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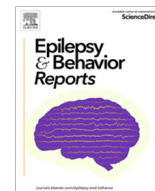
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## Drop attacks as a subtype of FND: A cognitive behavioural model using grounded theory



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### ABSTRACT

Idiopathic drop attacks are falls to the floor, without warning, and without loss of consciousness, for which the cause is uncertain. They are poorly studied but recent research suggests that many idiopathic drop attacks may be usefully considered within the spectrum of functional neurological disorder (FND).

The aim of this study was to test a cognitive behavioural model of idiopathic drop attacks, in order to inform formulation and treatment. Interviews and diaries were completed by seven individuals experiencing drop attacks, and were analysed using a grounded theory qualitative data approach.

Through the coding and synthesis of data into themes, a proposed cognitive behavioural model was identified, with a main precipitating event in all cases being a fall related to another cause, such as a mechanical fall or a fall due to medical reasons. Additional precipitating factors identified included situational triggers, high levels of stress, and dissociation. A maintaining cycle of thoughts, emotion and behaviour is outlined.

Our proposed theory is consistent with current cognitive behavioural models of FND. A cognitive behavioural understanding of drop attacks when considered part of FND aids formulation in clinical practice, and suggests that cognitive behavioural therapy interventions for FND may also be applicable in this population.

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### 1. Introduction

Idiopathic drop attacks have been defined as sudden falls to the floor without warning, and without loss of consciousness, where there is no identified cause, despite comprehensive medical assessment. They are not caused by malfunction of the lower limbs, or changes in body or head posture [1]. Although other causes of drop attacks have been highlighted, such as cardiac, cerebrovascular, vestibular or seizure disorders [e.g. 2,3], it has been suggested that an idiopathic presentation is the most common [1]. Idiopathic drop attacks have previously been referred to as 'cryptogenic drop attacks' [1] or 'La maladie des genoux bleus' [4]. In this paper, the term 'drop attacks' will be used synonymously with idiopathic or cryptogenic drop attacks.

Little research has investigated idiopathic drop attacks, with only two studies exploring them in detail [1,5]. Clinical features in a case series of 83 patients suggested that for some patients, idiopathic drop attacks can be reclassified within the category of functional neurological disorder [FND; 5],

Many more women than men present with drop attacks, with women comprising 89–100% of those studied [1,5]. The average age of onset is between 40 and 50, but does not appear to be linked to hormonal changes [1]. The frequency of drop attacks varies greatly between individuals, ranging from ten per day to less than one per month; some also experience clusters of attacks with freedom in between [1,5]. Stevens and Matthews [1] reported that falls usually happened while walking (96%), and usually occurred outside of the house, although 43% also had drop attacks inside the house. In Hoeritzauer et al's [5] sample, 34% of patients could identify triggers for their drop attacks, such as specific places, times or situations where falls would be more likely to occur. On direct questioning, 43% of patients described a brief period prior to a drop attack where they would experience feelings of dissociation or depersonalisation, and most (93%) could not remember the fall itself suggesting momentary impairment in awareness. Most strikingly in relation to FND, they found that 31% of their sample had functional limb weakness on examination, and 28% either emerged from or developed in to more typical functional seizures.

Injuries were frequently reported as an outcome of drop attacks, particularly to the knees, face and hands, with 9–18% also reporting fractured or broken bones [1,5]. The authors of both studies reported that many people would become afraid to go

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out due to both the risk of injury and embarrassment, impacting on their everyday functioning.

Hoeritzauer and colleagues [5] developed a hypothesis that drop attacks represent a conditioned behavioural response to negative external (environmental or situational) or internal (anxiety symptoms or dissociation) stimuli. It was proposed that this association is maintained through fear of collapse, and in some cases through the fall providing relief from negative stimuli. This mechanism overlaps with reported models of functional seizures [6,7]. Two case studies of idiopathic drop attacks have also been published [4,8]. One case study identified a 47 year old woman's drop attacks as occurring following recollection of traumatic experiences, suggesting a psychological mechanism [8].

Although there are similarities between drop attacks and functional seizures, drop attacks are not widely included in studies of functional seizures, which tend to focus on events with generalised shaking that superficially resemble epilepsy, or events where patients fall down and lie still and unresponsive, superficially resembling syncope. Hubsch et al. [9] analysed clinical signs in 145 episodes of functional seizures and identified different subtypes of seizure, none of which covered drop attacks. However, Galimberti et al. [10] and Devinsky et al. [11] included patients with drop attacks within an functional seizures sample, accounting for around 10% of each sample. This suggests that, at least in some cases, drop attacks have significant similarities to functional seizures.

Due to the limited literature, there are no recommended evidence-based interventions for drop attacks. Hoeritzauer and colleagues [5] report that for 12% of patients, drop attacks abated following an explanation of the episodes as conditioned responses, and the use of distraction techniques. However, they noted that 51% of their sample had reduced or no drop attacks when followed-up at an average of 38 months and therefore it is unclear how many would have experienced spontaneous resolution.

A better understanding of drop attacks is required to guide both formulation and treatment approaches. Given the potential overlap between drop attacks and other functional disorders, especially functional seizures, a deeper understanding of drop attacks could help to identify whether psychological interventions which show some efficacy in functional seizures, such as cognitive behavioural therapy (CBT) [12,13], may also be helpful in this population. A CBT intervention could improve functioning and quality of life, help individuals to manage their condition, and improve the ways they cope with the anxiety surrounding future falls.

### 1.1. Aims

The aim of our study was to build on the previous study by Hoeritzauer and colleagues [5] and explore a psychological understanding of drop attacks, in order to guide formulation and treatment. This was investigated through the collection of qualitative data from interviews and diaries from individuals experiencing drop attacks, and analysed using a grounded theory approach [14]. The primary research question asked, 'What are the predisposing and precipitating factors related to drop attacks?'. Secondary questions explored individuals' thoughts, emotions and behaviour both immediately prior to, and following, a drop attack.

## 2. Methods

### 2.1. Participants

Participants were consecutive individuals experiencing ongoing drop attacks recruited from a single neurologist at a regional neuroscience unit in Edinburgh, UK (the Department of Clinical Neurosciences, serving a population of approximately 800,000). Inclusion criteria were 1) Diagnosis of idiopathic drop attacks, following

assessment and relevant investigations, 2) Aged 18+, 3) Drop attacks occurring 6 + times per year, and 4) Able to provide informed consent. Ethical approval was granted by the South Yorkshire Research Ethics Committee (Reference: 17/YH/0438) and the NHS Lothian Research and Development Office (Reference: 2017/0335). The study protocol was registered with Clinicaltrials.gov (Reference: NCT03694769).

We aimed to recruit a homogenous sample of ten participants. Due to the low numbers of men presenting with drop attacks, an entirely female sample was recruited. In order to maximise data, and the likelihood of approaching saturation, two methods of data collection were used: interviews and written diaries. All those who had been seen at a single neurology clinic between 2016 and 2018 were screened for eligibility, and contacted if they met inclusion criteria and fit with the sampling method (Fig. 1). As shown in Fig. 1, due to the small numbers of patients presenting with drop attacks, it was only possible to recruit seven participants over the timescale of this project.

### 2.2. Design

In this exploratory qualitative study, neurology outpatients with ongoing drop attacks underwent a semi-structured interview and completed written diaries for eight weeks. Throughout the study, participants received treatment as usual from their neurologist.

### 2.3. Procedure

Participants were invited to take part by their neurologist, and subsequently met with a researcher to give written informed consent and complete an hour-long interview. Following this, participants were asked to record written accounts of any drop attack that occurred over the subsequent eight weeks during which the researcher contacted them fortnightly by telephone to discuss any difficulties or concerns. If participants did not experience any drop attacks during this period, they were asked to continue keeping a diary for an additional two to four weeks. Participants then met again with the researcher to return the diaries and discuss any reflections that they had about any aspect of the process.

### 2.4. Data collection

#### 2.4.1. Semi-structured assessment interview

The audio-recorded interview was semi-structured, with questions designed to facilitate discussion related to the research questions. The interview schedule included questions about recent drop attacks, the onset of these and relevant personal and social history. Participants' experiences of drop attacks were also discussed, focussing on thoughts, feelings and behaviour before and after the episodes. Participants were also asked about the impact that drop attacks had on their everyday functioning.

#### 2.4.2. Drop attack diary

Participants were given diaries along with an accompanying prompt sheet which asked them to record what had happened, along with their thoughts, physical symptoms, feelings and behaviour, as close to the event as possible. They were encouraged to write detailed accounts, outlining the period before, during and after the episode, in order to identify any potential triggers.

### 2.5. Analysis

The content of the interviews and diaries was analysed using a grounded theory approach [14]. This constructivist qualitative method allows exploration of data to identify a theory or model

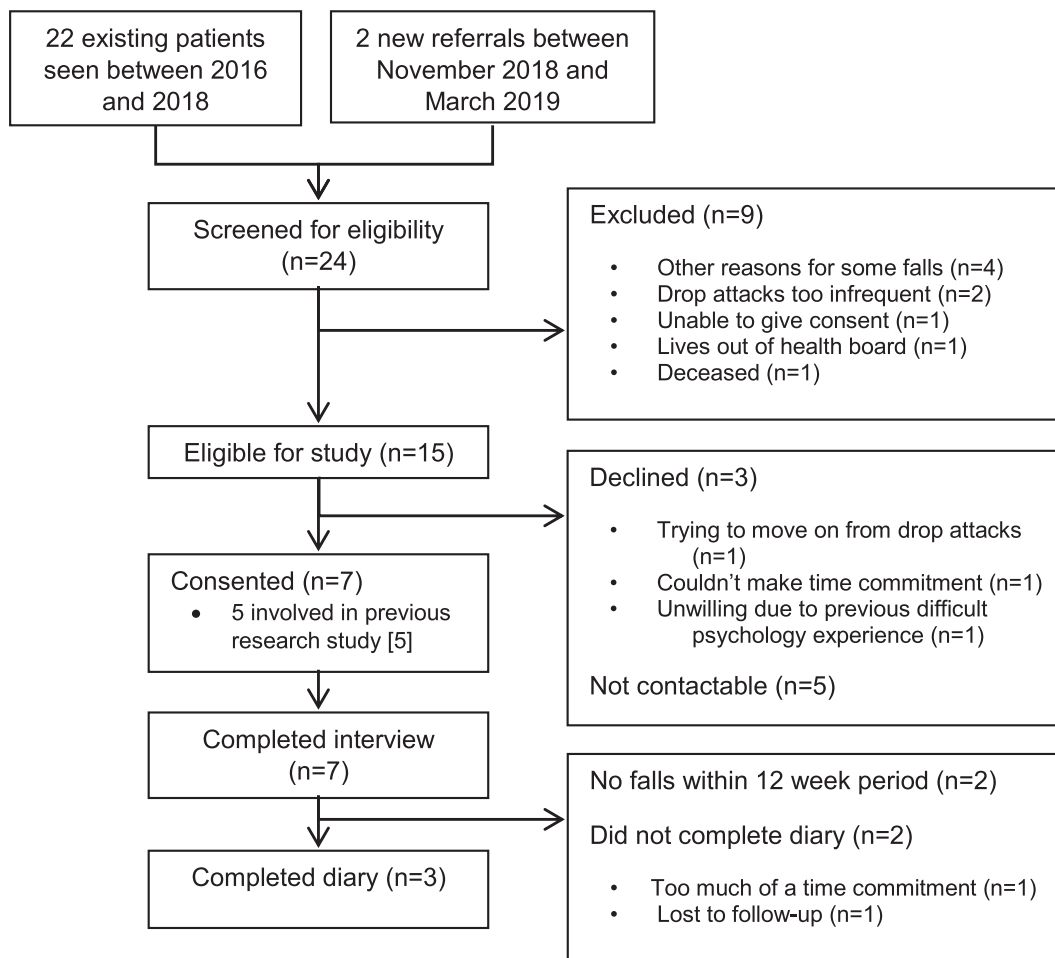


Fig. 1. Participant flowchart.

in an area where there is little existing literature [15], using a systematic approach to the analysis of data [16]. Using both interviews and diaries allowed information to be obtained from different viewpoints, enriching the data. Following Charmaz [14], data from both interviews and diaries were coded in three stages. Initial line-by-line open coding of transcripts was completed, followed by focused coding which involved sorting and grouping both frequently occurring codes, and those which were more relevant to the research questions. The third coding stage was theoretical coding. This comprised looking at relationships between codes in order to identify hypotheses which could be integrated into a theory.

Coding was completed as data were collected, allowing refinement and changes to be made over the course of the data collection period [17]. The codes that emerged from the first four interviews, along with memos written alongside these, were used to refine questions used in subsequent interviews. Focused codes and theoretical codes were refined and altered over time, based on information from subsequent interviews and memos.

As the grounded theory methodology acknowledges the role that the researcher has in interpreting data [18], several steps were taken to reduce potential bias. Memo-writing was used throughout data collection and analysis, in order to record reflections on the meaning in data and codes, explore connections between data, and outline methodological decision making. Particular focus was given to identifying data that was contrary to emerging themes, and which would not fit with an understanding consistent with FND. Participants were also invited to review the codes that were

identified within their interviews. Any discrepancies were discussed within the research team until consensus was reached.

### 3. Results

Participants were seven women between the ages of 40 and 71, who had been experiencing drop attacks for a mean of 14.6 years (SD = 9.5, range = 4–30). Each completed an interview and six participants agreed to complete diaries, with the other participant declining to take part in the diary portion of the research due to the perceived burden of doing so, as she was experiencing multiple drop attacks each day. Within the eight-week diary period, one participant experienced one drop attack, and another had two drop attacks. A third participant had no drop attacks within the eight-week period and agreed to continue keeping a diary for a further four weeks. She subsequently experienced a cluster of five drop attacks over the four weeks, the first of which involved a painful fall resulting in a hospital visit. Two participants did not have any drop attacks within the prolonged diary period, and so did not record any diary entries. One participant was lost to follow-up.

#### 3.1. Main themes

The nine main themes from the interviews and diaries, grouped by four key categories (critical event, predisposing, precipitating and maintaining factors), are displayed in Fig. 2. No new key themes were identified from the final two interviews, suggesting that theoretical saturation was approached [14]. Themes are

described in further detail below, grouped by the categories given, and with relevant example quotes.

### 3.1.1. Predisposing factors

Table 1 shows example quotes illustrating the main theme which emerged as a predisposing factor: life stressors. In the interviews, all participants described traumatic or stressful experiences in their lives prior to developing drop attacks. Most participants also spoke about current life stressors including relationship and family difficulties, chronic health difficulties, caring for family members, and work stress. Only one participant did not mention current life stressors, and she did not experience any drop attacks during the course of the study.

### 3.1.2. Critical incident

'Initial experiences of falling' was a key theme in all interviews, as shown in Table 1. For all participants, the initial experience of falling was notable in that it was a fall due to another medical reason, such as low blood pressure, pain, Meniere's disease, migraine

with motor aura, or was a mechanical fall. In all cases the fall itself was psychologically stressful in some way, leading to significant personal injuries or worry about risk to children, or occurred during an already stressful period. In all cases, the falls then continued, with varying courses, despite there no longer being a clear cause or trigger.

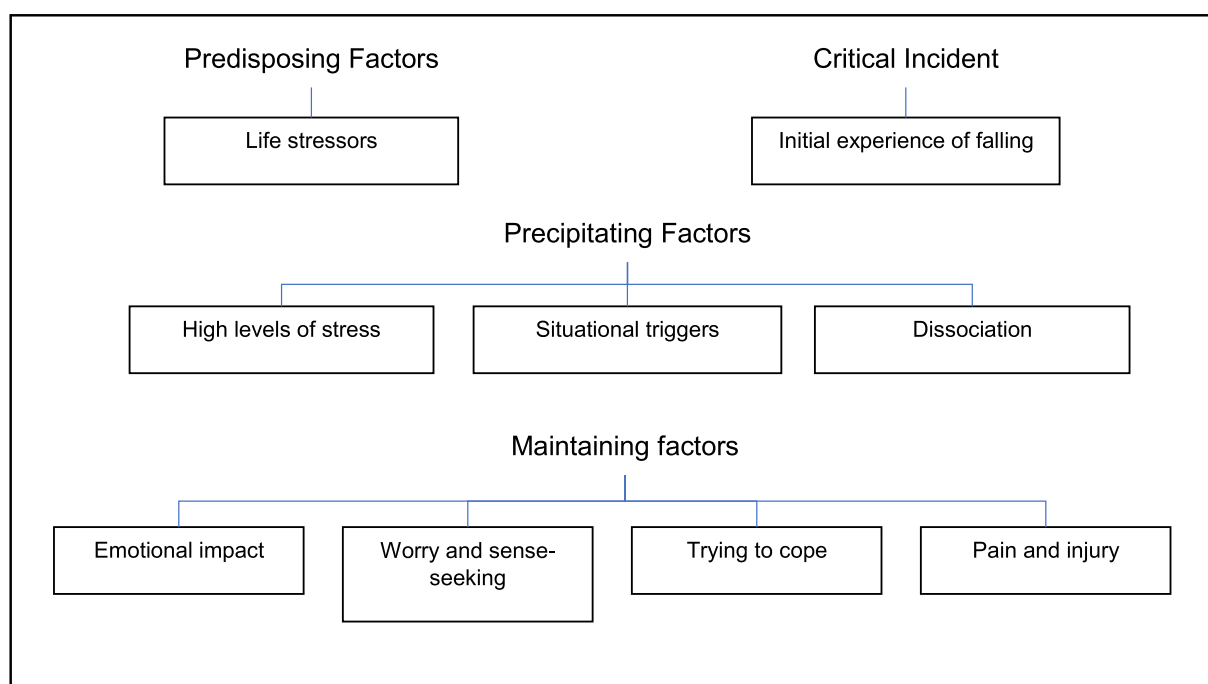
### 3.1.3. Triggers and precipitating factors

Table 2 shows the main themes in the precipitating factors category: situational triggers, high levels of stress, and dissociation. These are all factors which participants identified as triggers, or which they linked to an increased likelihood of a drop attack occurring.

3.1.3.1. *Situational triggers.* Participants reported falling in different locations and situations, with all participants reporting falls both outside and in the home. Falling in the home was mentioned less frequently, which may have been due to a lower incidence, due to under-reporting as these falls tended to be accompanied by less

**Table 1**  
Themes and supporting quotes within the predisposing factors and critical incident categories.

Themes	Quotes
Predisposing factors - past life stressors	P02: "The stress of having my little boys on my own. I worried about having a vertigo attack when they were just going about the house. That was very stressful as well." ( <i>note vertigo attacks separate to and predate drop attacks</i> ) P05: "When you go through difficult situations, can that make it worse? So I've got (daughter) through leukaemia twice. My youngest...who was very unhappy, has gone through severe depression and self-harming." P07: "I had three jobs at one point just to survive. . Just to survive, to pay the bills and survive. It's hard on your own."
Critical incident - Initial experience of fall due to another cause	P07: "I fell down the stairs, my neighbour was with me, she stayed with me in (place). She stayed along the landing from me and she was with me and she shouted '(Name)!' I slipped and tumbled right down to the bottom and blood was everywhere." ( <i>mechanical fall</i> ) P03: "I went down between the kerb and the road and I broke my ankle and then I had a blood clot. And I don't know if it was the blood clot that I had, because I was out of action for such a long time, and I don't know if it's... and then I had to try to learn to walk again because I was frightened to walk because of the pain." ( <i>mechanical fall</i> ) P06: "(The first drop was) not long after my migrainous stroke and it was scary. It just, just like the right side of my body wouldn't do anything. And I couldn't get up from that one. I was kind of like frozen." ( <i>note the migrainous stroke was with hindsight an episode of migraine with aura</i> )



**Fig. 2.** Main categories and themes.

embarrassment, or because falls were in part triggered by being outside. It may have been that the consequences of falling outside are more impactful, and therefore stress and worry were increased there as a potential precipitating factor, as described in the quote by participant five *"I don't want to be in a situation where I have to worry about (falling), because that would probably just make it worse"*. For some, falls were more likely to happen in specific situations, particularly in places where falls had happened before. Stairs and steps were a particularly common place for falls to happen, with five participants describing falls that had happened in these circumstances. It appeared that situational triggers were linked to increased levels of stress, as described in the quote from participant two in Table 2.

**3.1.3.2. High levels of stress.** Five participants identified high levels of stress as a trigger for their drop attacks. 'Stress' was the preferred word for participants to describe this feeling, although 'anxiety' was also used. For some, it was stress immediately prior to a fall which they noticed was a trigger. For others, they noticed falls were more likely during periods when they had a higher general level of stress. However, stress was not always a factor, with some falls not being linked to stress, as noted in the 'Fall even when calm' theme in Table 2. Two people who identified stress as a trigger for their falls reported that they also had falls when they were feeling calm. Another participant stated that they did not fall at all during particularly stressful periods but were more likely to have

falls in the period following this. For another participant, they had never considered the possibility of a link between stress and their falls and were unsure whether this could be a factor.

**3.1.3.3. Dissociation.** 'Detachment-type' dissociation [19] was identified as another precipitating factor. Four participants reported episodes of dissociation. In some cases, these were linked to falling (as described in quotes in Table 2), with three participants describing a sense of dissociation prior to the fall, and a further noticing a feeling of dissociation once on the floor. Three of these participants also described periods of dissociation in everyday life, for example, *"I would be sitting and talking to a friend and I would just go. And I remember talking to a friend of mine and she was going further and further back. She wasn't but she was going further and further back and I had like tunnel vision."* (P05).

**3.1.4. Maintaining factors**

Table 3 contains the themes and subthemes which fall under the maintaining factors category, along with supporting quotes.

**3.1.4.1. Worry and sense-seeking.** 'Why is this happening?'

The first of the subthemes captured by this theme was 'Why is this happening?' Participants reported having lots of questions about why this was happening to them. Despite often being given an explanation of drop attacks within a conditioned behavioural framework from their neurologist, participants did not report this explanation initially in interviews, and instead the dominant view was that nobody knows why the falls are happening. Participants talked about spending a lot of time trying to work out if there were any patterns or triggers to their falls, with the aim of trying to prevent the falls from happening. Four participants reported feelings of self-blame about the falls, thinking that it was their fault that they were happening, describing themselves as 'stupid' and 'silly'.

**Worry about falling**

Four participants described worry as being a factor, both generally in daily life, and specifically around falling. Participants also described worrying about falls becoming worse, about the potential for bad injuries, and about the impact of previous injuries on their health in the future. This worry included 'catastrophic' thinking about their falls, contemplating worst case outcomes with two people worried about death as an outcome. Two participants reported that thinking about falling made it more likely that they would fall. In some instances, participants linked not thinking about falling to having fewer falls, as described in the quotes from participant one and participant three in Table 3. However, this took the form of having something else to attend to, rather than suppressing thoughts which participants did not find to be effective.

**3.1.4.2. Emotional impact.** Embarrassment

The first of the emotional impact subthemes was embarrassment. All but one participant reported feeling embarrassed after a fall outside the house. Embarrassment was less, or absent, when falls happened within the home, and was mainly linked to falls being witnessed by other people. This theme linked to the 'trying to cope' subtheme of 'avoidance', where, due to embarrassment, participants reported going out less frequently, or trying to get out of a situation quickly after they had fallen. However, one participant reported no embarrassment when she fell, stating *"I've really never been embarrassed or anything like that about it."* (P02). She instead preferred to be in places where there were more people around, which provided reassurance.

**Low mood**

Another subtheme was low mood. Five participants described current low mood, often linked to their reduced levels of functioning due to their drop attacks, for example, *"If I try to live a more normal life, and I do at times try, I start dropping again and it's difficult."*

**Table 2**  
Themes and supporting quotes within the precipitating factors category.

Themes	Quotes
Situational triggers	P02: "If I'm in a situation like boarding an aeroplane where I've had a drop attack before then I can feel myself tensing up and thinking 'what if I do this again', which in turn probably makes it more likely that it will happen" P04: "the majority of times (the fall is) either out the back or coming down the stairs." P05: "I don't want to be in a situation where I have to worry about (falling), because that would probably just make it worse. You know, people who have stomach problems, the more you worry about it the worse it gets." P07: "(not going out is) a wee bit piece of mind. Because I've only fallen twice in the house, it's always been outside."
High levels of stress	P01: "It makes me feel anxious, because I know I've got all this happening and all this that needs to be done... but as I said I don't know if that's maybe part of why I could be falling" P02: "I know definitely that if I get anxious or stressed, that will mean I'm more likely to get an attack." P03: "I do know that if I get stressed, and I get worried about something, I'll have more falls." P06: "I've had a few (falls) but I think that's because I've been stressing myself..."
Fall even when calm	P02: "Although, ones that happen when I'm perfectly calm, I can't explain these at all." P06: "you could say reduce your stress and then it won't happen, well it still can. You can be totally stress free and standing washing your dishes and (fall)." P04: "What seems to happen is that, if I have a really stressful period, it can be not too bad, but then when the stressful period finishes, that's me."
Dissociation	P02: (describing immediately before and during a drop attack) "It's like I'm there but I'm not there. It's somebody talking not to me but to somebody else. And although I can see them and I can hear them, it's as if I'm away somewhere else if you see what I mean. It's like a sort of dreamlike situation I'm in." P05: "It's hard to separate (the falls) from the dissociation, because the dissociation comes first." P01: "You know, there's nothing going on in my head, nothing happening, when I actually fall. Even although I'm thinking this that and the other, when I actually fall, there's nothing there. When I get up again, I start thinking again."

**Table 3**  
Themes and supporting quotes within the maintaining factors category.

Themes	Subthemes	Quotes		
Worry and sense-seeking	‘Why is this happening?’	P03: “Sometimes I keep thinking why does it happen to me? Why can’t somebody else have this? Why is it me that’s got it?”		
		P06: “It’s also a lot of ‘why me’. Why did I get this? Was I a really cruel person in a previous life?”		
		P01: “I can’t put my finger on anything that would say why I’m falling.”		
		P02: “I’m trying to fathom out what I’ve been doing or what I’ve eaten or if I’ve overdone things, but I can’t find a common denominator anywhere.”		
		P04: “But it’s just like, it’s mad. How can your body just fall down without any warning?”		
		P05: “It had been years of me trying to deal with a situation that was a debilitating situation where I thought ‘what is this? Is it my fault? Am I depressed? Am I doing this to myself? You know, just beating myself up as to why this kept happening”		
		P07: “I still call myself stupid for doing it because I don’t know why I do it.”		
		P04: “Standing at the top of a flight of stairs scares the living daylight out of me. I’ll grab my husband and be like ‘take my hand’ and he says ‘you’ll be fine’ but I says ‘you dinnae know that”		
		P03: “There was a space but I kept looking at it and thinking, I’m going to fall and because I thought, I did fall.”		
		P06: “Sometimes when I do have them...I’ve been thinking about them, and I don’t know if that can bring them on”		
Emotional impact	Worrying about falling	P01: “If I’ve got something in my head to concentrate on, I might not have a fall, if that’s possible.”		
		P03: “When I’ve got (grandson), and he’s not in his pushchair and we’re talking and I’m holding his hand, I’m fine because I think I’m concentrating so much on him that I’m not thinking (about falling)”		
		P07: “I try to just say ‘oh it doesn’t worry me, it doesn’t worry me’ but I think it really does worry me. Because I’ve had a few bad ones and I don’t want to go through all that again but I just don’t know when it’s going to happen.”		
		P01 (diary): “I felt so embarrassed and it was as quick as I could get up and into my car and drove away. I then felt so stupid and glad that there was no-one around.”		
		P03: “The thing that I worry about is the embarrassment of falling. It’s got to the stage now I don’t care how bad it is after I’ve fallen, it’s just the fact that I’ve fallen and people see me.”		
		P05: “Yeah when someone is helping me and then I’m just mortified and I’m embarrassed because I’ve fallen over.”		
		P07: “You do feel embarrassed. I don’t think anybody saw me, that time. But you do feel embarrassed, even though you’re just by yourself.”		
		Low mood	P04: “there was one stage when, not for a wee while, but one stage when I was like ‘what’s the point? What’s the point in going on anymore?”	
			P07: “I just can’t be bothered. Just feeling on a wee bit of a downer.”	
		Trying to cope	‘Just get on’	P06: “(I) don’t want to see anyone, don’t want to do anything.”
P02: “I’m not going to stop going on holidays or doing anything because of it because I feel it would be taking control of me then. So you’ve just got to accept it and just carry on.”				
P03: “I go on holiday, I travel a lot and I travel myself as well. I travel all over the world. But I still fall. But I don’t want it to stop me going because, it’s a case of if I don’t go I’m actually giving in to this and I don’t want this to happen.”				
Avoidance	P03: “Even when I go on holiday, when I’m on the flight, because it’s long flights, I won’t even get up to go to the toilet, because I’m terrified I’m going to fall.”			
	P04: “Unless I’m going with somebody, I don’t feel secure going somewhere different. And if it’s somewhere I’ve never been before, I’m not going, definitely not.”			
Pain and injury				P07: “If I’ve nothing to do, well what’s the point (in going out). And that’s a wee bit piece of mind. Because I’ve only fallen twice in the house, it’s always been outside.”
				P06: “I think that is why I tend not to go out and do things. Just in case. Even though now I know what (the falls) are, I don’t really want to have them in public.”
				P01: “It felt as though my back was broken. I got a really excruciating pain.”
				P02: “The worst I’ve had is cracked ribs when I fell on my wooden floor in the house. Apart from that, a bump on the head or something.”
				P03 (diary): “(I) fell against the toilet bowl hit my ribs, hip, shoulder and neck. Also broke my front teeth and couldn’t breathe for a bit. Had to go to hospital.”
		P04: “the amount of times I’ve been in A&E with concussion it’s just unbelievable.”		

(P05). Drop attacks impacted on areas of independence, occupation and caring for children and grandchildren: “After I had been in the (hospital) and stuff, my work wouldn’t take me back because they weren’t insured to have me in the building.” (P04). Some had experienced times where they felt that their quality of life was so poor that they did not feel life was worth living.

3.1.4.3. *Trying to cope. ‘Just get on’*

Two subthemes were identified within this theme: ‘just get on’ and ‘avoidance’, with most participants engaging in both contrasting behaviours. Six participants reported that one approach they took towards their drop attacks was to ‘just get on’. For some this was a feeling of being resigned to having to cope with drop attacks being a part of their lives, and for others this was more a defiance that they were going to carry on regardless. However, despite trying to manage the impact of drop attacks on their lives, all partic-

ipants still made adjustments to their lives to help them to live with the falls.

Avoidance

Five participants reported avoiding certain situations, either due to fear of the response of others, or due to the fear of injury. This included social situations, particular locations such as supermarkets, and places within the home where risk was deemed to be higher, such as the shower. Two participants also stated that they would avoid standing or walking when they felt unsteady, despite this not often being a sensation that they would feel prior to a fall.

3.1.4.4. *Pain and injury.* All participants discussed sustaining injuries as a result of falls, with injuries to the face and knees most common. Although some participants reported significant injuries, such as broken bones, this was not a frequent result of a fall. One participant who could experience several falls a day, mentioned

that she was unsure how she had not been more severely injured, considering she had fallen down the stairs multiple times, stating “I’ve never broke a bone. . . I don’t understand how I’ve never broke a bone” (P04).

Participants reported that they were not usually injured after every fall, but that existing injuries could make falls more painful. When they were not injured, participants recovered quickly, and were able to get up off the floor immediately after a fall. Participants did not lose consciousness, however, for two of the participants who experienced dissociation around a fall, they stated that they needed longer to recover, for example, “if I’m on the ground, nobody could have hauled me up because I think that would have made me worse. So what I say to people is if I do drop, just leave me and I’ll come round in my own time.” (P02).

### 3.2. Emergent theory

The proposed grounded theory model of the links between themes and categories is displayed in Fig. 3. The links reported are based on those made by participants in interviews and diaries, however, experiences varied between participants, so not all factors will be relevant for all individuals or for all falls. The experiences that the participants reported were shaped by the research questions which were designed to elucidate potential predisposing and precipitating factors, along with thoughts, feelings and behaviour around drop attacks. The model therefore uses these as a framework to group themes, although it is acknowledged that this may introduce bias into the interpretation.

The proposed theory is that individuals initially had an experience of a traumatic fall, which appeared to arise due to another identifiable medical reason or a mechanical fall. The increased stress around this, either due to the stress of the fall, or the stressful life situation that this happened within, led to excessive attentional focus on the understandable belief that falls are dangerous or to be feared. The impact of previous life stressors, particularly those around the period of onset, may have also influenced the development of drop attacks, by raising stress levels more generally.

We propose that there is a maintenance cycle for ongoing drop attacks, whereby external triggers for drop attacks, such as being in a place where a fall has happened before, and/or internal triggers such increased worry about falling, or general heightened anxiety, lead to higher levels of stress. Individuals have thoughts of ‘why is this happening?’ and increasingly worry about falling. Stress levels and physical arousal become elevated, increasing the risk of a drop attack occurring. Falls frequently result in injury, pain, embarrassment and/or dissociation. This in turn serves to reinforce worries about falling, and leads to rumination about factors that may be causing the falls.

Individuals with drop attacks may try to cope with their falls by avoiding places where they feel they are likely to fall, or where the risk of injury from falling is higher. Some also avoid social situations due to the potential for embarrassment. However, the impact this has on their daily functioning contributes to low mood. They also experience increased stress when they cannot avoid ‘risky’ situations, further increasing the likelihood that they will have subsequent falls. In contrast, another approach to the falls is to ‘just get on’. However, it appeared from our sample that this approach was only taken in certain aspects of life, such as continuing to travel abroad, with all participants making some adjustments to their lives due to drop attacks. For some, ‘just get on’ manifested as resignation to the changes they felt they had to make to reduce their falls.

## 4. Discussion

### 4.1. Integration of findings to existing literature

Overall, our model has significant overlap with a previously hypothesised understanding of drop attacks as a conditioned behavioural response [5]. In this previous model, a mechanical fall or syncope was highlighted as a precipitating factor, and internal and external triggers were outlined, such as high anxiety and specific situations. Maintaining factors were also described, such as avoidance.

There is also considerable overlap between the model outlined in our study, and those in the functional symptoms literature, in particular those relating to functional seizures. The fear-avoidance model of functional seizures, as reported in a recent paper outlining different theoretical understandings [20] provides a CBT framework used to inform CBT interventions [e.g. 21], and overlaps significantly with our proposed theory. This model also outlines catastrophic thinking, fear of seizures, avoidance, and reduced functioning as important maintaining factors. A more recent cognitive model of functional seizures also highlights the role of internal and external cues as precipitating factors, as in our model [22].

A cognitive behavioural model of functional disorder more generally [23] describes a maintenance cycle where a lack of understanding or explanation for symptoms increases anxiety and attention to symptoms, which become paired through classical conditioning. Avoidance of triggers for symptoms feeds into an operant conditioning cycle of further sensitisation. This in turn becomes a vicious stress maintenance cycle of increased stress and physical symptoms, avoidance and selective attention.

In our study either a mechanical fall or medical event was reported as the first fall for individuals. Hoeritzauer et al. [5] proposed that, in individuals who are vulnerable to developing drop attacks through biological or biopsychosocial factors, an event such as a mechanical trip or fall, or an experience of syncope, can act as a triggering event. Worry about this then leads to a cognitive representation of drop attacks. This is in agreement with a recent perspective on functional symptoms outlined by Van den Bergh and colleagues [24], based on a review of the functional symptom literature. The authors suggest that functional symptoms are a set of perceptions, based on the brain’s interpretation of information from the body, which is guided by past experience. A cognitive representation of a symptom, which is preconscious in nature, is activated when certain triggers are present, such as physiological stress. This fits with our model, where an experience of one or more falls may have led to the expectation of falling within certain conditions. The idea of a functional disorder developing as a result of a similar physical experience has been highlighted previously [25], for example, with motor or sensory symptoms often being preceded by an injury [26,27] or persistent postural-perceptual dizziness (PPPD) being precipitated by a defined vestibular disorder such as vestibular neuronitis [28,29].

Overall, although there are factors within our model that would be present in those with recurrent mechanical falls, such as avoidance and embarrassment, there are also elements which highlight this as a potential form of FND. Dissociation was a significant theme in our study and is also central to functional seizures. Goldstein and Mellers [30] proposed a model of functional seizures where seizures are described as a dissociative response to arousal, despite a lack of reported general anxiety, with avoidance as a key maintaining factor. This fits within our model and may also help to explain drop attacks which occur without a subjective feeling of stress.



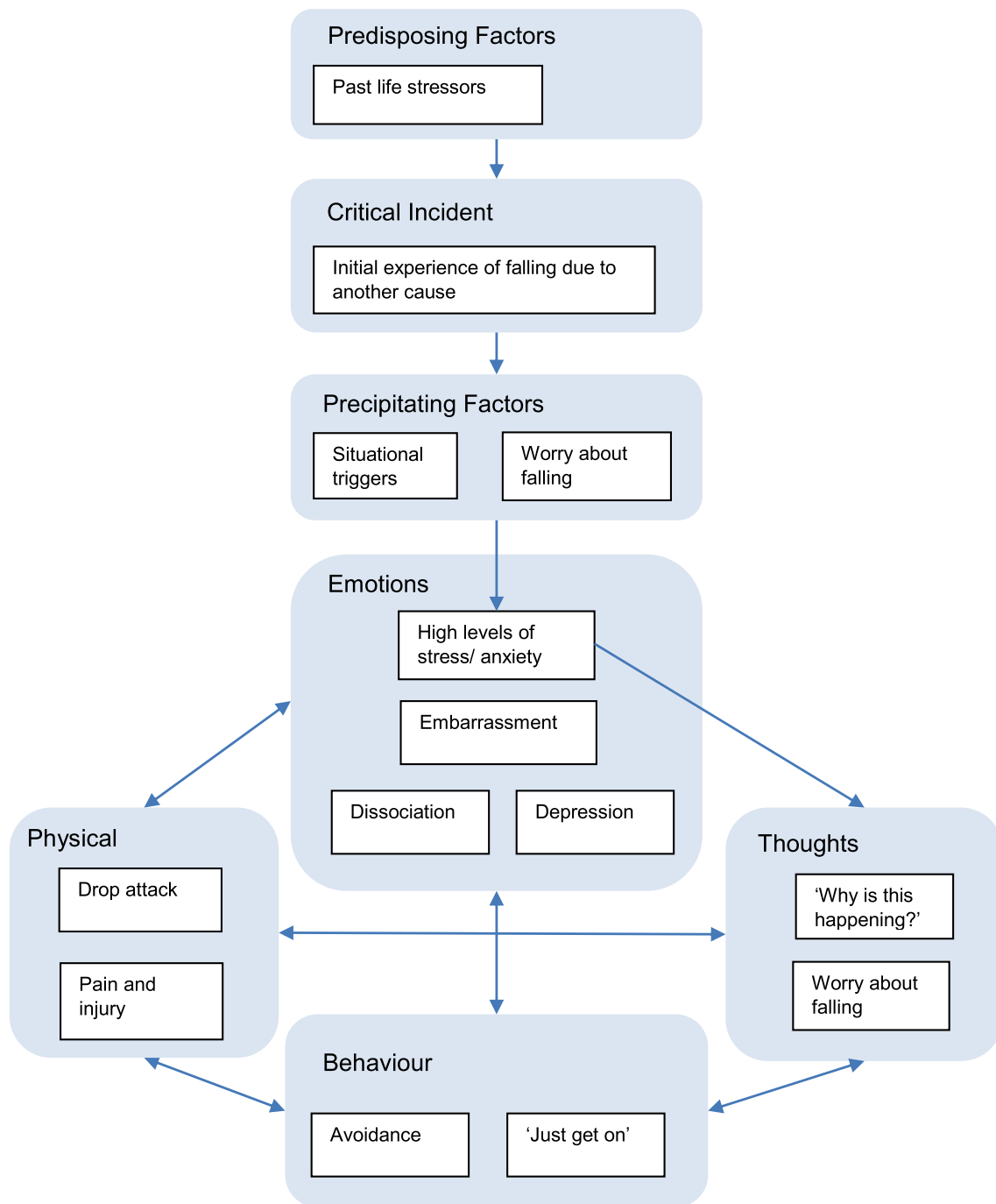


Fig. 3. Grounded theory model of idiopathic drop attacks.

Therefore, along with existing clinical data to support clinical overlap of idiopathic drop attacks with FND, our cognitive behavioural model of drop attacks is also compatible with FND, with particular overlap with models of functional seizures. Instead of showing prescriptive pathways, the model acts as a framework to help to make sense of individuals' experiences, as with other cognitive behavioural models of functional symptoms [23].

4.2. Methodological limitations

Participants were recruited from the clinic of a single neurologist with a special interest in FND, and who often explained drop attacks to patients within a conditioned behavioural framework.

To assess possible bias from this, participants were asked what their neurologist's understanding of their drop attacks was. It transpired that participants had not fully taken on this understanding, and instead their belief was that nobody knew why the falls are happening. However, this potential bias was also held in mind throughout analysis, and particular care was taken to look for codes and themes which were contrary to this.

Our study included a small sample, although it was homogeneous, and theoretical saturation was approached, with no new key themes identified in the final two interviews. Although only three of the participants were able to provide diary data (with two others agreeing to keep diaries but not experiencing any drop attacks in the follow-up period), these data were analysed along

with interview content and served to enrich the results. A study with a larger sample would be required to explore any differences between themes in interviews and diary data.

Recruitment was carried out in a systematic way but it is possible that those who were willing to engage with a psychology research study may not be representative of most of those who have drop attacks, given that those with FND are often reluctant to engage in psychological treatment [31]. However, only one participant who was approached stated that she was not willing to take part due to previous negative experience of psychology services.

The demographics of our sample fit with those in previous studies of drop attacks [1,5], but there are others who experience falls who were not captured in this sample, such as men and younger women. Although onset was at a younger age for many participants, their beliefs, contributing factors and life circumstances may have changed significantly and will not be captured in this data. A larger sample would be required to explore this further.

#### 4.3. Clinical implications and future research

This research may help to aid formulation and treatment planning in clinical settings. If a cognitive-behavioural model fits with an individual's symptoms, it may be that a CBT approach could be beneficial for them. Given the significant overlap between functional seizures and drop attacks, understanding and formulating drop attacks as a form of functional seizures may be beneficial in terms of understanding and treating them. As the unpredictability of drop attacks appeared to increase worry about falling, giving patients a clear formulation of their falls could help to begin to reduce their worry and anxiety about them, and encourage them to make behavioural changes to reduce their avoidance and improve their daily functioning.

Randomised controlled trials of CBT for functional seizures have shown positive results, reducing seizure frequency and improving daily functioning [12,32]. The CODES trial, a recently completed large multicentre randomised controlled trial, found that although CBT combined with routine medical care did not reduce seizure frequency, participants who received CBT did report less distress, better quality of life and better psychosocial functioning [13]. These interventions provide education about functional seizures and use CBT techniques to help patients to identify triggers, address thoughts and illness beliefs, develop coping strategies for life stressors, engage in avoided activities, learn seizure control techniques and address low self-esteem, low mood, or anxiety. These techniques would all be relevant within our proposed theory of drop attacks.

It would be beneficial for future research to further explore the spontaneous resolution that some individuals experience and identify factors which potentially contribute to this. This could help to determine optimum treatment approaches. Future research should also focus on identifying individuals who were not included demographically in this sample, such as men and younger women, to see whether their experiences also fit with our model.

#### 4.4. Conclusion

Idiopathic drop attacks for many people may be best understood as a subtype of FND. Our theory shows significant overlap with cognitive behavioural models of functional seizures and other functional symptoms such as leg weakness, and suggests that formulation and treatment within this model may be appropriate for those experiencing idiopathic drop attacks.

#### Ethical Statement

Ethical approval was granted by the South Yorkshire Research Ethics Committee (Reference: 17/YH/0438) and the NHS Lothian Research and Development Office (Reference: 2017/0335). The study protocol was registered with Clinicaltrials.gov (Reference: NCT03694769).

Participants gave written informed consent, and data were anonymised as soon as possible following collection. Every precaution has been taken to ensure all data has been anonymised prior to submission for publication.

This manuscript has not been published, or submitted for publication, elsewhere.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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