnostic value of conversational analysis to differentiate PNES and epilepsy. Two independent neurologists blindly assessed each interview. Rater 1 had a correct prediction rate of 84% and Rater 2 88% correct prediction rate. |
| [15] | Switzerland; Neurology Department | Pilot study | Establish the sensitivity and specificity of positive signs | Conversion disorder | $N$ = 40<br>CD group ($n$ = 20):<br>Age, mean: 37.4<br>Gender: F = 9, M = 11<br>Control group ($n$ = 20):<br>Age, mean: 60.2<br>Gender: F = 8. M = 12 | Positive signs | Six positive signs were found to be specific for conversion disorder and can be classified as 'highly reliable signs'.<br><br>Giveway weakness – 100% specificity and 85% sensitivity;<br>Drift without pronation - 95% specificity and 61% sensitivity;<br>Co-contraction - 100% specificity and 30% sensitivity;<br>Splitting the midline - 100% specificity and 42% sensitivity; Splitting of vibration sense - 88% specificity and 50% sensitivity; Hoover's sign - 100% specificity and 76% sensitivity |
| Level 5 evidence | | | | | | | |
| [13] | Switzerland; Neurological Department | Prospective controlled study | Establish the sensitivity and specificity of the "drift without pronation" sign. | Conversion disorder | $N$ = 54<br><br>Conversion Disorder group ($n$ = 26)<br>Mean age: 41.1<br>Gender: F = 17, M = 9<br><br>Organic illness group ($n$ = 28)<br>Mean age: 62.9<br>Gender: F = 14, M = 14 | Drift without pronation sign. | Drift without pronation was observed in all ($n$ = 26) Conversion Disorder subjects and in only 7.1% of organic patients. Results study revealed 93% specificity and 100% sensitivity. |
| [66] | Switzerland; Hospital | Prospective study | Explore the specificity and sensitivity of sternocleidomastoid (SCM) and platysma motor signs. | Conversion disorder | N = 70<br>CD group ($n$ = 30):<br>Age, mean: 44.5<br>Gender: F = 23, M = 7<br><br>Control group ($n$ = 40):<br>Age, mean: 65.4<br>Gender: F = 14, M = 16 | Sternocleidomastoid (SCM) functional sign and platysma sign | Finding symmetrical platysma contraction in conjunction with a weakness of head rotation is a predictor of conversion disorder (95% specificity) |
| [67] | USA; Hospital | Retrospective study | Determine the diagnostic benefit of the huffing and puffing behaviours | FMD | FMD patients $N$ = 131<br>Gender: F = 96, M = 35<br>Age at onset: 41.5 years | Healthcare worker observation<br><br>Three blinded healthcare workers rated standing and walking videos for huffing and puffing behaviours | Huffing and puffing–type behaviours generated a low sensitivity, but high specificity for an FMD diagnosis. |
| [21] | Australia; Hospital | Prospective, non- | Determine the accuracy of healthcare workers differentiating PNES and | PNES | $N$ = 27<br>Job title: general physicians (n = 5), | Healthcare worker observation | 55.4% of correct diagnoses were made when observing seizures |

(*continued on next page*)

**Table 1** (*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Diagnostic method | Main findings |
|---|---|---|---|---|---|---|---|
| | | randomised study | epileptic using videotaped events | | general medical registrars (n = 7), general medical residents($n$ = 7) psychiatry doctors (n = 8) | A questionnaire focusing on the given diagnosis, confidence in making the diagnostic decision, and an explanation on how the diagnostic decision was made | via videotape. Neither the general medical or psychiatry group were particularly confident in reaching a diagnosis. |
| [14] | UK; Hospital | Prospective unblinded cohort study | Determine the effectiveness of Hoover's sign for the presence of FND | FND | $N$ = 124<br>Gender: F = 74, M = 50<br>Age median: 77 (range: 66–85) | Hoover's sign | Hoover's sign was found to be very specific (100%) and moderately sensitive test (63%) for FND patients with unilateral leg weakness. |
| [68] | Australia; Hospital | Prospective observational study | Investigate the accuracy of an ambulatory diagnostic system | PNES | With PNES: N = 13<br>Gender: F = 9, M = 4<br>Age, median: 20 | Automated ambulatory system | The system detected all epilepsy and PNE seizures from >661 h of recording. Sensitivity and specificity for classifying PNES were found to be 81.3% and 100%, respectively. |
| [18] | Czech Republic; Neurology centre | Prospective, non-randomised study | Evaluate the number of PNES in patients with a refractory seizure disorder | PNES | With PNES: $N$ = 111<br>Gender: F - 88, M - 23<br>Age, mean: 31.2 | Video-EEG monitoring with suggestive seizure provocation | v-EEG monitoring with suggestive seizure provocation supported significantly contributed to an accurate PNES diagnosis. |
| [16] | USA; epilepsy monitoring unit | Prospective study | Assess eye-witness reports of seizure semiology in PNES prediction | PNES | $N$ = 35. No further details provided. | Eye-witness reports of seizure semiology, v-EEG | Signs that discriminate PNES and epilepsy were found. It was also found that unreliable eyewitness accounts of semiology can hinder the prediction of PNES. |
| [19] | Switzerland; Hospital | Prospective study | Establish whether resting-state (RS) fMRI could discriminate FND patients from controls | FND | $N$ = 48<br>FND group (n = 23):<br>Age, mean: 42.4<br>Gender: F = 21, M = 2<br><br>Control group ($n$ = 23):<br>Age, mean: 42.4<br>Gender: F = 22, M = 3 | fMRI scan | Results from that specificity, sensitivity and accuracy were over 68% ($p$ = 0.004) to discriminate between the FND group and control group. The most discriminative connections included the prefrontal, amygdala, and sensorimotor regions, and the right caudate. |
| [69] | Iran; N/A | Survey | Investigate the opinions of neurologists about PNES | PNES | $N$ = 18<br>Gender: F = 4, M = 14<br>Mean age [± (SD)]: 41.6 ± 7.5 years.<br>Years in practice: 8.9 ± 7.9 years (range: 1–30 years). | Respondents reported using EEG, v-EEG and serum creatine phosphokinase measurement for the diagnosis of PNES | There is a great variability in the approaches to the clinical management of PNES |
| [70] | Australia; Epilepsy monitoring unit | Retrospective case review | Determine the ideal time of long-term video-electroencephalographic monitoring to capture seizures in PNES patients | PNES | $N$ = 108; no other population details reported | (VEM) | When monitoring patients in a VEM program for up one week, it was found that monitoring for five days yielded the greatest number of diagnostic seizures. It may be sufficient to diagnose up to 99% of PNES patients. |
| [71]* | Survey completed across 63 countries | Survey | Examine the diagnosis and treatment of PNES globally | PNES | $N$ = 1146 (1098 health professionals completed the long survey, 48 completed the short survey)<br><br>Median age range | - Blood pressure recording<br>- Heart rhythm monitoring<br>- Tilt-table examination<br>- ECG/EKG<br>- Magnetic resonance Imaging<br>- Computed Tomography<br>- Postictal prolactin measurement | Psychological therapy was the most likely treatment of choice for PNES.<br><br>A relationship between access to income, access to diagnostic tests and expertise was found. |

(*continued on next page*)

**Table 1** (*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Diagnostic method | Main findings |
|---|---|---|---|---|---|---|---|
| | | | | | of respondents: 41–50 years (range 21–80). | - Neuropsychological testing<br>- EEG | |
| [72] | Not reported | Retrospective cohort study | Examine the effectiveness of Bereitschaftspotential as a diagnostic tool | FMD | $N = 29$<br><br>FMD (n = 20)<br>Mean age: 44<br>Gender: F – 10, M – 10<br><br>Control ($n = 9$)<br>Mean age: 48<br>Gender: F – 3, M - 6 | Bereitschaftspotential (BP) | BP was only present in 5 of the FMD patients (25%; $p \geq 0.05$), whereas 13 patients showed a significant event-related desynchronisation (ERD; $p \leq 0.001$). BP and ERP were not detected in the control group. |
| [73]* | China; N/A | Survey | Provide an overview of clinical management services for PNES patients in China | PNES | $N = 102$<br>Age: 21–30 = 28, 31–40 = 53, 41–50 = 15, 51–60 = 6.<br>Gender: F = 62, M = 40. | - EEG<br>- v-EEG<br>- Neuropsychological testing<br>- Postictal prolactin measurement<br>- Computed tomography<br>- Magnetic resonance imaging<br>- Tilt-table examination<br>- Routine heart recording | Diagnostic tools and interventions for PNES in China are lacking. Hospitals in urban settings were equipped to clinically manage PNES, however, more than half of the survey participants stated they would not make the PNES diagnosis. |
| [23] | The Netherlands; Tertiary mental health centre | Cross-sectional observational design | Explore the frequency of FND/CD misdiagnosis | FND | $N = 73$<br>Confirmed FND ($n = 64$)<br>Age: 43.14<br>Gender: F = 51, 13<br><br>Misdiagnosed (n = 9)<br>Age: 41.33<br>Gender: F = 7, M = 2 | FND predictors (type and duration of FND, Psychiatric and somatic comorbidity, early childhood sexual abuse or trauma, negative life events, medication use, family history of FND, demographic variables) | 12% of the patients in the study were misdiagnosed.<br><br>Diagnostic re-evaluations should be completed for chronic FND cases. |
| [17] | Italy; Regional Epilepsy Centre | Cross-sectional study | Identify a ML pipeline to categorise PNES from healthy controls | PNES | PNES patients ($N = 10$):<br>Gender: F - 8, M - 2<br>10<br>Age, mean: 28<br>Controls (N = 10):<br>Gender: F - 7, M - 3<br>Age, mean: 33 | v-EEG and EEG | It was found that PNES and control discrimination tasks performed via the ML algorithm and validated attained an average accuracy of 0.97 (±0.013). The results suggest that the ML algorithm may be valuable in supporting existing PNES clinical diagnosis. |
| [24] | Scotland; Neurology centres | Multi-centre cohort study | To assess the frequency of functional disorder diagnosis better explaining original symptoms | FND | N = 2378 (organic baseline diagnosis)<br>No further details reported | Questionnaire on diagnostic change | Diagnostic errors were found in 48 patients, 10 of which had a functional diagnosis. |

BP=bereitschaftspotential; CD=conversion disorder; EEG=electroencephalogram; FMD=functional movement disorder; fMRI=functional magnetic resonance imaging; FND=functional neurological disorder; ML=machine-learning; FS=functional seizures; PNES=psychogenic non-epileptic seizures; UK=United Kingdom; USA=United States of America; v-EEG=video-electroencephalogram; VEM=video-electroencephalographic monitoring.

*Record reports more than one research focus so is present in multiple tables.

reports of seizure semiology during v-EEG and identified signs that can discriminate between PNES and epilepsy during v-EEG assessments. However, it was reported that unreliable eyewitness accounts of semiology hindered the prediction of PNES [16].

#### 3.1.4. Misdiagnosis

Misdiagnosis (or diagnostic error) is the incorrect diagnosis of a condition or disease [22]. In terms of FND, misdiagnosis can refer to FND being diagnosed instead of an organic disorder, or an organic disorder being diagnosed instead of FND. Two included studies explored how patients were misdiagnosed with FND instead of an organic condition. One study [23] researched how FND predictors (e.g., stressful life events or childhood adverse experiences) can be used as a misdiagnosis indicator and found that not only are there no clinical factors which predict an FND misdiagnosis, 12% of the study patients were misdiagnosed. Walzl and colleagues [24] found that 2% ($n = 48$) of patients who were able to be followed-up ($n = 2378$) were misdiagnosed with an organic disorder.

### 3.2. Treatments/interventions

#### 3.2.1. Psychological therapies

Cognitive behavioural therapy (CBT), mindfulness-based therapy (MBT), dialectical behavioural therapy (DBT), and psychodynamic therapy were the main psychological interventions reported. One study [25] found that CBT led to a near or full remission in almost 75% FMD patients, whereas another reported that CBT was effective in improving functional symptoms, but no favourable effect from adjunctive physical

**Table 2**
Summary of data charting for the included studies focused on treatments.

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Treatment/ intervention | Main findings |
|---|---|---|---|---|---|---|---|
| Level 4 evidence | | | | | | | |
| [38] | UK; NHS hospital | Pilot study | Test the effectiveness of a CBT-based psychoeducation group on reducing PNES frequency | PNES | *N* = 25<br>Age: 18–25 = 5, 26–35 = 8, 36–45 = 8, 46+ = 4<br>Gender: F = 21, M = 4 | CBT-based psychoeducation group | The CBT group was found to be a valuable treatment for PNES, with almost 40% of treatment completers being seizure free. |
| [26] | Not reported | Pilot RCT | Assess the feasibility and efficacy of CBT and adjunctive physical activity (APA) for FMD | FMD | N = 29<br>CBT alone (*n* = 11):<br>Mean age: 34.7<br>Gender: F = 2, M = 9<br>CBT + APA (*n* = 10):<br>Mean age: 33.7<br>Gender: F = 4, M = 6<br>Care as usual (*n* = 8):<br>Mean age: 32.9<br>Gender: F = 2, M = 6 | - CBT alone<br>- CBT + APA (one hour session, twice-weekly)<br>- Care as usual | Both intervention groups significantly improved over time vs. the control group).<br><br>It was found that CBT is effective in improving FMD symptoms<br><br>No favourable effect of APA was found. |
| [44] | USA; Epilepsy monitoring unit | RCT | Evaluate common methods of PNES clinical management | PNES | *N* = 37<br>Standard practice (n = 12):<br>Mean age: 45.3 Gender: F = 10, M = 2<br><br>Structured Feedback (n = 10):<br>Mean age: 37.7<br>Gender: F = 7, M = 3<br>Structured ongoing feedback (*n* = 15):<br>Mean age: 34.1<br>Gender: F = 13, M = 2 | Scripted diagnosis; Inpatient psychiatry consult;<br>Weekly follow-up phone calls as well as inpatient psychiatry consultation and scripted diagnosis | Participants in the scripted diagnosis and psychiatric consultation had a reduction in PNE seizures. Participants receiving weekly phone calls had a reduction in seizures and improved mood. |
| [25] | USA; setting not reported | Pilot study | Evaluate the effectiveness of CBT on tremor severity and motor/emotion-processing circuits in patients with FMD | FMD | N = 40<br>FMD (*n* = 12):<br>Mean age: 50.5<br>Gender: F = 9, M = 3<br><br>Control (*n* = 25):<br>Mean age: 43.6<br>Gender: F = 21, M = 4 | CBT (12, weekly CBT outpatient sessions) | It was found that CBT led to near or full remission in almost 75% FMD patients. |
| [74] | The Netherlands; Neurology centre | RCT | Establish the effectiveness of an educational and self-help website added to usual versus usual care only. | FND | *N* = 186<br>Intervention group (*n* = 93):<br>Gender: 73% female<br>Mean age: 48<br><br>Control group (*n* = 93):<br>Gender: 70% female<br>Mean age: 49 | An educational website with self-help components<br>Care as usual | The educational website was found not to be an effective treatment. No significant difference in self-rated health improvement at three months (44% vs 40%, *p* = 0.899) or six months (42% vs 43%, *p* = 0.435) was reported. |
| [27] | UK; Neurology and Epilepsy centres | RCT | Compare the effectiveness of CBT plus care as usual (CAU) versus CAU to reduce dissociative seizure frequency. | PNES | *N* = 368<br>CBT + care as usual (*n* = 186)<br>Age: 37.3<br>Gender: F = 140, M = 46<br><br>Care as usual (*n* = 182)<br>Age: 37.7<br>Gender: F = 126, M = 56 | CBT + CAU<br>CAU | No statistically significant difference was found between the CBT and CAU group versus the CAU group. |
| [30] | Switzerland; Neurology department | RCT | Compare a brief interdisciplinary psychotherapeutic intervention (IPI) to CAU for PNES | PNES | N = 23<br>IPI (n = 11):<br>Mean age: 37.57<br>Gender: F = 60%, M = 40%<br>CAU (n = 12):<br>Mean age: 31.53<br>Gender: F = 91%, M = 9% | A brief psychotherapeutic intervention based on a psychodynamic interpersonal treatment | A statistically significant improvement of psychological and physical symptoms, and a reduction in new hospital stays were found in the IPI group. |
| [32] | Iran; Emergency department | RCT | Compare the effects of midazolam vs haloperidol for CD patients | Conversion disorder | *N* = 140<br>Midazolam group (n = 70)<br>Mean age: 29.67<br>Gender: F = 41 M = 29 | 2.5 mg of IV haloperidol<br><br>2.5 mg of IV midazolam | IV haloperidol was significantly more effective in managing CD than midazolam (91.5% vs 64.3%) |

(*continued on next page*)

**Table 2** (*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Treatment/ intervention | Main findings |
|---|---|---|---|---|---|---|---|
| | | | | | Haloperidol group ($n$ = 70)<br>Mean age: 29.54<br>Gender: F = 44, M = 24 | | |
| [33] | Iran; Hospital | RCT | Compare the effectiveness of haloperidol and quetiapine for CD symptoms | Conversion disorder | $N$ = 144<br>Haloperidol (n = 72):<br>Mean age: 31.56<br>Gender: F = 48, M = 25<br><br>Quetiapine ($n$ = 71):<br>Mean age: 32.52<br>Gender: F = 42, M = 29 | IV haloperidol (5 mg dose)<br><br>Rapid-releasing oral quetiapine (50 mg) | Both quetiapine and haloperidol relieved CD symptoms. It was reported that quetiapine is safer compared to haloperidol due to the prevalence of extrapyramidal side effects being significantly lower in the quetiapine group. |
| Level 5 evidence | | | | | | | |
| [35] | India; setting not reported | Quasi experimental study | Explore effectiveness of CBT in the treatment of PNES | PNES | $N$ = 50<br>CBT group (n = 30)<br><br>Waiting list group (n = 20)<br><br>No other details provided | Weekly comprehensive CBT for 3 months<br>Waiting control: Care as usual | The CBT group had a reduction in seizure frequency. A statistically-significant difference was found between intervention group and waiting control in seizure frequency. |
| [28] | USA; Hospital | Prospective uncontrolled trial | Explore the effectiveness of mindfulness-based therapy (MBT) for PNES | PNES | $N$ = 49<br>Therapy completers (n = 26)<br>Mean age: 46.4<br>Gender: F = 23, M = 3<br><br>Therapy non-completers ($n$ = 23)<br>Mean age: 34.4<br>Gender: F = 19, M = 4 | Mindfulness Based Therapy | Median PNES frequency decreased by 0.12 events/week on average with each session ($p$ = 0.002). At the last session, 70% reported they had at least a 50% reduction in seizure frequency and 50% reported seizure remission. |
| [29] | USA; Psychiatry department | Prospective naturalistic design | Assess the feasibility of standalone DBT-ST for CD | Conversion disorder | N = 19<br>Mean age: 44.5<br>Gender: F = 18, M = 1 | DBT skills training (DBT-ST) | The mean seizure rate decreased by 66%. Seizures halted for 35% of participants |
| [36] | India; Hospital | Quasi-experimental study | Study the efficacy of CBT and Sertraline to treat CD symptoms | Conversion disorder | N = 30<br>Age (range): 20–40<br>Gender: F = 30, M = 0 | CBT + Sertraline (50 mg)<br><br>Sertraline (50 mg) alone | CBT and Sertraline combined was found to be more effective to improve CD symptoms. Sertraline alone was not found to be effective in reducing CD symptoms. |
| [40] | UK; Neuropsychiatry service | Pre-post study | Provide results from a 5 MDT treatment programme for FNSD patients | FNSD | $N$ = 100; included in analysis $n$ = 78)<br>Mean age: 42.6 (range 19–76)<br>Gender: F = 60, M = 18 | - MDT outpatient programme occurred over twice weekly for 5 weeks | An analysis of the three time points (baseline, discharge, 6 months) found statistically-significant improvements from both baseline to discharge, and baseline to 6-month follow-up. |
| [37] | Argentina; Epilepsy Center and Neurosciences Service | Pre-post longitudinal non-randomised study | Examine the effectiveness of a three-session psychoeducational intervention | PNES | N = 12<br>Age, mean: 30.75<br>Gender: F = 10, M = 2 | A three-session group psychoeducational intervention | Most participants reported a decrease in seizures, and all reported that a positive intervention experience. |
| [39] | Switzerland; Neurology and psychiatry services | Cohort study | Establish the efficacy of an early MDT intervention for CD | CD | N = 23<br>Intervention group (n = 12):<br>Mean age at 1st symptom = 25.5<br>Gender: F = 9, M = 3<br>Control group ($n$ = 11):<br>Mean age at 1st symptom = 34.7<br>Gender = F 10, M = 1 | - Intervention: Multidisciplinary treatment plan<br>Control group: Care as usual | Early MDT intervention involving neurologists and psychiatrists is effective in the treatment of CD |
| [71]* | Survey completed across 63 countries | Survey | Examine the diagnosis and treatment of PNES globally | PNES | N = 1146<br>(1098 health professionals completed the long survey, 48 | - Psychological therapy<br>- Antidepressant drugs | Psychological therapy was the most considered treatment of choice for PNES. |

(*continued on next page*)

**Table 2** (*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Treatment/ intervention | Main findings |
|---|---|---|---|---|---|---|---|
| | | | | | completed the short survey)<br><br>Median age range of respondents: 41–50 years (range 21–80). | | |
| [41] | USA; Hospital | Retrospective study | Assess an FND specific interdisciplinary chronic pain rehabilitation program | FND | N = 49<br>Mean age: 42.53<br>Gender: F = 67.3%, M = 32.7% | Interdisciplinary chronic pain rehabilitation program | Results support the use of interdisciplinary care models for FND treatment. |
| [34] | USA; Hospital | Retrospective chart review | Establish whether adrenergic modulation is an effective PNES treatment | PNES | N = 14<br><br>Mean age: 38.6 years<br>Gender: F = 11, M = 3 | Propanolol<br>Prazosin<br>Clonidine | Adrenergic modulation of PNES associated with PTSD showed a favourable effect in reducing PNE seizures. |
| [42] | USA; Physical therapy clinic | Retrospective cohort study | Establish the efficacy and feasibility of physical therapy for FND | FND | N = 50<br>Mean age: 46.6<br>Gender: F = 40, M = 10 | Physical therapy | There was a statistically-significant positive correlation between the number of sessions attended and clinical improvement of FND symptoms |
| [31] | UK; Hospital | Service evaluation | Evaluate brief augmented psychodynamic interpersonal therapy for PNES | PNES | *N* = 47<br>Age, mean = 45 | Psychodynamic interpersonal therapy | 25.5% of patients had become seizure-free at follow-up and 40.4% had a seizure reduction of >50%. |
| [43] | Scotland, USA, and England; N/A | Consensus study | Summarise occupational therapy consensus recommendations for FND assessment and intervention | FND | N = 20<br>Profession: Occupational therapist = 12; Neuropsychiatrist = 1; Neurologist = 2; Neuro-physiotherapist = 2; Neuropsychologist =1. Patient and public representative = 2. No further details provided | Occupational therapy | Rehabilitation, education, and self-management strategies are reported to be the most common occupational therapy interventions for FND. |
| [73]* | China; N/A | Survey | Provide an overview of the clinical management of PNES in China | PNES | N = 102<br>Age: 21–30 = 28, 31–40 = 53, 41–50 = 15, 51–60 = 6.<br>Gender: F = 62, M = 40. | Education<br>Support groups<br>Psychological treatment<br>Antidepressant drugs<br>Antipsychotic drugs<br>Anti-epileptic drugs<br>Beta-blockers<br>Benzodiazepines<br>Occupational therapy | Diagnostic tools and interventions for PNES in China are lacking. Hospitals in urban settings were equipped to clinically manage PNES, however, more than half of the survey participants stated they would not make the PNES diagnosis. |

APA=adjunctive physical activity; CAU=care as usual; CBT=cognitive behavioural therapy; CD=conversion disorder; DBT-ST=DBT skills training; FMD=functional movement disorder; FND=functional neurological disorder; FS=functional seizures; IPI=interdisciplinary psychotherapeutic intervention; IV=intravenous; MBT=mindfulness-based therapy; MDT=multidisciplinary treatment; N/A=not applicable; NHS=National Health Service; PNES=psychogenic non-epileptic seizures; PTSD=post-traumatic stress disorder; RCT=randomised controlled trial; UK=United Kingdom; USA=United States of America.

⁎Record reports more than one research focus so is present in multiple tables.

activity (APA) was found [26]. Nevertheless, a recent RCT comparing the effectiveness of CBT and care as usual (CAU) versus CAU alone for PNES reported that no statistically significant difference was found between the groups [27]. In Baslet and colleagues' [28] study exploring the effectiveness of MBT for PNES, median PNES frequency decreased with each successive session. Similarly, it was found that DBT skills training led to a mean seizure rate decrease of 66% and seizures stopped for 35% [29].

Two records reported on the effectiveness of psychodynamic therapy. Hubschmid and colleagues [30] compared a brief intervention based on a psychodynamic interpersonal treatment to CAU and found a statistically-significant improvement in psychological and physical symptoms and a reduction in the number of hospital stays. Further, a service evaluation to establish the outcome of brief augmented psychodynamic interpersonal therapy reported that 25.5% of PNES patients had become seizure-free at follow-up [31].

### 3.2.2. *Medication*

Medication (such as antidepressants, anti-epileptics, and benzodiazepines) was investigated in 15 studies. One RCT [32] compared the effect of midazolam versus haloperidol and found that haloperidol was significantly more effective in managing FND symptoms than midazolam. Another RCT investigating haloperidol and quetiapine found that both reduced FND symptoms, but fewer side effects were reported in the quetiapine group [33]. Kale and colleagues [34] found that adrenergic modulation therapy was beneficial in reducing PNES. However, in studies comparing medication to psychological treatment, the latter was found to be more effective in reducing FND symptoms [35,36].

### 3.2.3. *Psychoeducational interventions*

Sarundiansky and colleagues [37] examined the effectiveness of a three-session psychoeducational intervention and found most participants reported a decrease in seizure frequency, and all reported that the intervention was a positive experience. Cope and colleagues' [38] study

**Table 3**
Summary of data charting for the included studies focused on patient and healthcare worker experiences and perspectives.

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Experience/ perspective type | Main findings |
|---|---|---|---|---|---|---|---|
| Level 5 evidence | | | | | | | |
| [75] | France; Neurology departments | Longitudinal Ancillary study | Describe the doctor-patient relationship after PNES diagnosis and adherence to follow-up appointment | PNES | N = 108<br>Mean age: 34 Gender: F = 78, M = 30 | Treatment adherence | Between 6 and 24 months after diagnosis, the number of patients engaged in ongoing care decreased from two-thirds to one-quarter. The most common reasons given for ceasing treatment were spontaneous subjective clinical improvement after diagnosis and lack of interest. |
| [45] | UK; setting not reported | Non-randomised survey study | Examine how neurologists understand CD and how neurologists communicate with patients | CD | *N* = 349<br>Age: <41 = 49, 41–45 = 107, 46–50 = 81, 51–55 = 48, 56–60 = 38, >60 = 26<br>Gender: F = 62, M = 286 | Healthcare worker perspectives | Most respondents reported that malingering was enmeshed with CD, and a minority of respondents saw malingering and CD as similar disorders. Respondents who preferred malingering models were older, whereas younger, female respondents had a preference for psychological models of CD. Younger respondents found communicating with CD patients easier than it was previously. |
| [76] | UK; Neuroscience centres | Non-randomised study | Describe the resources health professionals use when delivering a functional symptom diagnosis | PNES and FNSD | N = 20<br>Age: 41.5 (range: 20–75)<br>Gender: F = 12, M = 8 | Doctor-patient relationship; healthcare worker perspective | Formulation effort was recognised as the main factor of the challenges faced by healthcare workers during appointments. |
| Level 5 evidence | | | | | | | |
| [77] | UK; Neurology centre | Interview study | Examine PNES patient perceptions of a psycho-educational intervention | PNES | N = 12<br>Mean age: 35.4<br>Gender: F = 8, M = 4 | Patient perspective | To be perceived as useful, psychoeducational treatments for PNES should help patients understand how the psychological causation, and the relationship between the condition and emotions. |
| [54] | UK; setting not reported | Survey | Investigate complaints from FND patients and understand the reaction of consultant neurologists when receiving these complaints | FND | *N* = 58<br>Profession: Consultant neurologists = 58<br><br>No further details provided | Patient experience; Healthcare worker perspectives | The majority of patient complaints were due to disagreement with the FND diagnosis or the tools used to make the diagnosis.<br><br>Patient complaints had a negative effect on the mental well-being of many of the participants and also negatively impacted attitudes on work and clinical judgements. |
| [48] | The Netherlands; the Dutch Society for Neurology and the Department for Consultation-liaison | Survey | Investigate healthcare professionals perspectives on the clinical management of FNS. | FNS | *N* = 407<br>Neurologists (*n* = 343)<br>Gender: F = 104, M = 239<br>Age: <41 = 102, 41–45 = 41, 46–50 = 46, 51–55 = 59, 56–60 = 55, >60 = 40<br><br>Psychiatrists (*n* = 64)<br>Gender: F = 30, M = 34<br>Age: <41 = 11 (17%), 41–45 = 4, 46–50 = 11, 51–55 = 10, 56–60 = 17, >60 = 11 | Healthcare worker perspectives | Most respondents reported that disordered brain functioning and psychogenic factors are responsible for FNS. Further, the majority of respondents stated a preference for MDT (explaining the FNS diagnosis, physiotherapy and psychotherapy) provided by a trained healthcare worker. |
| [53] | USA; Level-4 epilepsy centres | Survey | Examine communication patterns of the PNES diagnosis during practice and training. | PNES | *N* = 126<br>Profession: Epilepsy experts = 126<br><br>No further details provided Not reported | Patient-doctor relationship | Only 10% of participants stated that they "always", and 43% "occasionally", discuss the possibility of a PNES diagnosis to patients when applicable. Key phrases used when communicating the PNES diagnosis to patients |

(*continued on next page*)

**Table 3** (*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Experience/ perspective type | Main findings |
|---|---|---|---|---|---|---|---|
| | | | | | | | include: PNE seizures are not treated with medication, seizures are real and not deliberately produce, and they have psychological basis. Over 20% of respondents stated on mental health follow-ups were needed, and many respondents 'were not bothered' by patients who challenged the PNES and felt they didn't need a follow-up appointment. Most respondents provide a maximum of one formal lecture focused on PNES when educating trainees. |
| [64] | South Africa; setting not reported | Interview study | Examine the strategies and barriers experienced when communicating the PNES diagnosis | PNES | *N* = 13<br>Gender: F = 7, M = 6<br>Practice Area: Neurology (n = 4), Psychiatry (*n* = 5), Clinical Psychology (n = 4) | Healthcare worker perspectives | It was found that a one-size-fits-all approach should not be used when managing PNES. |
| [78] | UK; Psychology assessment and formulation service | Service evaluation | To explore the views of healthcare professionals of the FND psychology pathway | FND | N = 8<br>Profession:<br>Physiotherapist = 2<br>Epilepsy specialist nurse = 1<br>Occupational therapist = 1<br>Consultant physiotherapist = 1<br>Neurology Consultant = 1<br>Clinical Specialist physiotherapist = 1<br>Rehab Neurology Consultant = 1<br>No further details provided | Healthcare worker perspectives | Respondents agreed that FND is poorly understood and there is confusion about the terminology of the condition. Some respondents had negative opinions about FND and found it difficult to work with FND patients. Respondents agreed that an MDT approach and an early diagnosis is important.<br><br>A positive and timely diagnosis is important for patients accepting the FND diagnosis. |
| [79] | Iceland; Rehabilitation Centre and acute Neurological Department | Focus group study | Explore the perspectives of healthcare professionals on the facilitators and barriers of inpatient care for FND patients | FND | N = 18<br>Age, years: 25–29 5 (27), 30–50 6 (34), >50 7 (39)<br>Gender: F = 16, M = 2<br>Profession:<br>Nursing = 8,<br>Physical therapy = 5,<br>Medicine = 3,<br>Occupational therapy = 1,<br>Neuropsychology = 1 | Healthcare worker perspectives; facilitators and barriers | A trusting relationship between healthcare workers and patients was reported as a major factor for knowing how to help patients to receive treatment.<br>It was reported that FND patients were deemed as a lower priority than patients with an organic neurological disorder.<br>Facilitators to clinical management included education, organisational support, documentation of symptoms, and professional dialogue. Barriers included stigma, and knowledge and clinical experience of FND. |
| [55] | Survey completed in 92 countries | Survey | Determine if opinions on FMD and clinical practices have changed | FMD | *N* = 864<br>Age: 25–35 = 189, 36–45 = 220, 46–55 = 115, 56–65 = 85, >66 = 25<br>Gender: F = 286, M = 346 | Healthcare worker perspectives | The clinical management of FMD varies widely. Many neurologists use exclusionary diagnosis techniques instead of 'positive' diagnostic criteria. Differences in FMD clinical management were somewhat explained by practices between countries but not by age, gender or years in practice. |
| [46] | Australia; N/A | Survey | Identify support needs and knowledge gaps of health professions in contact with FND patients | FND | *N* = 516<br>Mean age: 43.4<br>Gender: F = 74.3%, M = 25.7%<br>Profession: Neurologist = 79, Psychiatrist = 35, | Healthcare worker perspective | Neurologists, nurses, and GP respondents were more likely report having a negative attitude towards FND. While FND patients are seen by many healthcare workers, |

(*continued on next page*)

**Table 3** (*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Experience/ perspective type | Main findings |
|---|---|---|---|---|---|---|---|
| | | | | | Psychologist = 81, Physiotherapist = 195, Neuroscience nurse = 70, General practitioners = 56. | | little FND training is provided. Most respondents did not feel sufficiently trained about FND; only 14% of GPs reported having 'good' knowledge of the condition. Most respondents did not feel confident discussing an FND diagnosis with patients. Seeing more FND patients was significantly correlated with having confidence diagnosing the condition ($r = 0.49$) and confidence in communicating the FND diagnosis ($r = 0.44$). |
| [50] | N/A | PhD study | Assess the experiences of patients and healthcare workers on treatment interventions for FND | FND | $N = 152$<br><br>Healthcare workers ($n = 122$)<br>Age:34.5<br>Gender: F = 87, M = 29, missing = 6<br><br>Patients ($n = 30$)<br>Age: 48.9<br>Gender: F = 22, M = 8 | Patient perspective; healthcare worker perspective | Healthcare workers' lack of awareness of FND may worsen patients' symptoms and experiences in health care. |
| [80] | USA; FND clinic | Retrospective case review | Investigate predictors of initial attendance of suspected FNSD patients referred to FND clinics | FNSD | $N = 62$<br>Mean age: 37.8<br>Gender: F = 46, M = 16 | Facilitators and barriers to treatment adherence | FNSD patients referred from accident and emergency were less likely to attend the first appointment than patients referred from other services. |
| [52] | South Africa; Epilepsy Unit and neurology department | Interview study | Examine the life experiences patients with PNES | PNES | N = 10<br>Mean age: 39.2 (range 19–55)<br>Gender: F = 8, M = 2 | Patient experience | Patients diagnosed with PNES experienced both challenges and resources. Experiences of resources included religion and spirituality, social support, and healthcare professionals. Challenges experienced included healthcare professionals, belief systems, family, and unexpected seizures.<br><br>As healthcare professionals were describes as both a resource and a challenge, it can be assumed that they are key in the experiences of patients diagnosed with PNES. |
| [51] | South Africa; Hospital | Interview study | Examine the experiences of PNES patients during the diagnostic process | PNES | N = 10<br>Age: Mean – 39.2 (range 26–55)<br>Gender: F = 8, M = 2 | Patient perspective | Analysis revealed that an early PNES diagnosis is vital to not only address the patient's loss of independence, but also to reduce healthcare burden and the chance of potentially harmful interventions. It was found that PNES education courses for healthcare professionals can lead to patients having a positive PNES diagnostic experience. |
| [49] | UK; setting not reported | Qualitative writing study | Explore patient experiences of living with PNES | PNES | $N = 19$<br>Age: 42 (median)<br>Gender: F = 16, M = 3 | Patient experiences | It was found that the patients perceived PNES as having an incapacitating effect and there was a lack of understanding of the condition by healthcare workers, the public, and even themselves. Further, patients were struggling with their mental health and self-worth, and most had experienced a past traumatic event. Seizure |

(*continued on next page*)

**Table 3** (*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Sample size and Population details | Experience/ perspective type | Main findings |
|---|---|---|---|---|---|---|---|
| | | | | | | | symptoms, treatments, and outcomes were reported by participants. Participants' perception of the clinical management of PNES differed greatly |
| [81] | UK; setting not reported | Interview study | Explore participants' experience of cognitive behavioural therapy (CBT) | PNES | *N* = 30<br>Age range: 18–80<br>Gender: F = 21, M = 9 | Patient experiences | Patients who received CBT reported that the techniques learnt during CBT treatment were simple to practice and gave them better control over their seizures. A positive therapeutic alliance led to patients being more connected to their emotions. |
| [47] | USA; Hospital | Survey | Explore the opinion of healthcare workers on PNES | PNES | *N* = 115<br>Profession: Primary care doctors = 60, Neurologists = 16, Nurses = 39 | Healthcare worker perspective | Both nurses and neurologists reported a high level of confidence in the clinical management of PNES. Although 61% of respondents stated that PNES were involuntary, 48% of nurses surveyed stated that patients have voluntary control over their non-epileptic seizures and that PNES is fake. |
| [82] | USA; Hospital | Prospective cohort study | Investigate long-term adherence to psychiatric treatment | PNES | *N* = 123<br>Mean age: 38 (range = 18–80)<br>Gender: F = 104, M = 19 | Treatment adherence | 80% of participants attended the first outpatient visit, whereas only 14% attended all four outpatient appointments. Prior diagnosis of PNES (hazard ratio 1.57, $p = 0.046$) and a low score on the Brief Illness Perception Questionnaire (hazard ratio 0.77 for every 10-point increment, $p = 0.008$) were linked to low adherence. |
| [63] | UK; Adult neuropsychology NHS service | Qualitative interviews | Explore patient experiences of psychological therapy | PNES | N = 6<br>Mean age: 47.3 (range 20–55)<br>Gender: F = 5, M = 1 | Patient experience; treatment adherence | The attitude of the healthcare professional had an impact on treatment engagement. |

CD=conversion disorder; FMD=functional movement disorder; FND=functional neurological disorder FNS=functional neurological symptom(s); FNSD=functional neurological symptom disorder; FS=functional seizures; GP=general practitioner; MDT=multidisciplinary treatment; N/A=not applicable; PNES=psychogenic non-epileptic seizures; UK=United Kingdom; USA=United States of America.

supports these findings, reporting that their CBT-based psychoeducation group was beneficial, with almost 40% of treatment completers being seizure free.

### 3.2.4. *Multidisciplinary treatment plans*

Aybek and colleagues [39] conducted a cohort study exploring the effectiveness of an early multidisciplinary intervention involving neurologists and psychiatrists and found that multi-disciplinary treatment (MDT) was effective in reducing FND symptoms. These findings are supported by Petrochilos and colleagues [40], who reported a statistically significant improvement at both discharge and 6 month follow-up in participants involved in an MDT outpatient programme. A retrospective study assessing an interdisciplinary chronic pain rehabilitation programme reported that FND patients using the programme had a reduction in pain-related disability, depression, anxiety, and stress [41].

### 3.2.5. *Other treatment options*

The remaining intervention studies reported on occupational therapy, physical therapy, educational websites, scripted diagnosis, weekly follow-up phone calls and inpatient psychiatry consultations. Maggio and colleagues [42] explored the feasibility and efficacy of physical therapy for FND symptoms and found a statistically-significant positive correlation between the number of sessions attended and clinical improvement. A consensus study [43] found that the main occupational therapy interventions for FND included rehabilitation, education, and self-management strategies. Finally, an RCT evaluating the common clinical management methods for PNES reported that participants in the scripted diagnosis and psychiatric consultation group had a reduction in seizures, whereas participants receiving weekly phone calls had a similar reduction in seizures and improved mood [44].

### 3.2.6. *Experiences and perspectives*

The experiences and perspectives of healthcare workers and patients on the diagnosis and treatment of FND were reported in multiple studies.

Healthcare worker perspectives were typically collected via survey [45–47]. One survey found that healthcare workers were confident in the clinical management of PNES patients [47], whereas another found that most respondents did not feel confident discussing the diagnosis with patients [46].

Malingering and negativity towards FND were explored in two surveys. One survey found that 48% of nurses stated that patients have voluntary control over PNES [47], and another reported that neurologists, nurses, and general practitioner (GP) respondents were more likely report having a negative attitude towards FND [46]. A minority of the respondents in one study [45] stated that malingering and FND are similar disorders. However, one survey [48], found that most

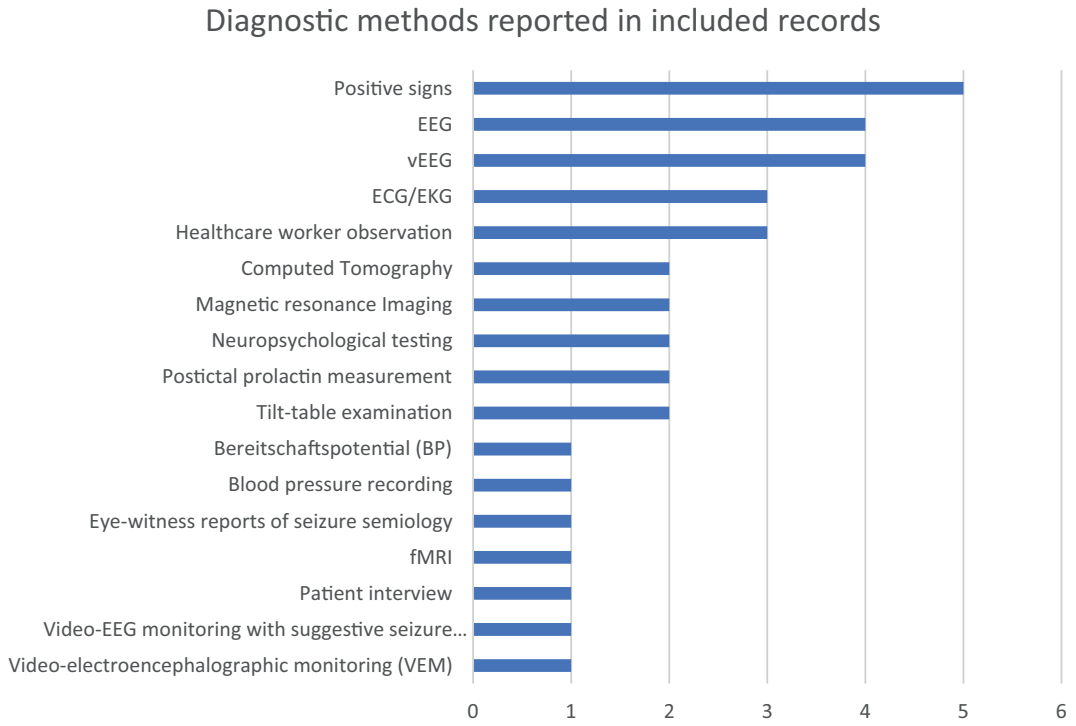


**Fig. 2.** Diagnostic methods reported in included studies.
ECG/EKG=electrocardiogram; EEG=electroencephalogram; vEEG=video-electroencephalogram.

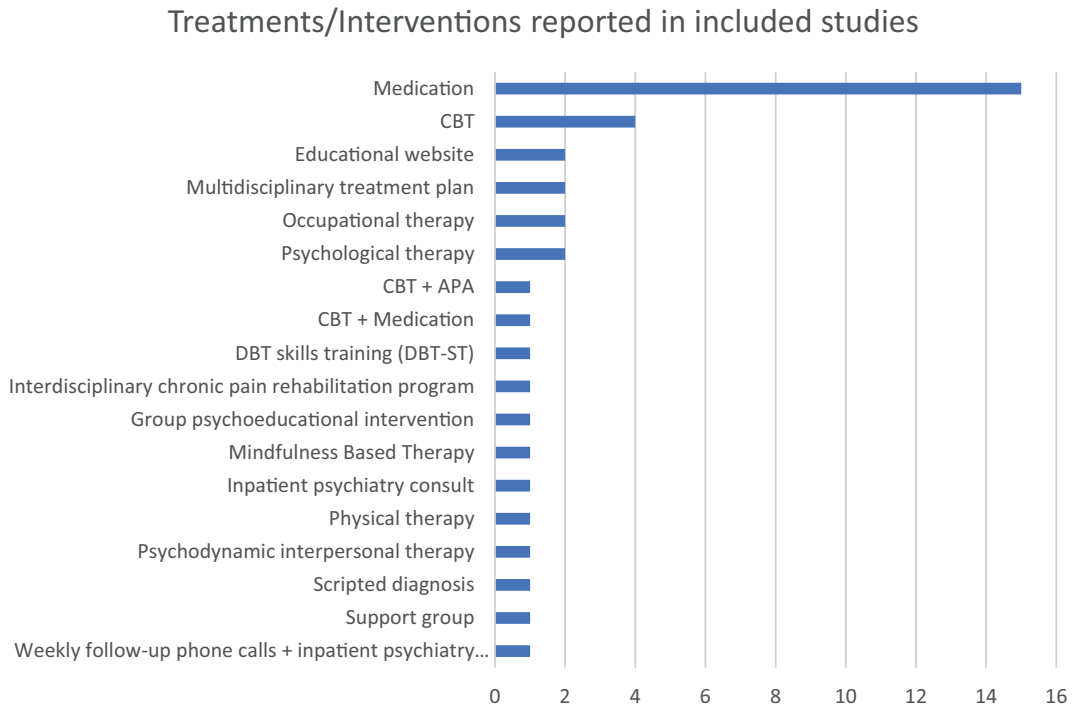


**Fig. 3.** Treatments reported in included studies.
APA=adjunctive physical activity; CBT=cognitive behavioural therapy; DBT=dialectical behavioural therapy;

respondents believed that disordered brain functioning, and psychogenic factors are responsible for FND.

The perceptions of the clinical management of FND and PNES differed greatly between patients [49].

Patients in several studies reported that healthcare professionals were key in the experiences of PNES patients [50–52]. The findings from these studies [50–52] relate to another exploring doctor-patient relationships [53], where only 10% of participants stated that they "always", and 43% "occasionally", discuss the possibility of a PNES diagnosis to patients when applicable, and many respondents 'were not

bothered' by patients who challenged the diagnosis and felt they didn't need a follow-up appointment. In another study [54], healthcare workers were surveyed to investigate complaints from FND patients. Most patient complaints were about the FND diagnosis, or the tools used to make the diagnosis.

## 4. Discussion

This review used scoping review methodology to identify, chart, and synthesis findings from 162 records reporting on the clinical management of FND.

### 4.1. Diagnostic methods

Traditionally, FND has been typically diagnosed by tests to rule out other organic disorder [55]. However, from the studies included in this review it is apparent that the use of rule-out tests is beginning to decline, and positive tests are being used. There are also new mechanistic studies exploring links between FND and inflammation, and possible biomarkers. One recent study reported that neuropeptide Y and adrenocorticotropic hormone levels were the optimal combination of predictors for PNES, with over 90% accuracy [56]. Another study found elevated levels of IL6, IL12, IL17A, IFNg, TNFa and lower levels of VEGF-a, suggesting systemic low-grade inflammation in motor FND. Also, microRNAs involved in inflammation and vascular inflammation were correlated with TNFa and VEGFa respectively, suggesting proof of concept for an epigenetic mechanism [57].

v-EEG monitoring has been reported as the gold standard diagnostic tool for PNES [58–60]. This is supported by findings from this review, the included v-EEG evidence is much stronger than the evidence for other diagnostic tools. Several studies reported that v-EEG assessments could discriminate between PNES and epilepsy [16,17]. Other neurological examinations reported similar findings, with one study [19] reporting positive results and moderate sensitivity and specificity when using fRMI to diagnosis FND. Positive clinical bedside signs were a further diagnostic method reported with high specificity and sensitivity, and are highly reliable [13–15]. Therefore, positive clinical bedside signs have merit in the FND diagnostic process, especially since we are moving away from the use of rule-out tests.

Following the examination of diagnostic tools for FND, misdiagnosis was explored. Two directions of research were found here. One article [23] found that 12% of the patients included in the study as having FND/CD were misdiagnosed as they turned out to suffer from an earlier unrecognised neurological or other somatic disorder. Another study [24] examined whether FND was misdiagnosed as a neurological disorder and found that 2% ($n = 48$) of patients were misdiagnosed in that direction. *Re*-evaluating the diagnosis of chronic FND patients to ensure they have not been misdiagnosed is of great importance to ensure the correct treatments are offered and to improve outcomes.

Although the included reviews generally provided support for the diagnostic method typically used by services, most of the diagnostic methods studies were retrospective case reviews, cross-sectional studies, or non-randomised prospective trials, and only recruited a small sample size. Therefore, the evidence reported should be interpreted with caution.

### 4.2. Treatments

The most common treatment type included in this review was medication, with all studies reporting that medication reduced FND symptoms [32,33].

Psychotherapy focuses on thoughts, feelings, and behaviours to assist in a person understanding negative feelings and difficult personal events, and how to make positive changes. A range of studies examined the effectiveness of psychotherapeutic treatments, reporting conflicting findings. Goldstein and colleagues' RCT comparing the effectiveness of CBT and CAU versus CAU for patients with a PNES diagnosis found no statistically-significant difference between the two groups [27]. In contrast, two studies found that CBT led to a reduction in PNES frequency [25,35]. However, these studies only recruited a small number of participants compared to Goldstein's RCT, suggesting that their seizure reduction rates may be due to small sample sizes. Hubschmid's [30] RCT compared a brief interdisciplinary psychotherapeutic intervention versus CAU, finding a statistically-significant improvement in psychological and physical symptoms. These findings are supported by a recent systematic review [61] which reported both CBT and psychodynamic therapy are beneficial for FND. One study found that combining an SSRI and psychotherapy is more effective in reducing symptoms [36].

A pilot study explored the effectiveness of CBT in conjunction with adjunctive physical activity (APA) versus CBT in FMD patients and reported that both groups significantly improved over time, with no favourable effect from APA being found. The use of psychotherapy (specifically shared individual formulation therapy) for FND is also supported by a recent prospective trial [62]. Therefore, it may be prudent for future studies to explore the effectiveness of multiple treatment options being implemented simultaneously to reduce FND symptoms and improve outcomes.

Lastly, one retrospective cohort study aimed to establish the feasibility of physiotherapy for reducing FND symptoms and found a statistically significant correlation between the number of sessions attended and clinical improvement [42].

Similar to the diagnostic studies, the treatment studies were mainly retrospective cohort and case reviews, surveys, and non-randomised trials. Although the treatment studies typically recruited more participants, the majority were underpowered. Therefore, the evidence reported should be interpreted with caution.

### 4.3. Patient and healthcare worker experiences

A small number of studies reported the experiences of patients and healthcare workers. From the scoped research, it appears that both healthcare workers and patient belief and support systems have a direct impact on patients' experience of the clinical management of FND [49–52,63].

Conflicting results were found when exploring the confidence of healthcare workers [46,47], with some not feeling confident in discussing the diagnosis with patients. Two studies reported that a large number had a negative attitude towards patients presenting with FND [46] or believed patients have voluntary control over their non-epileptic seizures and that PNES is fictitious [47]. This is supported by Kanaan and colleagues [45], who found that a minority of respondents stated that malingering and FND are similar disorders. These attitudes are concerning as the healthcare workers may not be providing suitable and appropriate support to patients. These negative attitudes can in turn impact on patients', with patients less likely to accept the FND diagnosis and engage with therapy [64]. Indeed, a recent study reported that a lack of information from healthcare workers led to the patient experiencing anxiety and stress during therapy sessions. [65]

As stated previously, only a handful of studies have explored the experiences and perspectives of patients and healthcare workers. Further research is needed in this area to establish how patients can be better supported throughout the diagnostic and treatment processes for FND.

### 4.4. Strengths and limitations

The current review used a rigorous approach to gather evidence to answer the research question. Most of the studies were published in English; where possible, studies published in other languages were assessed and included (if applicable) if a member of the review team was fluent.

Both peer-reviewed and grey literature were included to ensure that

relevant evidence would be chartered and synthesised. A consultation exercise was employed to gather any information potentially missed during the database searches. As scoping reviews provide a narrative account of the body of literature and do not focus on potential risk of bias, a formal quality assessment was not completed for this review.

This review presents a description of the evidence concerning the management of FND between 2010 and 2020. Recent developments indicate that knowledge and understanding in this field are advancing; updating this work in the coming years would be advantageous.

### 4.5. Clinical and research implications

The management of FND presents a clinical challenge; there are limited laboratory-based diagnostic tests and only a handful of treatments being studied using RCT methodology. This review may be useful in the creation and development of future clinical guidelines as it provides an overview of FND-specific diagnostic and treatment tools.

This review reveals a need for more rigorous and fully-powered, prospective studies examining the diagnostic methods and treatments for FND. Further research focussing on establishing the effectiveness of utilising a multidisciplinary approach for the management of FND is recommended.

Lastly health professionals should be given adequate training on FND. Some attitudes and stigma shown by healthcare workers to patients with FND are deeply concerning and it has been found that providing education to healthcare workers reduces negative attitudes. Additionally, healthcare workers gaining confidence in approaching FND patients and acquiring more knowledge leads to a reduction in stigma [64].

## 5. Conclusion

This review provides an overview of the evidence for the clinical management of FND. Remarkably, many articles were retrieved, with 162 being included in this review. A wide variety of diagnostic tools and treatments and interventions were found, with more focus being placed on tests which confirm a diagnosis than 'rule-out' tests. The main treatment type found in this review was medication, with most of these studies reporting positive outcomes.

There is a lack of high-quality evidence reporting on the diagnostic and treatment processes for FND (as judged by the levels of evidence hierarchy [11]), indicating that more rigorous studies are needed.

This review reflects the need for official clinical guidelines to provide the support needed to navigate the clinical management for FND. The findings of this review may be useful for the development of future guidelines as it maps out the current research evidence into the clinical management of FND. This review recommends that future guidelines focus on utilising a multi-disciplinary approach to the clinical management of FND, including using diagnostic methods which confirm the diagnosis rather than tools which simply 'rule-out' other conditions, prescribing pharmacological treatment where necessary, and shared-decision making between patients and healthcare workers to ensure more favourable outcomes for patients.

## Funding

This review was undertaken as part of PhD research supported by the University of York (grant number: PhD2019CFCApril).

## Sources of support

This review was undertaken as part of PhD research supported by the University of York (grant number: PhD2019CFCApril).

## Declaration of Competing Interest

The authors have no competing interests to report.

## Acknowledgements

We would like to thank Jonathan Ratcliffe and Jill Pattenden for their support during the record sifting process. We would also like to thank Melissa Harden who supported the search strategy development.

## Appendix A. Search Strategy example

### A.1. MEDLINE and MEDLINE in Process (Ovid)

| | |
|---|---|
| 1 | exp conversion disorder/ |
| 2 | Conversion disorder$.ab,ti. |
| 3 | (Functional neurological disorder* or functional neurological symptom* or FND).ab,ti. |
| 4 | (Functional movement disorder* or Functional neurological symptom disorder* or FNSD).ab,ti. |
| 5 | Neurological conversion symptom*.ab,ti. |
| 6 | exp dissociative disorders/ |
| 7 | Dissociative neurological disorder*.mp. or Dissociative neurological symptom*.ab,ti. [mp = title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh] |
| 8 | (psychogenic seizure* or non-epileptic seizure* or dissociative seizure* or non-epileptic attack* or non-epileptic attack* or pseudoseizure* or PNES).ab,ti. |
| 9 | Functional cognitive symptom*.mp. or Functional cognitive motor skill*.ab,ti. [mp = title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh] |
| 10 | Conversion symptoms*.ab,ti. |
| 11 | Functional weakness*.ab,ti. |
| 12 | 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 |
| 13 | exp therapy/ |
| 14 | exp Guideline/ |
| 15 | exp Diagnosis/ |
| 16 | "clinical management".ab,ti. |
| 17 | 13 or 14 or 15 or 16 |
| 18 | 12 and 17 |
| 19 | ((Alzheimer* disease) or cancer or epilepsy or stroke or surgery or autis*).ab,ti. |
| 20 | 18 NOT 19 |

## Appendix B. Levels 6 and 7 evidence breakdown

| Reference | Condition of interest | Study design | Diagnostic method (if applicable) | Treatment type (if applicable) | Key findings |
|---|---|---|---|---|---|
| [83] | FNSD | Case presentation | N/A | Interdisciplinary treatment (psychotherapeutic interventions, physical therapy and occupational therapy) | The proposed model may allow for a quick deployment of an appropriate treatment approach for patients with FNSD. |
| [84] | Conversion Disorder | Case report | N/A | Electroconvulsive therapy (ECT) | Small improvements were found, however, the patient relapsed after the last ECT session was completed. |
| [85] | Conversion disorder | Case report | N/A | Caloric vestibular stimulation (CVS) | Results found that lateralized cold vestibular caloric stimulation was an effective treatment |
| [86] | Conversion disorder | Case report | Diagnosed by a psychiatrist (no further information provided) | Psychotherapy | Psychotherapy was effective in reducing the patient's PNES |
| [87] | Conversion disorder | Case report | Psychiatric examination (no further information provided) | Neuropsychological treatment (TPM) | After TPM the patient's conversion disorder went into remission. |
| [88] | Conversion disorder | Case report | A review of the patient's medical files in conjunction with information was gathered | DBT | At the end of treatment, the patient had improved motor ability |
| [89] | FND | Case report | Diagnosis confirmed by consultant neurologist | Psychological therapy and EMDR | Psychological treatment plus EMDR led to improvements |
| [90] | FND | case report | Hoover's sign.<br><br>A genetic test was completed. | A specialised FND treatment programme | The treatment programme led to positive outcomes |
| [91] | PNES | Case report | N/A | Acceptance and commitment therapy (ACT) - individual and group sessions. | The patient rapidly recovered most of their autobiographical memory and tremors no longer occurred. |
| [92] | PNES | Case report | N/A | CBT sessions. | Frequency of the patient's PNES from seven to two-three per week. |
| [93] | PNES | Case report | video-EEG<br>Neuropsychological testing | Prolonged Exposure Therapy | The patient attained full remission from PNES |
| [94] | PNES | Case report | EEG | CBT | Early diagnosis and clinical management of PNES is imperative and treatment should focus on CBT. |
| [95] | FND | Case series | Diagnosis delivered by neurologist (no further information provided) | ACT | The majority of patients had improvements in symptom interference and/or mood. |
| [96] | Conversion disorder | Case study | EEG | The expanded CBT model for medically unexplained symptoms | The patient reported to have 75% improvement |
| [97] | PNES | Case study | N/A | Hypnosis | The patient's seizures reduced in number and intensity. |
| [98] | FND | Conference abstract | N/A | N/A | Two thirds of participants felt their symptoms had deteriorated while waiting for treatment. |
| [99] | Conversion disorder | Conference abstract | Telestroke service | N/A | The unadjusted telemedicine CD diagnostic accuracy was 0.98. |
| [100] | PNES | Conference paper | Wrist-worn accelerometer device | N/A | The algorithm correctly detected all seizure events.<br>The algorithm correctly classified 8 (100%), and 6 (75%) of the detected seizure events as PNES and ES, respectively. |
| [101] | FND | Letter | N/A | Neurostimulation treatment (TMS) | The treatment measured that the left motor cortex increased in conjunction with clinical improvement of right-sided functional weakness. |
| [102] | FND | Letter | N/A | Group integrated inpatient rehabilitation | The patients started to gain trust and developed coping strategies. |
| [103] | PNES | Letter | V-EEG monitoring | Repetitive transcranial magnetic stimulation (rTMS). | rTMS is a successful treatment option in the reported case. |
| [104] | PNES | Letter | N/A | N/A | The article explained how to (and how not to) communicate the PNES diagnosis to patients. |
| [105] | FND | Letter | N/A | N/A | A clear, early diagnosis can have a strong positive impact on the patient's symptoms, prognosis and quality of life. |
| [106] | FND | Opinion | N/A | Placebo | A mechanism-based rationale that supports the potential use of placebo effects for the treatment of FND was provided in the record. |
| [107] | FND | Opinion | N/A | N/A | A successful neurological consultation should be the beginning of treatment. |
| [108] | PNES | Opinion | N/A | N/A | Using a cognitive model to discuss the PNES diagnosis is recommended |
| [109] | Conversion disorder | Opinion | N/A | N/A | Effective and clear communication is vital when explaining the conversion disorder diagnosis |
| [110] | FND | Perspective | N/A | N/A | FND treatment can begin in hospital by utilising an early interdisciplinary approach and thoughtful communication |
| [111] | FND | Perspective | N/A | N/A | Physical therapy and occupational therapy may be useful diagnostic assessments for some FND patients. |

(*continued on next page*)

(*continued*)

| Reference | Condition of interest | Study design | Diagnostic method (if applicable) | Treatment type (if applicable) | Key findings |
|---|---|---|---|---|---|
| [112] | PNES | Special report | N/A | N/A | Although recent findings regarding the aetiology and treatment of PNES are likely to be correct, improvements need to be specific to individual countries, reflecting differing cultural traditions. |
| [113] | FMD | Viewpoint/ pilot clinic | N/A | Multidisciplinary treatment (neurology, psychiatry, and physical therapy) | 64% of patients had improved. This improvement had sustained at 3 months. |
| [114] | FND | Website | N/A | N/A | N/A |
| [115]. | FMD | Viewpoint | N/A | Physiotherapy | Physiotherapy treatment for FMD is acceptable to patients and is becoming increasingly researched. |
| [116] | FNSD | Communication | N/A | Therapeutic sedation | Therapeutic sedation and medication (propofol) may be a useful treatment for FNSD. |
| [117] | PNES | Perspective | N/A | Multimodular psychotherapy | It is unclear which psychological treatment is most effective for PNES patients. |
| [118] | FND | Case study | N/A | Vibroacoustic therapy | The patient showed improvement and developed strategies to help in everyday situations. |
| [119] | PNES | Case series | N/A | ACT | Reduction in seizure frequency were reported after ACT. |

ACT=Acceptance and commitment therapy; CBT=cognitive behavioural therapy; CD=conversion disorder; CVS=Caloric vestibular stimulation; DBT=dialectical behavioural therapy; ECT=Electroconvulsive therapy; EEG=electroencephalogram; EMDR=eye movement desensitisation and reprocessing; ES=epileptic seizure; FMD=functional movement disorder; FND=functional neurological disorder; FNSD=functional neurological symptom disorder; FS=functional seizures; N/A=not applicable; PNES=psychogenic non-epileptic seizures; $r_{TM}$S=Repetitive transcranial magnetic stimulation; $_{TM}$S=transcranial magnetic stimulation; TPM=time pressure management; v-EEG=video-electroencephalogram.

## Appendix C. Included reviews

| Author | Country and setting | Study design | Study aims | Condition of interest | Diagnostic method | Treatment/ intervention | Patient perspectives | Main findings |
|---|---|---|---|---|---|---|---|---|
| [120] | N/A | Narrative review | Review the role of neuroimaging in establishing an FND diagnosis | FND | Reviews the following:<br>- Positive signs<br>- Co-contraction<br>- computed tomography (CT)<br>- Functional magnetic resonance imaging<br>- La belle indifference<br>- magnetic resonance imaging<br>- Positron emission tomography<br>- Single photon emission computed tomography | N/A | N/A | There is no single test that positively supports an FND diagnosis. Numerous functional neuroimaging studies report that neuro-correlates that are useful to discern FND from malingering. |
| [121] | N/A | Review | Review the literature on the clinical management of CD | CD | N/A | Review includes:<br>- Psychotherapy<br>- Physical therapy<br>- Medication | Doctor-patient relationship | Building a good therapeutic alliance is crucial for successful treatment. Regular follow-up appointments in conjunction with treatments show favourable results. |
| [122] | N/A | Review | Review the literature on CBT for CD | CD | N/A | Review includes:<br>- CBT | Treatment | Further research is needed to test the effectiveness of CBT for CD |
| [123] | N/A | Review | Review a framework for treatment of PNES | PNES | N/A | Review includes:<br>- CBT<br>- Mindfulness-based psychotherapy<br>- Medication | Patient adherence | Adherence to treatment is imperative to managing CD.<br><br>There is CBT is successful in treating CD symptoms. |
| [28] | N/A | Systematic review | Define the clinical factors and diagnostic tests which assist in a PNES diagnosis | PNES | Reviewed the following:<br>- v-EEG<br>- EEG<br>- Semiological signs | N/A | N/A | EEG and v-EEG are the gold standard of diagnostic tools for PNES and have the highest level of diagnostic certainty. Induction techniques can assist in the diagnosis of PNES. |
| [124] | N/A | Book chapter | Review the role of the neurologist in the | PNES | N/A | N/A | Doctor-patient relationship | Neurologists are an essential member of an MDT and responsible in |

(*continued on next page*)

(*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Diagnostic method | Treatment/ intervention | Patient perspectives | Main findings |
|---|---|---|---|---|---|---|---|---|
| | | | clinical management of PNES | | | | | assisting in the clinical management of PNES. Healthcare workers should ensure that patients and caregivers understand and accept the PNES diagnosis. |
| [125] | N/A | Systematic review | Review research involving the use of psychedelics in FND | FND | N/A | Psychedelic treatments:<br>- LSD<br>- Psilocybin<br>- Mescaline | N/A | Over two-thirds of patients recruited to the included studies were found to have made some recovery with psychedelic treatment and psychotherapy. |
| [126] | N/A | Systematic review and meta-analysis | Evaluate the utility of psychological interventions for PNES | PNES | N/A | Review includes:<br>- CBT<br>- Psychodynamic therapy<br>- Paradoxical intention therapy<br>- Mindfulness<br>- Psychoeducation<br>- Eclectic psychotherapy | N/A | Patients accessing psychological interventions for PNES may have a reduction in seizures compared to patients who do not receive psychotherapy. |
| [127] | N/A | Review | To report relevant literature on functional neurological symptoms | Functional neurological symptoms | Review includes:<br>- Functional imaging | Review includes:<br>- Pharmacotherapy<br>- Psychological therapies | Diagnosis and treatment options | New diagnostic methods are being explored. The field is leaning towards using other methodologies to investigate clinical signs. |
| [128] | N/A | Review | Explore the evaluation process involved in PNES diagnosis | PNES | Review includes:<br>- v-EEG monitoring<br>- Ambulatory EEG<br>- Home video recording | N/A | Doctor-patient relationship | The diagnosis of PNES can be difficult but using a multi-component approach can facilitate the clinical management of the condition. |
| [129] | N/A | Review | Investigate the evaluation process involved in the diagnosis of PNES | PNES | Review includes:<br>- Semiological signs<br>- Physical exam<br>- v-EEG monitoring<br>- Historical exam | N/A | N/A | A PNES diagnosis can be reliably made using video-EEG findings, historical exam, and physical exam. |
| [130] | N/A | Systematic review | Review the evidence of eye movement desensitisation and reprocessing (EMDR) as an FND treatment | FND | N/A | EMDR | N/A | Four of the five participants in the included studies were treated successfully using EMDR. |
| [131] | N/A | Review article | Provide an overview of psychiatric and psychotherapeutic aspects of conversion disorder | Conversion disorder | N/A | N/A | Doctor-patient relationship | The coordination of clinicians is needed for effective treatment |
| [132] | N/A | Review | Review the management of functional movement disorder | Functional movement disorder | Review includes:<br>- Neuroimaging<br>- Electrophysiological tests | Review includes:<br>- Medication<br>- CBT<br>- Physical therapy | N/A | More research is needed to develop treatments for FMD |
| [133] | N/A | Systematic review | Review evidence regarding the sensitivity and specificity of positive signs for conversion disorder | Conversion disorder | Positive signs | N/A | N/A | Only 14 positive clinical signs have been validated and generally have high specificity but low sensitivity. |
| [58] | N/A | Review | Provide an overview of the PNES diagnostic evaluation | PNES | Reviews the following:<br>- v-EEG<br>- EEG<br>- Home video recordings<br>- Provocative testing (including verbal suggestion, hypnosis, body part compression)<br>- MRI | N/A | N/A | v-EEG is the diagnostic gold standard for PNES, but diagnostic accuracy can be improved by considering the patient's neurological and psychiatric history. |

(*continued on next page*)

(*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Diagnostic method | Treatment/ intervention | Patient perspectives | Main findings |
|---|---|---|---|---|---|---|---|---|
| | | | | | - Neurophysiological assays<br>- Single-photon emission CT<br>- Psychiatric evaluation | | | |
| [134] | N/A | Book chapter | Evaluate current evidence regarding the clinical management of functional gait disturbance | FNS | N/A | Review includes:<br>- Diagnostic explanation<br>- Physical therapy | N/A | A diagnostic explanation that is understood and accepted by the patient is essential for successful treatment. |
| [135] | N/A | Review | Review treatments for FND | FND | N/A | Review includes:<br>- Diagnostic explanation<br>- CBT<br>- Physical therapy | N/A | Successful treatment relies on a diagnostic delivery which gives the patient an insight into the condition. |
| [136] | N/A | Review | Review the diagnosis and treatment of PNES | PNES | Review includes:<br>- v-EEG monitoring | Review includes:<br>- Psychotherapy | N/A | v-EEG provides a highly reliable diagnosis for PNES. Psychotherapy has been reported to reduce the frequency of dissociative seizures by at least 50%. |
| [137] | N/A | Book chapter | Provide an update on the clinical management of PNES | PNES | Review includes:<br>- v-EEG | Review includes:<br>- Diagnosis explanation<br>- CBT<br>- Psychotherapy | N/A | An empathic communication of the diagnosis and transparent information on the most appropriate treatments should be given to patients and caregivers. |
| [138] | N/A | Review | Provide an update on diagnostic and treatment methods for FND | FND | Review includes:<br>- Positive signs | Review includes:<br>- Transcranial Magnetic Stimulation (TMS)<br>- Physical therapy<br>- CBT<br>- Psychodynamic therapy | N/A | A multidisciplinary approach to diagnosing and treating FND is important. If needed, further treatment can be proposed (e.g., TMS or hypnosis) |
| [139] | N/A | Review | Review the rating scales and diagnostic criteria for PNES and FMD | FND | Review includes:<br>- Positive signs<br>- v-EEG | N/A | N/A | The presence of positive signs should be relied on for FMD and PNES diagnosis. |
| [140] | N/A | Review | Examine strategies for the clinical management of FND | FND | Review includes:<br>- v-EEG<br>- EEG | Review includes:<br>- Diagnostic explanation<br>- Physical therapy<br>- CBT<br>- Medication<br>- Non-invasive brain stimulation | N/A | FND requires thorough diagnostic assessments, open and holistic discussion of the diagnosis, and tailored treatments for each patient. |
| [141] | N/A | Review | Provide a treatment-focused review for FND | FND | N/A | Review includes:<br>- Medication<br>- Physiotherapy<br>- CBT<br>- repetitive TMS (rTMS) | N/A | Treatment led by a multidisciplinary team show promising results. |
| [142] | N/A | Review | To provide an overview of the evidence-based and emerging FMD treatments. | FMD | N/A | Review includes:<br>- Physiotherapy<br>- Occupational therapy<br>- Speech therapy<br>- CBT<br>- Medication<br>- Botulinum toxin<br>- rTMS | N/A | There is insufficient evidence for the effectiveness of FMD treatments. There is a need for RCTs to compare the available treatments. |
| [143] | N/A | Book chapter | Review PNES treatments | PNES | N/A | Review includes:<br>- Psychotherapy | N/A | Psychological therapy and psychoeducational approaches may be |

(*continued on next page*)

(*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Diagnostic method | Treatment/ intervention | Patient perspectives | Main findings |
|---|---|---|---|---|---|---|---|---|
| | | | | | | - Medication<br>- Hypnosis<br>- CBT<br>- Psychoeducation | | effective PNES treatments. Further research is needed to assess the effectiveness due to current studies using limited sample sizes. |
| [144] | N/A | Review | Report the evaluation process for PNES diagnosis | PNES | Review includes:<br><br>- Eyewitness history<br>- v-EEG monitoring<br>- Home video recording | N/A | N/A | Eyewitness history, home video recording, and v-EEG monitoring can establish a PNES diagnosis with a high level of confidence. |
| [145] | N/A | Literature review | Review the evidence on treatment for conversion disorder | Conversion disorder | N/A | Review includes:<br><br>- Psychotherapy<br>- Hypnosis<br>- rTMS | N/A | rTMS is a promising new treatment for FMD. |
| [146] | N/A | Systematic review | Assess the effectiveness of behavioural and psychological treatments for PNES | PNES | N/A | Review includes:<br><br>- CBT<br>- Hypnosis<br>- Paradoxical intention therapy<br>- Psychotherapy | N/A | There is little evidence to show how effective treatments are for PNES. |
| [147] | N/A | Review | To assess the evidence base focused on magnetic stimulation and sedation | FND | N/A | Transcranial magnetic stimulation (TMS) and sedation | N/A | There is evidence supporting that TMS is a safe and potentially effective FND treatment. However, the available evidence is largely based on case series.<br>The role of placebo may be significant for the treatment of FND but has not been tested widely in studies. |
| [148] | N/A | Review | Investigate the efficacy of large-field stimulation for FND patients | FND | N/A | Large-field rTMS | N/A | Large-field rTMS is a safe and efficacious intervention for FND patients with difficult-to-treat symptoms. |
| [149] | N/A | Book chapter | Report the healthcare workers response to diagnosing PNES | PNES | N/A | N/A | Healthcare worker perspective | It was found that many health professionals have a negative attitude to providing healthcare for them and that they are difficult to understand and clinically manage. This negative attitude can impact the therapeutic relationship and lead to premature termination of treatment.<br><br>Education for healthcare professional and utilising a patient-centred approach to clinical management is needed for a successful therapeutic relationship. |
| [150] | N/A | Systematic review | Review studies of TMS to treat FNS | FNS | N/A | TMS | N/A | Only non-placebo-controlled studies have been conducted exploring TMS as an effective treatment for FNS. Nearly all included studies found TMS to be successful. |
| [151] | N/A | Systematic review | Review the available evidence which report on the use of | CD | N/A | Abreaction | N/A | The evidence studying the effectiveness of abreaction is of low |

(*continued on next page*)

(*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Diagnostic method | Treatment/ intervention | Patient perspectives | Main findings |
|---|---|---|---|---|---|---|---|---|
| | | | drug interviews for CD symptoms | | | | | quality. However, abreaction may be useful in the treatment of acute and treatment-resistant CD. |
| [152] | N/A | Systematic review | Review the use of suggestive seizure induction (SSI) for PNES | PNES | SSI | N/A | N/A | SSI can have a strong diagnostic yield and is an effective tool to diagnose PNES. |
| [153] | N/A | Review | Provide a review of examination techniques to identify functional weakness | Functional weakness | Review includes:<br><br>- Positive signs<br>- MRI | N/A | N/A | Clear positive signs should support an FND diagnosis.<br><br>An FND diagnosis relying on psychosocial factors, negative imaging, or psychiatric comorbidity may lead to a misdiagnosis. Neuroimaging can support the diagnosis of FND. |
| [154] | N/A | Review | Review the diagnostic and treatment strategies for FND | FND | Review includes:<br>- Positive clinical signs | Review includes:<br>-rTMS<br>- Hypnosis<br>- CBT<br>- Physiotherapy | N/A | Positive findings should be conducted to diagnosis FND. |
| [155] | N/A | Review | Provide a summary of the evidence regarding the treatment of FMD | FMD | N/A | Review includes:<br><br>- Diagnostic explanation<br>- Physiotherapy<br>- CBT<br>- Psychotherapy<br>- Medication<br>- Placebo<br>- Hypnosis<br>- Transcutaneous electrical nerve stimulation (TENS)<br>- TMS<br>- Inpatient multi-disciplinary therapy | N/A | There are few high-quality studies exploring the effectiveness of treatments for FMD. |
| [156] | N/A | Review | Provide an overview of treatment options and barriers to treatment | Conversion disorder | N/A | Review includes:<br><br>- Abreaction<br>- Psychotherapy<br>- Pharmacotherapy | N/A | Psychotherapy (psychodynamic or cognitive-behavioural based) is the main treatment for CD. Barriers to treatment include delayed diagnosis, and the patient not accepting the CD diagnosis. |
| [59] | N/A | Review | Review the literature on the clinical management of PNES | PNES | N/A | Review includes:<br><br>- EEG<br>- MRI | N/A | Although numerous clinical features have been described to assist in the PNES diagnosis, v-EEG is considered the gold standard diagnostic tool. |
| [157] | N/A | Book chapter | Detail models of care for PNES patients | PNES | N/A | N/A | Barriers | There are significant barriers to PNES management, including: diagnostic and treatment barriers, healthcare system barriers, healthcare worker education and knowledge, lack of research evidence.<br><br>These barriers can be |

(*continued on next page*)

(*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Diagnostic method | Treatment/ intervention | Patient perspectives | Main findings |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | addressed by utilising a holistic care model involving both the healthcare worker and patient, as well as the healthcare service. |
| [158] | N/A | Systematic review | Discuss the potential of Non-invasive brain stimulation (NIBS) method in the treatment of CD | CD | N/A | NIBS methods | N/A | There is initial evidence that NIBS (notably rTMS) may be effective in treating CD |
| [159] | N/A | Book chapter | Review the difficulties of the clinical management of PNES patients | PNES | Review includes:<br>- v-EEG<br>- EEG<br>- MRI<br>- Psychiatric exam | Review includes:<br>- Diagnostic explanation<br>- Psychological therapy | N/A | PNES is a symptom of an underlying psychiatric disorder which can be improved by undergoing treatment. |
| [160] | N/A | Review | Provide a guide for the diagnosis and treatment of FND | FND | Review includes:<br>- History taking<br>- Positive signs | Review includes:<br>- Diagnostic explanation<br>- Physical therapy<br>- Psychological therapy<br>- Hypnosis<br>- Sedation<br>- rTMS | N/A | Diagnosis should focus on using positive methods. Clinicians should aim to explain the diagnosis clearly and educate patients. |
| [107] | N/A | Review | Provide an overview of diagnostic instruments for functional weakness | FND | Positive signs | N/A | N/A | Many positive signs exist to support the clinical diagnosis. The functional weakness diagnosis should be made on the basis of a physical examination. |
| [161] | N/A | Systematic review | Review non-v-EEG candidate biomarkers that may assist the PNES diagnosis | PNES | Review includes:<br>- Neuroimaging markers<br>- Heart rate and heart rate variability<br>- Prolactin<br>- Cortisol,<br>- Thyrotropin-releasing hormone,<br>- Catecholamine<br>- melatonin<br>- Adrenocorticotropic hormone<br>- Nesfatin-1<br>- Ghrelin<br>- white blood cell count<br>- Creatine kinase<br>- Creatine<br>- phosphokinase<br>- Neuron-specific enolase<br>- Brain derived neutrotrophic factor<br>- Platelet membrane Serotonin transport | N/A | N/A | No single biomarker was found to successfully differentiate PNES from epileptic seizures. |
| [162] | N/A | Review | Suggest PNES diagnosis strategies to assist healthcare workers | PNES | Review includes:<br>- Homemade video<br>- Induction test<br>- Placebo<br>- EEG<br>- Prolactin level | N/A | N/A | Diagnosing PNES requires knowledge of the relevant non-epileptic features. |
| [163] | N/A | Review | Review motivational interviewing (MI) for PNES | PNES | N/A | Motivational interviewing | Treatment barriers; treatment adherence | Motivational interviewing is effective in improving psychotherapy adherence. Reasons for high treatment adherence includes loss of self-respect or independence, and the |

(*continued on next page*)

(*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Diagnostic method | Treatment/ intervention | Patient perspectives | Main findings |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | nature of the PNES. Reasons for low treatment adherence includes patients' reluctance to acknowledge that the seizures are stress related; previous negative health care experiences and the care and attention received after PNES. |
| [164] | N/A | Review | Provide an overview of evidence-based CD treatments | CD | N/A | Review includes:<br>- CBT<br>- Hypnotherapy<br>- Physical rehabilitation<br>- Inpatient multidisciplinary treatment<br>- Paradoxical intention treatment | N/A | There is robust evidence for inpatient multidisciplinary treatment for CD. There is some evidence for hypnotherapy and CBT being effective interventions for CD. |
| [60] | N/A | Review | Provide an overview of v-EEG research findings | PNES | v-EEG monitoring | N/A | N/A | An integrated multidisciplinary approach will assist in the differentiation between epilepsy and PNES. |
| [165] | N/A | Book chapter | Review the literature on the clinical management of PNES | PNES | Review includes:<br>- v-EEG<br>- EEG<br>- Home video recording<br>- Serum prolactin assay<br>- SPECT | Review includes:<br>- Diagnostic explanation<br>- Psychotherapy<br>- CBT<br>- Family therapy<br>- Biofeedback<br>- Medication | N/A | Treatment should be individualised for each patient and focus on learning new coping skills. A combination of treatments may be the most beneficial for symptom reduction. |
| [166] | N/A | Book chapter | Provide an overview of the clinical management of PNES | PNES | Review includes:<br>- MMPI/ MMPI-2<br>- PAI<br>- v-EEG | Review includes:<br>- Medication<br>- Diagnosis explanation<br>- Psychotherapy<br>- CBT<br>- Psychoeducation | Treatment adherence | Patients who initiated treatment were often more likely to continue to treatment completion than those who did not initiate treatment. |
| [167] | N/A | Review | Provide an overview of the clinical and cognitive aspects of functional tremor | FND | Electrophysiology | N/A | N/A | Accelerometry is a useful diagnostic tool. |
| [168] | N/A | Review | Review recent FND studies | FND | Review includes:<br>- EEG<br>- V-EEG | Review includes:<br>- Physiotherapy<br>- CBT<br>- TENS<br>- Biofeedback<br>- Sedation<br>- TMS | N/A | Positive diagnostic criteria should be used and a transparent explanation should be given to the patient. |
| [169] | N/A | Book chapter | Discuss the history and current evidence of hypnosis as a treatment for FND | FND | N/A | Hypnosis | N/A | The majority of hypnosis evidence is from case series and case studies. |
| [170] | N/A | Book chapter | Discuss the psychological treatments used to treat FND | FND | N/A | Review includes:<br>- CBT<br>- Psychoeducation | N/A | The diagnosis should be given clearly to patients and a multidisciplinary approach to treatment should be used. |
| [171] | N/A | Review | Provide a practical approach to treating FND | FND | Review includes:<br>- fMRI<br>- Electromyography<br>- Positive signs | Review includes:<br>- Physical therapy<br>- CBT<br>- Hypnosis | N/A | A multidisciplinary approach is needed to treat FND. |

(*continued on next page*)

(*continued*)

| Author | Country and setting | Study design | Study aims | Condition of interest | Diagnostic method | Treatment/ intervention | Patient perspectives | Main findings |
|---|---|---|---|---|---|---|---|---|
| [172] | N/A | Review | Examine the overlap between FND and CRPS. | FND | N/A | Review includes:<br>- Explanation-based physical therapy<br>- Multimodal physiotherapy<br>- Psychological therapy | N/A | Explanation-based physical therapy is an effective treatment for FND |
| [173] | N/A | Review | Review the physical signs of functional coma | FNSD | Review includes:<br>- Positive signs<br>- EEG | Sedation with propofol | N/A | Diagnosis using exclusion should not be used, clinical history and positive signs are more appropriate. |
| [174] | N/A | Review | Discuss the differential diagnosis of PNES | PNES | v-EEG | N/A | Patient-doctor relationship | It is important to use v-EEG to rule out epilepsy |
| [175] | N/A | Review | Review the clinical criteria to diagnose PNES | PNES | v-EEG | N/A | N/A | v-EEG is the gold standard when diagnosing PNES |
| [176] | N/A | Review | Provide information on whether there are reliable criteria and treatments for PNES | PNES | v-EEG | - Psychoeducation<br>- Psychotherapy | N/A | How the diagnosis is presented to the patient affects the likelihood of them accepting or denying the diagnosis. |
| [177] | N/A | Review | Discuss why ACT may be an effective treatment for PNES | PNES | N/A | ACT | N/A | ACT is potentially an effective treatment option for PNES patients. |

ACT=acceptance and commitment therapy; CBT=cognitive behavioural therapy; CD=conversion disorder; CRPS=complex regional pain syndrome; CT=computed tomography; EEG=electroencephalogram; EMDR=eye movement desensitisation and reprocessing; FMD=functional movement disorder; fMRI=functional magnetic resonance imaging; FND=functional neurological disorder; FNS=functional neurological symptom(s); FNSD=functional neurological symptom disorder; FS=functional seizures; LSD=lysergic acid diethylamide; MI=motivational interviewing; MRI=magnetic resonance imaging; N/A=not applicable; NIBS=Non-Invasive Brain Stimulation; PNES=psychogenic non-epileptic seizures; $_{r}$TMS=repetitive Transcranial Magnetic Stimulation; SPECT=single-photon emission computerized tomography; SSI=suggestive seizure induction; TENS =Transcutaneous electrical nerve stimulation; $_{TM}$S=Transcranial Magnetic Stimulation; v-EEG=video-electroencephalogram.

## References


[1] American Psychiatric Association, Diagnostic and Statistical Manual of Mental Disorders (DSM-5), American Psychiatric Publishing, Washington, D.C, 2013.
[2] A.D. Fobian, L. Elliott, A review of functional neurological symptom disorder etiology and the integrated etiological summary model, J. Psychiatry Neurosci. 44 (1) (2019) 8–18.
[3] J. Stone, C. Burton, A. Carson, Recognising and explaining functional neurological disorder, BMJ. 371 (2020), m3745.
[4] E. Keatley, I. Molton, A Shift in approach: assessment and treatment of adults with functional neurological disorder, J Health Serv Psychol. 48 (2) (2022) 79–87.
[5] M.D.J. Peters, C. Marnie, A.C. Tricco, D. Pollock, Z. Munn, L. Alexander, et al., Updated methodological guidance for the conduct of scoping reviews, JBI Evid Synth. 18 (10) (2020) 2119–2126.
[6] A.C. Tricco, E. Lillie, W. Zarin, K. O'Brien, H. Colquhoun, M. Kastner, et al., A scoping review on the conduct and reporting of scoping reviews, BMC Med. Res. Methodol. 16 (2016) 15.
[7] H. Arksey, L. O'Malley, Scoping studies: towards a methodological framework, Int. J. Soc. Res. Methodol. 8 (1) (2005) 19–32.
[8] D. Varley, J. Ratcliff, D. Lagos, C. van der Feltz-Cornelis, Clinical Management of Conversion Disorder/Functional Neurological Disorder: A Scoping Review of the Literature, Open Science Framework, 2020.
[9] The Joanna Briggs Institute, Joanna Briggs Institute Reviewers' Manual: 2015 Edition Suppliement, The Joanna Briggs Institute, Adelaide, 2015.
[10] M.L. McHugh, Interrater reliability: the kappa statistic, Biochem Med (Zagreb). 22 (3) (2012) 276–282.
[11] J. Glover, D. Izzo, K. Odato, L. Wang, EBM Pyramid, Dartmouth University, New Haven, 2006.
[12] The World Bank, World Bank Country and Lending Groups, Available from, https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups, 2021.
[13] C. Daum, S. Aybek, Validity of the "drift without pronation" sign in conversion disorder, BMC Neurol. 13 (2013) 31.
[14] L. McWhirter, J. Stone, P. Sandercock, W. Whiteley, Hoover's sign for the diagnosis of functional weakness: a prospective unblinded cohort study in patients with suspected stroke, J. Psychosom. Res. 71 (6) (2011) 384–386.
[15] C. Daum, F. Gheorghita, M. Spatola, V. Stojanova, F. Medlin, F. Vingerhoets, et al., Interobserver agreement and validity of bedside 'positive signs' for functional weakness, sensory and gait disorders in conversion disorder: a pilot study, J. Neurol. Neurosurg. Psychiatry 86 (4) (2015) 425–430.
[16] T. Syed, W.C.J. LaFrance, E. Kahriman, S. Hasan, V. Rajasekaran, D. Gulati, et al., Can semiology predict psychogenic nonepileptic seizures? Ann. Neurol. 69 (6) (2011) 997–1004.
[17] G. Varone, S. Gasparini, E. Ferlazzo, M. Ascoli, G.G. Tripodi, C. Zucco, et al., A comprehensive machine-learning-based software pipeline to classify EEG signals: a case study on PNES vs control subjects, Sensors (Basel). 20 (4) (2020).
[18] T. Nežádal, J. Hovorka, E. Herman, I. Němcová, M. Bajaček, E. Stichová, Psychogenic non-epileptic seizures: our video-EEG experience, Neurol. Res. 33 (7) (2011) 694–700.
[19] J. Wegrzyk, V. Kebets, J. Richiardi, S. Galli, D.V. de Ville, S. Aybek, Identifying motor functional neurological disorder using resting-state functional connectivity, Neuroimage Clin. 17 (2018) 163–168.
[20] J. Biberon, A. de Liege, B. de Toffol, N. Limousin, W. El-Hage, A.M. Florence, et al., Differentiating PNES from epileptic seizures using conversational analysis on French patients: a prospective blinded study, Epilepsy Behav. 111 (2020), 107239.
[21] T. MacDonald, A. Hill, T. Phan, P. Fitzgerald, U. Seneviratne, Psychiatry versus general physicians: who is better at differentiating epileptic from psychogenic non-epileptic seizures? Australas Psychiatr. 20 (5) (2012) 379–383.
[22] E. Balogh, B. Miller, J. Ball, Improving Diagnosis in Health Care, National Academies Press (US), Washington D.C., 2015.
[23] C. van der Feltz-Cornelis, S. van Eck Allen, J. van der Sluijs, Misdiagnosis of an underlying medical condition as conversion disorder/functional neurological disorder (CD/FND) still occurs, Gen. Hosp. Psychiatry 65 (2020) 43–46.
[24] D. Walzl, A.J. Carson, J. Stone, The misdiagnosis of functional disorders as other neurological conditions, J. Neurol. 266 (8) (2019) 2018–2026.
[25] A.J. Espay, S. Ries, T. Maloney, J. Vannest, E. Neefus, A.K. Dwivedi, et al., Clinical and neural responses to cognitive behavioral therapy for functional tremor, Neurology. 93 (19) (2019) e1787-e98.
[26] C. Dallocchio, M. Tinazzi, F. Bombieri, N. Arno, R. Erro, Cognitive behavioural therapy and adjunctive physical activity for functional movement disorders (conversion disorder): a pilot, single-blinded randomized study, Psychother. Psychosom. 85 (6) (2016) 381–383.
[27] L.H. Goldstein, E.J. Robinson, J.D.C. Mellers, J. Stone, A. Carson, M. Reuber, et al., Cognitive behavioural therapy for adults with dissociative seizures (CODES): a pragmatic, multicentre, randomised controlled trial, Lancet Psychiatry 7 (6) (2020) 491–505.
[28] G. Baslet, A. Ehlert, M. Oser, B.A. Dworetzky, Mindfulness-based therapy for psychogenic nonepileptic seizures, Epilepsy Behav. 103 (Pt A) (2020), 106534.
[29] K.D. Bullock, N. Mirza, C. Forte, M. Trockel, Group dialectical-behavior therapy skills training for conversion disorder with seizures, J. Neuropsychiatr. Clin. Neurosci. 27 (3) (2015) 240–243.

[30] M. Hubschmid, S. Aybek, G.E. Maccaferri, O. Chocron, M.M. Gholamrezaee, A. O. Rossetti, et al., Efficacy of brief interdisciplinary psychotherapeutic intervention for motor conversion disorder and nonepileptic attacks, Gen. Hosp. Psychiatry 37 (5) (2015) 448–455.

[31] R. Mayor, P.E. Smith, M. Reuber, Management of patients with nonepileptic attack disorder in the United Kingdom: a survey of health care professionals, Epilepsy Behav. 21 (4) (2011) 402–406.

[32] M. Jafari, A.A. Biuki, M. Hajimaghsoudi, M. Bagherabadi, E. Zarepur, Intravenous haloperidol versus midazolam in Management of Conversion Disorder; a randomized clinical trial, Emerg (Tehran). 6 (1) (2018), e43.

[33] S.R. Ghanbarizadeh, H. Dinpanah, R. Ghasemi, Y. Salahshour, S. Sardashti, M. Kamali, et al., Quetiapine versus haloperidol in controlling conversion disorder symptoms; a randomized clinical trial, Emerg (Tehran). 6 (1) (2018), e47.

[34] A. Kale, D. Lardizabal, B. Nimmana, D. Bahl, A. Aggarwal, P. Sahota, The effect of adrenergic modulation treatment of psychogenic nonepileptic seizures (PNES): a retrospective chart review, Neurology. 80 (7) (2013). P03.120.

[35] M. Bajaj, V. Sharma, V. Barre, Cognitive behaviour therapy in the treatment of psychogenic non-epileptic seizures (PNES), Indian J. Public Health Res. Develop. 8 (2) (2017) 140–143.

[36] S. Jain, N. Jahan, D. Jataria, Efficacy of cognitive behaviour therapy and SSRI in treatment of conversion disorder, Indian J. Public Health Res. Develop. 11 (2) (2020) 308–313.

[37] M. Sarudiansky, G. Pablo Korman, A.I. Lanzillotti, M.M. Areco Pico, C. Tenreyro, G.V. Paolasini, et al., Report on a psychoeducational intervention for psychogenic non-epileptic seizures in Argentina, Seizure. 80 (2020) 270–277.

[38] S.R. Cope, J.G. Smith, T. King, N. Agrawal, Evaluation of a pilot innovative cognitive-behavioral therapy-based psychoeducation group treatment for functional non-epileptic attacks, Epilepsy Behav. 70 (Pt A) (2017) 238–244.

[39] S. Aybek, M. Hubschmid, C. Mossinger, A. Berney, F. Vingerhoets, Early intervention for conversion disorder: neurologists and psychiatrists working together, Acta Neuropsychiatr. 25 (1) (2013) 52–56.

[40] P. Petrochilos, M.S. Elmalem, D. Patel, H. Louissaint, K. Hayward, J. Ranu, et al., Outcomes of a 5-week individualised MDT outpatient (day-patient) treatment programme for functional neurological symptom disorder (FNSD), J. Neurol. 267 (9) (2020) 2655–2666.

[41] X.F. Jimenez, A. Aboussouan, J. Johnson, Functional neurological disorder responds favorably to interdisciplinary rehabilitation models, Psychosomatics. 60 (6) (2019) 556–562.

[42] J.B. Maggio, J.P. Ospina, J. Callahan, A.L. Hunt, C.D. Stephen, D.L. Perez, Outpatient physical therapy for functional neurological disorder: a preliminary feasibility and naturalistic outcome study in a U.S cohort, J. Neuropsychiatr. Clin. Neurosci. 32 (1) (2020) 85–89.

[43] C. Nicholson, M.J. Edwards, A.J. Carson, P. Gardiner, D. Golder, K. Hayward, et al., Occupational therapy consensus recommendations for functional neurological disorder, J. Neurol. Neurosurg. Psychiatry 91 (10) (2020) 1037–1045.

[44] D.L. Drane, S.M. LaRoche, G.A. Ganesh, D. Teagarden, D.W. Loring, A standardized diagnostic approach and ongoing feedback improves outcome in psychogenic nonepileptic seizures, Epilepsy Behav. 54 (2016) 34–39.

[45] R.A. Kanaan, D. Armstrong, S.C. Wessely, Neurologists' understanding and management of conversion disorder, J. Neurol. Neurosurg. Psychiatry 82 (9) (2011) 961–966.

[46] A. Lehn, J. Bullock-Saxton, P. Newcombe, A. Carson, J. Stone, Survey of the perceptions of health practitioners regarding functional neurological disorders in Australia, J. Clin. Neurosci. 67 (2019) 114–123.

[47] K. Sahaya, S.A. Dholakia, D. Lardizabal, P.K. Sahota, Opinion survey of health care providers towards psychogenic non epileptic seizures, Clin. Neurol. Neurosurg. 114 (10) (2012) 1304–1307.

[48] L.J. de Schipper, M. Vermeulen, A.M. Eeckhout, E.M. Foncke, Diagnosis and management of functional neurological symptoms: the Dutch experience, Clin. Neurol. Neurosurg. 122 (2014) 106–112.

[49] G.H. Rawlings, I. Brown, B. Stone, M. Reuber, Written accounts of living with psychogenic nonepileptic seizures: a thematic analysis, Seizure. 50 (2017) 83–91.

[50] N. O'Connell, Functional Neurological Disorder in Acute Stroke and Mental Health Services, Kings College London, London, 2017.

[51] C. Pretorius, Barriers and facilitators to reaching a diagnosis of PNES from the patients' perspective: preliminary findings, Seizure. 38 (2016) 1–6.

[52] C. Pretorius, M. Sparrow, Life after being diagnosed with psychogenic non-epileptic seizures (PNES): a South African perspective, Seizure. 30 (2015) 32–41.

[53] B. Dworetzky, What are we communicating when we present the diagnosis of PNES? Epilepsy Curr. 15 (6) (2015) 353–357.

[54] C. Bolton, P. Goldsmith, Complaints from patients with functional neurological disorders: a cross-sectional UK survey of why patients complain and the effect on the clinicians who look after them, BMJ Open 8 (11) (2018), e021573.

[55] K. LaFaver, A.E. Lang, J. Stone, F. Morgante, M. Edwards, S. Lidstone, et al., Opinions and clinical practices related to diagnosing and managing functional (psychogenic) movement disorders: changes in the last decade, Eur. J. Neurol. 27 (6) (2020) 975–984.

[56] A. Miani, A.S. Pedersen, C.U. Rask, L. Uber-Zak, P.J. Zak, M. Winterdahl, Predicting psychogenic non-epileptic seizures from serum levels of neuropeptide Y and adrenocorticotropic hormone, Acta Neuropsychiatr. 31 (3) (2019) 167–171.

[57] C. van der Feltz-Cornelis, S. Brabyn, J. Ratcliff, D. Varley, V. Allgar, S. Gilbody, et al., Assessment of cytokines, microRNA and patient related outcome measures in conversion disorder/functional neurological disorder (CD/FND): the CANDO clinical feasibility study, Brain Behav Immun Health. 13 (2021), 100228.

[58] O. Devinsky, D. Gazzola, W.C. LaFrance Jr., Differentiating between nonepileptic and epileptic seizures, Nat. Rev. Neurol. 7 (4) (2011) 210–220.

[59] K. Sahaya, S.A. Dholakia, P.K. Sahota, Psychogenic non-epileptic seizures: a challenging entity, J. Clin. Neurosci. 18 (12) (2011) 1602–1607.

[60] K. Whitehead, N. Kane, A. Wardrope, R. Kandler, M. Reuber, Proposal for best practice in the use of video-EEG when psychogenic non-epileptic seizures are a possible diagnosis, Clin. Neurophysiol. Pract. 2 (2017) 130–139.

[61] M. Gutkin, L. McLean, R. Brown, et al., Systematic review of psychotherapy for adults with functional neurological disorder, J. Neurol. Neurosurg. Psychiatry 92 (2021) 36–44.

[62] M. Gutkin, R.J. Brown, L. McLean, J. Streimer, R.A. Kanaan, Shared individual formulation therapy (SIFT): an open-label trial of a new therapy accommodating patient heterogeneity in functional neurological disorder, J. Neurol. 268 (12) (2021) 4882–4889.

[63] C. Wyatt, A. Laraway, S. Weatherhead, The experience of adjusting to a diagnosis of non-epileptic attack disorder (NEAD) and the subsequent process of psychological therapy, Seizure. 23 (9) (2014) 799–807.

[64] M. Fouche, L. Hartwig, C. Pretorius, Management of uncertainty in the diagnosis communication of psychogenic nonepileptic seizures in a south African context, Epilepsy Behav. 98 (Pt A) (2019) 45–52.

[65] H.J.A.H.S. Andrini, A.M. Okhovat, J. Lockman, G.R. Goldsmith, Functional seizures: the patient's perspective of a diagnostic and treatment odyssey, Epilepsy Behav Rep. 17 (2021), 100509.

[66] D. Horn, S. Galli, A. Berney, F. Vingerhoets, S. Aybek, Testing head rotation and flexion is useful in functional limb weakness, Mov Disord Clin Pract. 4 (4) (2017) 597–602.

[67] H.N. Laub, A.K. Dwivedi, F.J. Revilla, A.P. Duker, C. Pecina-Jacob, A.J. Espay, Diagnostic performance of the "huffing and puffing" sign in psychogenic (functional) movement disorders, Mov Disord Clin Pract. 2 (1) (2015) 29–32.

[68] V.D. Naganur, S. Kusmakar, Z. Chen, M.S. Palaniswami, P. Kwan, T.J. O'Brien, The utility of an automated and ambulatory device for detecting and differentiating epileptic and psychogenic non-epileptic seizures, Epilepsia Open. 4 (2) (2019) 309–317.

[69] A. Asadi-Pooya, Psychogenic nonepileptic seizures in adult neurology clinics in southern Iran: a survey of neurologists, Iranian J. Neurol. 15 (2) (2016) 100–102.

[70] M. Foong, U. Seneviratne, Optimal duration of video-electroencephalographic monitoring to capture seizures, J. Clin. Neurosci. 28 (2016) 55–60.

[71] C. Hingray, W. El-Hage, R. Duncan, D. Gigineishvili, K. Kanemoto, W. C. LaFrance Jr., et al., Access to diagnostic and therapeutic facilities for psychogenic nonepileptic seizures: an international survey by the ILAE PNES Task Force, Epilepsia. 59 (1) (2018) 203–214.

[72] A.M. Meppelink, S. Little, A. Oswal, R. Erro, J. Kilner, M.A.J. Tijssen, et al., Event related desynchronisation predicts functional propriospinal myoclonus, Parkinsonism Relat. Disord. 31 (2016) 116–118.

[73] X. Tong, A. Dongmei, M. Reuber, Q. Zhang, D. Zhou, Diagnostic and treatment services for patients with psychogenic nonepileptic seizures (PNES): a survey of health professionals in urban China, Seizure. 56 (2018) 78–87.

[74] J.M. Gelauff, J.G.M. Rosmalen, A. Carson, J.M. Dijk, M. Ekkel, G. Nielsen, et al., Internet-based self-help randomized trial for motor functional neurologic disorder (SHIFT), Neurology. 95 (13) (2020) e1883-e96.

[75] M. Fettig, W. El-Hage, I. Klemina, J. Biberon, B. de Toffol, A. Thiriaux, et al., Adherence to mental health care and caregiver-patient relationship after diagnosis of psychogenic non-epileptic seizures: longitudinal follow-up study, Seizure. 80 (2020) 227–233.

[76] C. Monzoni, R. Duncan, R. Grünewald, M. Reuber, How do neurologists discuss functional symptoms with their patients: a conversation analytic study, J. Psychosom. Res. 71 (6) (2011) 377–383.

[77] S. Baxter, R. Mayor, W. Baird, R. Brown, H. Cock, S. Howlett, et al., Understanding patient perceptions following a psycho-educational intervention for psychogenic non-epileptic seizures, Epilepsy Behav. 23 (4) (2012) 487–493.

[78] A. Jones, Evaluation of the New Psychology Assessment and Formulation Service Pathway for People with Functional Neurological Disorders (FND) at Mid Yorkshire NHS Trust, Mid Yorkshire NHS Trust, Leeds, 2020.

[79] M.E. Klinke, T.E. Hjartardottir, A. Hauksdottir, H. Jonsdottir, H. Hjaltason, G. T. Andresdottir, Moving from stigmatization toward competent interdisciplinary care of patients with functional neurological disorders: focus group interviews, Disabil. Rehabil. 43 (9) (2019) 1237–1246.

[80] D.L. Perez, S. Young, J. King, Preliminary predictors of initial attendance, symptom burden, and motor subtype in a US functional neurological disorders clinic population, Cogn. Behav. Neurol. 29 (4) (2016) 197–205.

[81] J. Read, H. Jordan, I. Perdue, J. Purnell, J. Murray, T. Chalder, et al., The experience of trial participation, treatment approaches and perceptions of change among participants with dissociative seizures within the CODES randomized controlled trial: a qualitative study, Epilepsy Behav. 111 (2020), 107230.

[82] B. Tolchin, B.A. Dworetzky, G. Baslet, Long-term adherence with psychiatric treatment among patients with psychogenic nonepileptic seizures, Epilepsia. 59 (1) (2018) e18–e22.

[83] A.S. Hardin, C. Carson, Interdisciplinary treatment of functional neurological symptom disorder in an inpatient rehabilitation setting: a case report, PM R. 11 (6) (2019) 661–664.

[84] A. Gaillard, R. Gaillard, F. Mouaffak, A. Radtchenko, H. Loo, Case report: electroconvulsive therapy in a 33-year-old man with hysterical quadriplegia, Encephale. 38 (1) (2012) 104–109.

[85] M. Noll-Hussong, S. Holzapfel, D. Pokorny, S. Herberger, Caloric vestibular stimulation as a treatment for conversion disorder: a case report and medical hypothesis. Frontiers, Psychiatry. 5 (63) (2014).

[86] H.-M. Chen, K. Chang, M.-S. Chung, A woman patient with conversion disorder in psychotherapy: from the perspective of self psychology, Taiwanese J. Psychiatr. 31 (2) (2017) 170–176.
[87] L. de Vroege, D. Khasho, A. Foruz, C. van der Feltz-Cornelis, Cognitive rehabilitation treatment for mental slowness in conversion disorder: a case report. Cogent, Psychology. 4 (1) (2017).
[88] D. Rancourt, J. Darkes, Conversion disorder (functional neurological symptom disorder) in primary care mental health, Clin. Case Stud. 18 (1) (2019) 54–68.
[89] S.R. Cope, EMDR as an adjunctive psychological therapy for patients with functional neurological disorder: illustrative case examples, J. EMDR Pract. Res. 14 (2) (2020).
[90] Y. Hsieh, S. Deshpande, A therapy-led, multidisciplinary programme for treatment-resistant functional fixed dystonia, BMJ Case Rep. 13 (7) (2020).
[91] G. Baslet, J. Hill, Case report: brief mindfulness-based psychotherapeutic intervention during inpatient hospitalization in a patient with conversion and dissociation, Clin. Case Stud. 10 (2) (2011) 95–109.
[92] C. Atnas, T. Lippold, Cognitive behaviour therapy with a woman in her twenties with a mild intellectual disability presenting with psychogenic non-epileptic seizures, Adv. Ment. Health Intellect. Disabil. 7 (4) (2013) 245–250.
[93] L. Myers, U. Vaidya-Mathur, M. Lancman, Prolonged exposure therapy for the treatment of patients diagnosed with psychogenic non-epileptic seizures (PNES) and post-traumatic stress disorder (PTSD), Epilepsy Behav. 66 (2017) 86–92.
[94] S.H. Kamil, M. Qureshi, R.S. Patel, Cognitive behavioral therapy (CBT) in psychogenic non-epileptic seizures (PNES): a case report and literature review, Behav Sci (Basel). 9 (2) (2019).
[95] C.D. Graham, D.J. O'Hara, S. Kemp, A case series of acceptance and commitment therapy (ACT) for reducing symptom interference in functional neurological disorders, Clin Psychol Psychother. 25 (3) (2018) 489–496.
[96] F. Choudhry, K. Munawar, J. Khaiyom, T. Lian, Cognitive behavior therapy with a migrant Pakistani in Malaysia: a single case study of conversion disorder, Jurnal Psikologi Malaysia. 33 (2) (2020) 45–64.
[97] J. Knight, There neads to be another way: treating non-epileptic attack disorder using hypnotherapy, The Australian J. Clin. Hypnother. Hypn. 39 (2) (2017) 42–50.
[98] C. Symeon, A. Isaacs-Itua, A. Saramandi, 8 functional neurological disorder (FND) patients' experience of healthcare interventions, J. Neurol. Neurosurg. Psychiatry 91 (2020), e11.
[99] Y. Wen, A. Mohammed, R. Ulep, H. Chokhawala, G. Vidal, I. Iwuchukwu, et al., Abstract TP264: telestroke diagnosis of conversion disorder, in: International Stroke Conference, 2019.
[100] S. Kusmakar, C.K. Karmakar, B. Yan, T.J. OrBrien, M. Palaniswami, R. Muthuganapathy, Improved detection and classification of convulsive epileptic and psychogenic non-epileptic seizures using FLDA and Bayesian inference, Annu Int Conf IEEE Eng Med Biol Soc. 2018 (2018) 3402–3405.
[101] M.J. Burke, R. Isayama, G. Jegatheeswaran, C. Gunraj, A. Feinstein, A.E. Lang, et al., Neurostimulation for functional neurological disorder: evaluating longitudinal neurophysiology, Mov Disord Clin Pract. 5 (5) (2018) 561–563.
[102] A. Joos, N. Leiprecht, K. Wiesand, R. Schmidt, A. Hartmann, Integrated inpatient rehabilitation for patients with functional neurological symptom disorder (FNSD) - a specific group therapy, J. Psychosom. Res. 120 (2019) 102–104.
[103] R. Agarwal, S. Garg, S.K. Tikka, S. Khatri, D. Goel, Successful use of theta burst stimulation (TBS) for treating psychogenic non epileptic seizures (PNES) in a pregnant woman, Asian J. Psychiatr. 43 (2019) 121–122.
[104] M. Reuber, Trauma, traumatisation, and functional neurological symptom disorder-what are the links? Lancet Psychiatry 5 (4) (2018) 288–289.
[105] S.C. Lidstone, R. Araujo, J. Stone, B.R. Bloem, Ten myths about functional neurological disorder, Eur. J. Neurol. 27 (11) (2020) e62-e4.
[106] M.J. Burke, V. Faria, D. Cappon, A. Pascual-Leone, T.J. Kaptchuk, E. Santarnecchi, Leveraging the shared neurobiology of placebo effects and functional neurological disorder: a call for research, J. Neuropsychiatr. Clin. Neurosci. 32 (1) (2020) 101–104.
[107] J. Stone, Functional neurological disorders: the neurological assessment as treatment, Pract. Neurol. 16 (1) (2016) 7–17.
[108] C. Rockliffe-Fidler, M. Willis, Explaining dissociative seizures: a neuropsychological perspective, Pract. Neurol. 19 (3) (2019) 259–263.
[109] M. Vermeulen, J. Hoekstra, M.J. Kuipers-van Kooten, E.A. van der Linden, Management of patients with conversion disorder, Ned. Tijdschr. Geneeskd. 158 (3) (2014) A6997.
[110] K. McKee, S. Glass, C. Adams, C.D. Stephen, F. King, K. Parlman, et al., The inpatient assessment and management of motor functional neurological disorders: an interdisciplinary perspective, Psychosomatics. 59 (4) (2018) 358–368.
[111] J.R. Anderson, V. Nakhate, C.D. Stephen, D.L. Perez, Functional (psychogenic) neurological disorders: assessment and acute management in the emergency department, Semin. Neurol. 39 (1) (2019) 102–114.
[112] K. Kanemoto, W.C. LaFrance Jr., R. Duncan, D. Gigineishvili, S.P. Park, Y. Tadokoro, et al., PNES around the world: where we are now and how we can close the diagnosis and treatment gaps-an ILAE PNES task force report, Epilepsia Open. 2 (3) (2017) 307–316.
[113] S.C. Lidstone, L. MacGillivray, A.E. Lang, Integrated therapy for functional movement disorders: time for a change, Mov Disord Clin Pract. 7 (2) (2020) 169–174.
[114] J. Stone, Functional Neurological Disorder (FND): A Patient's Guide, Available from, https://www.neurosymptoms.org/en_GB/, 2019.
[115] G. Nielsen, J. Stone, A. Matthews, M. Brown, C. Sparkes, R. Farmer, et al., Physiotherapy for functional motor disorders: a consensus recommendation, Neurol. Neurosurg. Psychiatry 86 (10) (2015) 1113–1119.
[116] J. Stone, I. Hoeritzauer, K. Brown, A. Carson, Therapeutic sedation for functional (psychogenic) neurological symptoms, J. Psychosom. Res. 76 (2) (2014) 165–168.
[117] N. Agrawal, D. Gaynor, A. Lomax, M. Mula, Multimodular psychotherapy intervention for nonepileptic attack disorder: an individualized pragmatic approach, Epilepsy Behav. 41 (2014) 144–148.
[118] M. Leandertz, A Psychotherapeutically Oriented Approach to Vibroacoustic Therapy : Therapy Process with a Client Diagnosed with Functional Neurological Disorder Experiencing Dissociative Symptoms, University of Jyväskylä, Jyväskylä, 2018.
[119] R. Barrett-Naylor, D. Gresswell, D. Dawson, The effectiveness and acceptability of a guided self-help acceptance and commitment therapy (ACT) intervention for psychogenic nonepileptic seizures, Epilepsy Behav. 88 (2018) 332–340.
[120] L. Abdelnour, F. El-Nagi, Functional neurological disorder presenting as stroke: a narrative review, J Psychol Abnorm. 6 (2017) 159.
[121] S. Ali, G. Bakkeren, Conversion of BAC clones into binary BAC (BIBAC) vectors and their delivery into basidiomycete fungal cells using agrobacterium tumefaciens, Methods Mol. Biol. 1227 (2015) 199–215.
[122] L. Allen, R. Woolfolk, Somatization and conversion disorders, in: S.G. Hofmann (Ed.), The Wiley Handbook of Cognitive Behavioral Therapy, John Wiley & Sons, Ltd, 2013.
[123] G. Baslet, B. Dworetzky, D.L. Perez, M. Oser, Treatment of psychogenic nonepileptic seizures: updated review and findings from a mindfulness-based intervention case series, Clin EEG Neurosci. 46 (1) (2015) 54–64.
[124] A. Bermeo-Ovalle, A. Kanner, The role of the neurologist after diagnosis, in: B. A. Dworetzky, G. Baslet (Eds.), Psychogenic Nonepileptic Seizures: Toward the Integration of Care, Oxford University Press, Oxford, 2017.
[125] M. Butler, M. Seynaeve, T.R. Nicholson, S. Pick, R.A. Kanaan, A. Lees, et al., Psychedelic treatment of functional neurological disorder: a systematic review, Ther Adv. Psychopharmacol. 10 (2020), 2045125320912125.
[126] P. Carlson, Perry K. Nicholson, Psychological interventions for psychogenic non-epileptic seizures: a meta-analysis, Seizure. 45 (2017) 142–150.
[127] A.J. Carson, R. Brown, A.S. David, R. Duncan, M.J. Edwards, L.H. Goldstein, et al., Functional (conversion) neurological symptoms: research since the millennium, J. Neurol. Neurosurg. Psychiatry 83 (8) (2012) 842–850.
[128] D.K. Chen, W.C. LaFrance Jr., Diagnosis and treatment of nonepileptic seizures, Continuum (Minneap Minn). 22 (1 Epilepsy) (2016) 116–131.
[129] D.K. Chen, E. Sharma, W.C. LaFrance Jr., Psychogenic non-epileptic seizures, Curr. Neurol. Neurosci. Rep. 17 (9) (2017) 71.
[130] S. Cope, L. Mountford, J. Smith, N. Agrawal, EMDR to treat functional neurological disorder: a review, J. EMDR Pract. Res. 12 (3) (2018).
[131] O. Cottencin, Conversion disorders: psychiatric and psychotherapeutic aspects, Neurophysiol. Clin. 44 (4) (2014) 405–410.
[132] K. Czarnecki, M. Hallett, Functional (psychogenic) movement disorders, Curr. Opin. Neurol. 25 (4) (2012) 507–512.
[133] C. Daum, M. Hubschmid, S. Aybek, The value of 'positive' clinical signs for weakness, sensory and gait disorders in conversion disorder: a systematic and narrative review, J. Neurol. Neurosurg. Psychiatry 85 (2) (2014) 180–190.
[134] M. Edwards, Functional (psychogenic) gait disorder: diagnosis and management, Handb. Clin. Neurol. 159 (2018) 417–423.
[135] A.J. Espay, S. Aybek, A. Carson, M.J. Edwards, L.H. Goldstein, M. Hallett, et al., Current concepts in diagnosis and treatment of functional neurological disorders, JAMA Neurol. 75 (9) (2018) 1132–1141.
[136] K. Fritzsche, K. Baumann, K. Gotz-Trabert, A. Schulze-Bonhage, Dissociative seizures: a challenge for neurologists and psychotherapists, Dtsch. Arztebl. Int. 110 (15) (2013) 263–268.
[137] R. Furlan, A. Alciati, Psychogenic pseudosyncope and pseudoseizure: approach and treatment, in: M. Brignole, D. Benditt (Eds.), Syncope, Springer, Cham, 2020.
[138] B. Garcin, Motor functional neurological disorders: An update, Rev. Neurol. (Paris) 174 (4) (2018) 203–211.
[139] C. Gasca-salas, A. Lang, Neurologic diagnostic criteria for functional neurologic disorders, in: M. Hallett, J. Stone, A. Carson (Eds.), Handbook of Clinical Neurology, Elsevier, Amsterdam, 2016.
[140] G.S. Gilmour, G. Nielsen, T. Teodoro, M. Yogarajah, J. Coebergh, M. Dilley, et al., Management of functional neurological disorder, J. Neurol. 267 (7) (2020) 2164–2172.
[141] C. Greiner, A. Schnider, B. Leemann, Functional neurological disorders: a treatment-focused review, Swiss Arch. Neurol. Psychiatr. Psychother. 167 (8) (2016) 234–240.
[142] K. LaFaver, Treatment of functional movement disorders, Neurol. Clin. 38 (2) (2020) 469–480.
[143] W. LaFrance, L. Goldstein, Evidence-based treatments, in: B.A. Dworetzky, G. Baslet (Eds.), Psychogenic Nonepileptic Seizures: Toward the Integration of Care, Oxford University Press, Oxford, 2017.
[144] W.C. Lafrance Jr., R. Ranieri, A.S. Blum, Nonepileptic seizures - objective phenomena, Handb. Clin. Neurol. 139 (2016) 297–304.
[145] J. Lai, Reclaiming trapped limbs: current and emerging treatment strategies for motor conversion disorder, Neuropsychiatry. 3 (4) (2013) 385.
[146] J. Martlew, J. Pulman, A.G. Marson, Psychological and behavioural treatments for adults with non-epileptic attack disorder, Cochrane Database Syst. Rev. 2 (2014) CD006370.
[147] T.R.J. Nicholson, V. Voon, Transcranial magnetic stimulation and sedation as treatment for functional neurologic disorders, Handb. Clin. Neurol. 139 (2016) 619–629.
[148] D. Parain, N. Chastan, Large-field repetitive transcranial magnetic stimulation with circular coil in the treatment of functional neurological symptoms, Neurophysiol. Clin. 44 (4) (2014) 425–431.

[149] S. Plioplys, S. Abbas, B. Brien, Clinicans' response to the diagnosis, in: B. Dworetzky, G. Baslet (Eds.), Toward the Integration of Care, Oxford University Press, New York, 2017.
[150] T.A. Pollak, T.R. Nicholson, M.J. Edwards, A.S. David, A systematic review of transcranial magnetic stimulation in the treatment of functional (conversion) neurological symptoms, J. Neurol. Neurosurg. Psychiatry 85 (2) (2014) 191–197.
[151] N.A. Poole, A. Wuerz, N. Agrawal, Abreaction for conversion disorder: systematic review with meta-analysis, Br. J. Psychiatry 197 (2) (2010) 91–95.
[152] S. Popkirov, W. Gronheit, J. Wellmer, A systematic review of suggestive seizure induction for the diagnosis of psychogenic nonepileptic seizures, Seizure. 31 (2015) 124–132.
[153] S. Popkirov, J. Stone, A. Buchan, Functional neurological disorder: a common and treatable stroke mimic, Stroke. 51 (5) (2020) 1629–1635.
[154] M. Restrepo, D. Restrepo, From conversion disorders to functional neurological disorders. overcoming the rule-out diagnosis? Rev. Colomb. Psiquiatr (Engl Ed) 48 (3) (2019) 174–181.
[155] L. Ricciardi, M. Edwards, Treatment of functional (psychogenic) movement disorders, Neurotherapeutics : The J. Am. Soc. Exp. NeuroTherapeut. 11 (1) (2014) 201–207.
[156] P.I. Rosebush, M.F. Mazurek, Treatment of conversion disorder in the 21st century: have we moved beyond the couch? Curr. Treat. Options Neurol. 13 (3) (2011) 255–266.
[157] T. Sawchuk, J. Austin, D. Terry, Models of care, in: B.A. Dworetzky, G. Baslet (Eds.), Psychogenic Nonepileptic Seizures: Toward the Integration of Care, Oxford University Press, Oxford, 2017.
[158] C. Schonfeldt-Lecuona, J.P. Lefaucheur, P. Lepping, J. Liepert, B.J. Connemann, A. Sartorius, et al., Non-invasive brain stimulation in conversion (functional) weakness and paralysis: a systematic review and future perspectives, Front. Neurosci. 10 (2016) 140.
[159] M. Schmutz, Neuropsychiatric Symptoms of Epilepsy, Springer International Publishing, Switzerland, 2016.
[160] J. Stone, A. Carson, Functional neurologic disorders, Continuum (Minneap Minn) 21 (3 Behavioral Neurology and Neuropsychiatry) (2015) 818–837.
[161] T. Sundararajan, G.E. Tesar, X.F. Jimenez, Biomarkers in the diagnosis and study of psychogenic nonepileptic seizures: a systematic review, Seizure. 35 (2016) 11–22.
[162] D.H. Toffa, L. Poirier, D.K. Nguyen, The first-line management of psychogenic non-epileptic seizures (PNES) in adults in the emergency: a practical approach, Acta Epileptologica. 2 (7) (2020).
[163] B. Tolchin, G. Baslet, S. Martino, J. Suzuki, H. Blumenfeld, L.J. Hirsch, et al., Motivational interviewing techniques to improve psychotherapy adherence and outcomes for patients with psychogenic nonepileptic seizures, J. Neuropsychiatr. Clin. Neurosci. 32 (2) (2020) 125–131.
[164] P. Tsui, A. Deptula, D.Y. Yuan, Conversion disorder, functional neurological symptom disorder, and chronic pain: comorbidity, assessment, and treatment, Curr. Pain Headache Rep. 21 (6) (2017) 29.
[165] P. Widdess-Walsh, B. Mostacci, P. Tinuper, O. Devinsky, Psychogenic nonepileptic seizures, in: M.J. Aminoff, F. Boller, D. Swaab (Eds.), Handbook of Clinical Neurology, Elsevier, Amsterdam, 2012.
[166] D. Williamson, M. Ogden, D. Drane, Psychogenic Nonepileptic Seizures. In: S Koffler, J Morgan, B Marcopulos, M Greiffenstein, Editors. Neuropsychology: A Review of Science and Practice. 2, Oxford University Press, New York, 2014.
[167] K.E. Zeuner, R. Schmidt, P. Schwingenschuh, Clinical and cognitive aspects of functional (psychogenic) tremor, Nervenarzt. 89 (4) (2018) 400–407.
[168] A. Lehn, J. Gelauff, I. Hoeritzauer, L. Ludwig, L. McWhirter, S. Williams, et al., Functional neurological disorders: mechanisms and treatment, J. Neurol. 263 (3) (2016) 611–620.
[169] Q. Deeley, Hypnosis as therapy for functional neurologic disorders, Handb. Clin. Neurol. 139 (2016) 585–595.
[170] L. Goldstein, J.D.C. Mellers, Psychologic treatment of functional neurologic disorders, Handb. Clin. Neurol. 139 (2016) 571–583.
[171] M.A. O'Neal, G. Baslet, Treatment for patients with a functional neurological disorder (conversion disorder): an integrated approach, Am. J. Psychiatry 175 (4) (2018) 307–314.
[172] S. Popkirov, I. Hoeritzauer, L. Colvin, A. Carson, J. Stone, Complex regional pain syndrome and functional neurological disorders - time for reconciliation, J. Neurol. Neurosurg. Psychiatry 90 (2019) 608–614.
[173] L. Ludwig, L. McWhirter, S. Williams, C. Derry, J. Stone, Functional coma, Handb. Clin. Neurol. 139 (2016) 313–327.
[174] A. Joos, K. Baumann, C.E. Scheidt, C. Lahmann, R. Konig, H.J. Busch, et al., Differential diagnosis of dissociative seizures, Nervenarzt. 88 (10) (2017) 1147–1152.
[175] A.M. Staack, B.J. Steinhoff, Differential diagnosis of epileptic and psychogenic non-epileptic seizures and treatment consequences, Fortschr. Neurol. Psychiatr. 83 (12) (2015) 702–711.
[176] M. Frauenheim, Psychogene nicht-epileptische Anfälle (PNES): Gibt es verlässliche Kriterien und Therapiemöglichkeiten? Neurol Rehabil. 24 (3) (2018) 215–224.
[177] S. Cope, N. Poole, N. Agrawal, Treating functional non-epileptic attacks - should we consider acceptance and commitment therapy? Epilepsy Behav. 73 (2017) 197–203.