Sleep Medicine 104 (2023) 105–112

Contents lists available at ScienceDirect

Sleep Medicine

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

Isolated sleep paralysis: Clinical features, perception of aetiology, prevention and disruption strategies in a large international sample☆

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ARTICLE INFO

Article history:
Received 19 July 2022
Received in revised form
17 January 2023
Accepted 26 February 2023
Available online 2 March 2023

Keywords:
Isolated sleep paralysis
Parasomnia
REM-Sleep disorder
Sleep disturbances
Sleep-wake disorder

ABSTRACT

Study objectives: Isolated sleep paralysis is a benign but frightening condition characterised by a temporary inability to move at sleep onset or upon awakening. Despite the prevalence of this condition, little is known concerning its clinical features, associated demographic characteristics, and prevention as well as disruption strategies.

Methods: An online cross-sectional study was conducted. The sample comprised 3523 participants who had reported at least one lifetime episode of ISP and 3288 participants without a lifetime episode. Participants answered a survey including questions about sleep quality, sleep paralysis, and sleep paralysis prevention/disruption techniques.

Results: A total of 6811 participants were investigated (mean age = 46.9, SD = 15.4, age range = 18–89, 66.1% female). Those who reported experiencing ISP at least once during their lives reported longer sleep onset latencies, shorter sleep duration, and greater insomnia symptoms. Females (vs. male) and younger (vs. older) participants were more likely to experience ISP. Significant fear during episodes was reported by 76.0% of the participants. Most people (63.3%) who experienced ISP believed it to be caused by 'something in the brain'. A minority endorsed supernatural causes (7.1%). Five prevention strategies (e.g., changing sleep position, adjusting sleep patterns) with at least 60.0% effectiveness, and five disruption strategies (e.g., physical/bodily action, making noise) with varying degrees of effectiveness (ranging from 29.5 to 61.8) were identified through open-ended responses.

Conclusions: ISP is associated with shorter sleep duration, longer sleep onset latency, and greater insomnia symptoms. The multiple prevention and disruption techniques identified in this study support existing treatment approaches and may inform subsequent treatment development. Implications for current diagnostic criteria are discussed.

1. Introduction

Sleep paralysis (SP) is a parasomnia characterised by a temporary immobility that occurs during sleep onset or upon awakening [1]. During these episodes, individuals remain aware of their surroundings and can open their eyes, despite the momentary inability to speak or move their muscles. Extreme fear reactions and hypnagogic and hypnopompic hallucinations (i.e., seeing, hearing, and feeling things that are not there) sometimes accompany these episodes [2]. SP is a component of narcolepsy – a neurological disorder [3], but it can also occur independently of the condition [4]. SP occurring outside of narcolepsy is referred to as *isolated* sleep paralysis (ISP) [5], and SP episodes involving clinically significant levels of fear have been termed fearful ISP [6]. Individuals who experience recurrent episodes of ISP and significant clinical distress may meet criteria for the disorder of recurrent ISP [1]. More stringent clinical criteria have also been developed for use in

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https://doi.org/10.1016/j.sleep.2023.02.023

research (i.e., *fearful recurrent isolated sleep paralysis*) which include frequency thresholds (i.e., at least two fearful ISP episodes in the past six months) and the presence of either clinically-significant distress and/or impairment [6,7].

While a benign phenomenon on its own [8], there is often a lot of fear and anxiety surrounding SP [5]. For example, of 635 college students who had experienced SP in Japan, 60% reported feelings of anxiety and terror during an episode [9]. Subsequent research has reported associations between anxiety, stress, and SP episodes [10,11]. A systematic review including 36,533 participants found that 7.6% of the general population experienced at least one episode of SP [4]. However, prevalence rates vary by population [12], with higher levels in rural (vs. urban) areas [13], in students (28%), and clinical populations (32%) [4]. Racial disparities regarding SP frequency have also been noted, with African American participants reporting more recurrent SP than White participants [14]. To further understand population disparities, more research is needed to document prevalence rates by demographics as well as to extend knowledge of other clinical features of SP including fear and clinical distress.

SP can be associated with various negative factors, including psychological stress [15], sleep deprivation, erratic sleep schedules [10] and other sleep disturbances [16,17]. Sleep difficulties can serve as predisposing factors that may make SP episodes more likely to occur [18] or can be a consequence of the phenomenon in other cases [19]. Replication of the associations between psychological difficulties, sleep disturbances and SP will strengthen existing evidence, contributing to the development of sleep science.

1.2. Perceptions of aetiologies

SP episodes appear to constitute a mixture of waking consciousness and two aspects of rapid eye movement (REM) sleep (i.e., muscle atonia and dream imagery) [1,20]. However, some sufferers explain their symptoms as something supernatural or extraordinary, whether it be a result of aliens, spirits, or ghost visits [20,21]. In Egypt for example, SP is conceptualised as a "jinn attack" – a supernatural creature that assaults, and in many cases murders its victims [22]. Similarly, many people experiencing SP in China believe it is ghost oppression [10]. It is unclear to what extent these beliefs are held in those experiencing SP, and future research is needed to assess this in order to understand the relationships between them.

1.3. Preventing/coping with SP

Given that so many sufferers find SP episodes upsetting and frightening, it is surprising that there are very few well-established treatment options [23]. One relatively small (N = 156) study catalogued methods used by those affected to both prevent and disrupt ISP episodes and document their perceived effectiveness. Methods of preventing SP include changing sleep positions and patterns as well as the use of various relaxation techniques. Attempting to move extremities and smaller body parts (e.g., fingers and toes) as well as trying to "calm down" in the moment were reported to be the most effective disruption techniques [7,24]. These methods were combined with existing treatment methods for insomnia and nightmare disorder to formulate a manualised, short-term treatment termed cognitive-behavioural therapy for ISP (CBT-ISP) [25]. However, given the paucity of evidence, further research on this topic is clearly of value.

Research has come a long way in terms of pinpointing factors associated with SP [15], however, less is available in the literature about ISP, and basic questions remain. To extend the literature to date, the specific aims of this paper were to understand more about ISP in terms of:

1. Clinical features: we examined prevalence rate by demographics, assessed fear and clinical distress/impairment associated with ISP, and attempted to replicate associations between psychological difficulties, sleep disturbances and ISP.
2. Perception of aetiology: We examined self-reported perceptions about the aetiology of ISP.
3. Prevention/coping strategies: We attempted to replicate self-reported prevention and coping strategies and the perceived effectiveness (according to the person experiencing ISP) of these different approaches.

2. Methods

2.1. Procedure

The current study was initiated by the BBC *Science Focus Magazine*. Ethical approval for this research was given by Goldsmiths, University of London. Those who provided informed consent and were at least 18 years old were eligible for participation. Participants were made aware that their anonymised data could be widely available once published and that withdrawal of responses would not be possible once they had completed the survey. Informed consent was obtained online if the participants agreed to all of the points stated by checking boxes associated with each. All identifying information was stored in a password-protected file which is only available to authorised parties. No identifying information was stored with the password-encrypted response data file. UK nationals could enter a prize draw to receive gift cards. The survey took approximately 15–20 min to complete. Pre-registration for this study was submitted (osf.io/6qv78/).

2.2. Participants

Those who clicked on the survey link but supplied no other data were assigned a participant ID number and identified by the survey platform as an incomplete case. No data was collected from these participants. Out of the 6881 participants who completed the screening question for SP, 3593 (52.2%) reported experiencing SP at least once during their lifetime. As our primary interest is in ISP, we excluded data from participants with diseases and disorders with potentially overlapping symptoms (e.g., narcolepsy, schizophrenia, cataplexy). The final number of those reporting at least one ISP episode was 3523 (51.7%) (see Fig. 1 for detailed description of participant flow and exclusions).

2.3. Questionnaire items

2.3.1. Sleep variables

Sleep efficiency, the ratio between sleep duration and the total time dedicated to sleep in bed expressed as a percentage, was measured using three items from the well-validated and reliable *Pittsburgh Sleep Quality Index* (PSQI) [26]. Severity of insomnia symptoms was measured using items from the Insomnia Severity Index (ISI) [27] which has shown good reliability and validity [28]. In our survey, our first item *("Please rate your overall difficulties sleeping (i.e., falling asleep, staying asleep or waking up too early) in the past two weeks")* summarised three items regarding sleep difficulties from the ISI. In addition, two other items (i.e., interference and sleep satisfaction) from the ISI were used. Responses for each item used different wordings but all ranged from 1 (indicative of no problem) to 5 (indicative of a very severe problem). Together, all three items showed a Cronbach's alpha of .89. The overall range of

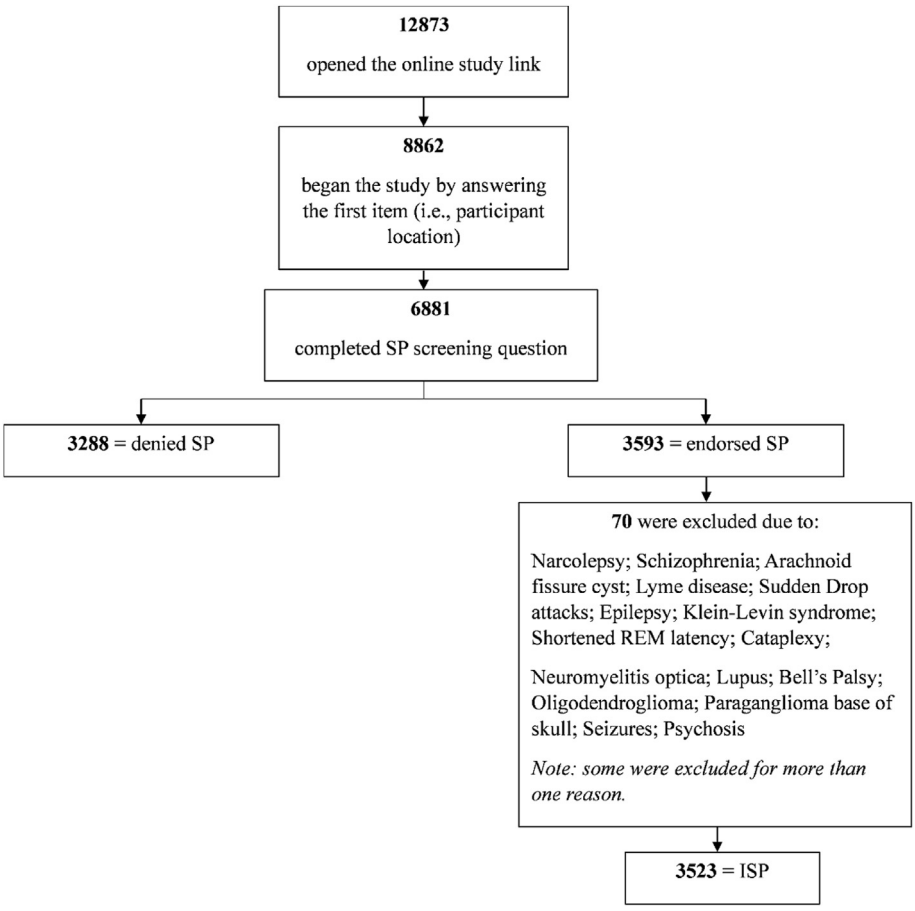

Fig. 1. Participant flow and exclusions
Note. SP = sleep paralysis; ISP = isolated sleep paralysis.

scores for the current study was 3–15, higher scores reflecting greater insomnia symptoms.

2.3.2. ISP and ISP-related questions

ISP was assessed using 11 items adapted *the Fearful Isolated Sleep Paralysis Interview (FISPI)* [6], which assesses ISP symptoms based on the *International Classification of Sleep Disorders – Third Edition criteria* (AASM, 2014) [1]. An example of an item is "*Have you ever had periods of time when you were going to sleep or waking up and found yourself unable to move (like you were paralysed)?*". The response options ranged from "Never" to "Several times a week".

Participants who reported experiencing ISP also reported their fear levels during episodes as well as their levels of distress, and interference in daily life as a result of ISP episodes via questions such as *"How afraid are you during a typical episode of this paralysis?*". Scores ranged from "No fear" (i.e., 0) to "Very severe fear" (i.e., 4). They were also asked fixed choice questions about their perceived aetiologies of ISP (e.g., '*What do you think causes you to feel paralysed?*') with possible answers: medication side effects, something in the brain, stress, electronic equipment, something supernatural, other, and don't know.

2.4. Qualitative data

Participants were also asked open-ended questions about the perceived aetiologies of their ISP and could list up to four prevention as well as disruption strategies, and their perceived effectiveness (0–100%). Responses were coded using conventional content analyses without imposing preconceived categories as well as a priori consensus procedures (see Sharpless, Denis et al., 2020). This process was repeated to explore sub-themes. Coding was conducted by six students under the supervision of a psychology researcher (RP) with experience in qualitative procedures. Inter-rater agreement was good (Kappa = .81). To maintain the independence of responses (i.e., preventing the possibility that multiple responses given by the same respondent were analysed as belonging to a single strategy which may skew results), qualitative data were analysed separately for each response given. Responses that were coded as reflecting multiple strategies were removed to enhance the validity of the analysis.

2.5. Statistical analysis

All analyses were performed using IBM SPSS Statistics (Version 27). When making scales, we did not use data replacement strategies given the large sample size. This means that where data were system missing for an item within a scale, the participant did not have a scale score. Elsewhere, all data were used unless otherwise stated. Given the large sample size, the variables were considered to be distributed approximately normally if skewness and kurtosis were between −2 and +2 SD, as recommended by George [29]. Consequently, parametric analyses, including independent *t*-test and Chi-square tests were conducted. Non-parametric analyses were used when parametric assumptions were violated. Sensitivity analyses removing outliers were conducted and the results remained within negligible variation (less than 1%). Therefore, we present results from the full dataset.

3. Results

3.1. Descriptive statistics

Participants (N = 6811) resided in the UK (81.4%), the US (6.4%), and different countries in Europe (6.1%). They identified as White (92.1%), followed by mixed ethnic groups (2.6%), and Asian (2.0%). Ethnicity was further dichotomised into those who identified as White (93.6%) and non-White (6.4%) for analytic purposes. The mean age for the entire sample was 46.9 years (*SD* = 15.4; *range* = 18–89). Females made up 66.1% of the entire sample. Of the 3523 participants who had reported at least one ISP episode, most of them where White (91.3%), mixed ethnic groups (4.2%), and Asian (2.9%), dichotomised into White (90.3%) and non-White (9.7%). The mean age was 42.4 years (SD = 14.6; range = 18–86), and 68.5% were female.

3.2. Demographic differences

Non-white participants were more likely to report ISP than White participants (78.2% vs 49.7%; $\chi^2(1, N = 6698) = 130.0$, $p < .001$, Cramer's $V = 0.14$). Females were more likely to report ISP than males (53.0% vs 48.6%; $\chi^2(1, N = 6746) = 11.8$, $p = 001$, Cramer's V = 0.04). Participants reporting ISP were younger ($M = 42.4$ years, $SD = 14.6$) than those who did not ($M = 51.7$ years, $SD = 14.7$), $t(6809) = 26.1$, $p < .001$, Cohen's d = 0.63).

3.3. ISP frequency, fear, distress, and impairment

ISP distribution is shown in Fig. 2. Out of 3496 participants who reported their fear levels during ISP episodes, 76.0% ($N = 2657/3496$) experienced clinically significant (i.e., moderate or above) levels of fear, indicating at least one fearful ISP episode. Of the ISP sample who reported their fear levels, 27.6% ($N = 966/3496$) also met criteria for recurrent fearful ISP (RFISP) based on a combination of the frequency of episodes as well as the presence of clinically significant distress as a result of episodes and/or impairment. Of note, clinically significant levels of interference were reported in 47.0% of individuals with RFISP ($N = 454/966$), but only 1.9% met RFISP criteria based on interference alone ($N = 18/966$; i.e., without the presence of significant distress; see Sharpless & Doghramji, 2015, Chapter 11 for diagnostic criteria). Correlation analyses indicated that an increased frequency of episodes was associated with higher distress (Spearman Rank-Order Correlation; (rs (3474) = 0.30, $p < .001$), greater fear (rs(3496) = 0.14, $p < .001$) and interference with life (rs (3464) = 0.40, $p <. 001$).

3.4. Sleep and ISP

Participants who reported ISP reported longer sleep onset latencies ($M = 31.2$ min, $SD = 32.7$) over the past month than those who did not ($M = 25.6$ min, $SD = 31.6$) ($U = 3340174.0$, $p < .001$, effect size $r = 0.13$). Similarly, those reporting ISP had shorter sleep durations ($M = 6$ h and 48 min, $SD = 1$ h and 10 min) than those who did not ($M = 6$ h and 53 min, $SD = 1$ h and 9 min) ($t(5937,233) = 2.8$, $p = .005$, Cohen's d = 0.07). Insomnia symptoms as measured by the ISI were greater in ISP participants ($M = 8.6$, $SD = 3.0$) than non-ISP participants ($M = 7.6$, $SD = 3.0$) ($t(6769) = -13.2$, $p < .001$, Cohen's d = −0.32). There were no statistically significant differences in sleep efficiency between those with ISP ($M = 84.4$, $SD = 13.0$) and those without ($M = 84.3$, $SD = 12.7$; $p = .732$).

3.5. Self-reported aetiologies

Of those reporting ISP, 98.6% ($N = 3474$) provided possible causes for the condition. The most common answers about aetiology were: “something in the brain” ($N = 2198$; 63.3%), “stress” ($N = 1373$; 39.5%), “medication side effects” (N = 262; 7.5%), “something supernatural” ($N = 245$; 7.1%), and “electronic equipment” ($N = 36$; 1.0%).

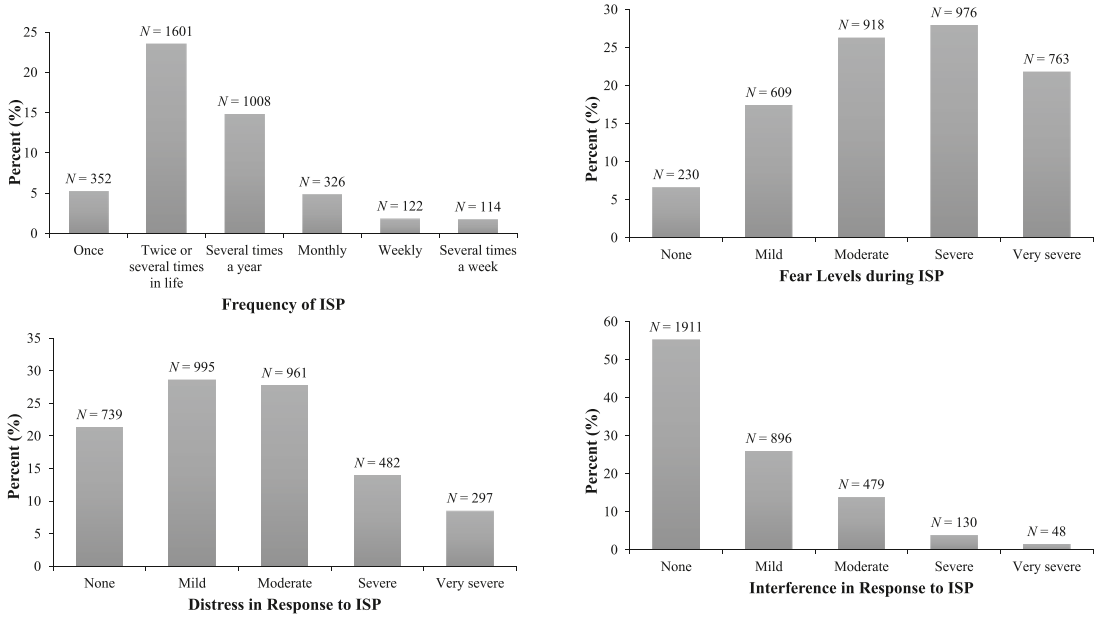

Fig. 2. Distributions of ISP Frequency, Distress, Fear, and Interference
Note. ISP = isolated sleep paralysis. *N* = number of participants in each group. Only individuals reporting ISP are included in the figures. Interference in response to ISP refers to daytime interference because of ISP.

3.6. Prevention strategies

The five most common ISP prevention strategies reported by participants and their perceived effectiveness are displayed in Table 1. Overall, the five prevention strategies had mean perceived effectiveness ratings of above 60.0%. An attempted internal replication of these findings can be found in Supplementary Tables S1 and S2. Through replication, the same strategies were identified in the second (all five strategies) and third (four strategies) responses, and perceived effectiveness for all techniques also had mean ratings of at least 60.0%. The most common strategies using the second and third responses were among those identified using the first response. Their perceived effectiveness also had overall mean ratings of at least 60.0% apart from two strategies (adjusting sleep environment and using/refraining from substances) in the 3rd response. There was a significant association between ISP frequency and the utilisation of prevention techniques, ($\chi^2(5, N = 3500) = 378.3$, $p < .001$, Cramer's $V = 0.33$), indicating that people reporting more episodes were more likely to take steps to prevent their episodes (see Supplementary Table S3 for detailed results).

3.7. Disruption strategies

The five most common ISP disruption strategies and their perceived effectiveness are listed in Table 2. Most participants used techniques that involved physical/bodily action, noises, and arousal of the brain (i.e., physical action e.g., get out of bed, wake up, move body). The overall mean effectiveness ratings varied, with only two strategies (contextualisation and breathing) being rated as over 50.0% effective. The remaining disruption strategies had mean effectiveness ratings between 29.5 and 43.1%. Replication revealed that the second and third responses included approximately the same strategies identified using the first response, although perceived effectiveness was lower for all strategies. There was a significant association between ISP frequency and the utilisation of disruption techniques, ($\chi^2(5, N = 3472) = 428.9$, $p < .001$, Cramer's $V = 0.35$). In general, results indicated that people reporting more episodes were more likely to take steps to disrupt their episodes (see Supplementary Table S4).

4. Discussion

The present study aimed to further our understanding of ISP, its perceived aetiologies, clinical features, demographic characteristics, and common prevention/disruption techniques. Overall, we found that sleep disturbances, fear, distress, and daily life interference were highly prevalent in our sample of people reporting ISP. Moreover, common ISP prevention and disruption techniques were raised by the experiencers. Findings obtained here have potential diagnostic implications.

Participants who reported at least one episode of ISP reported poorer sleep quality as compared to those who did not. Further, those reporting ISP had a longer sleep onset latency, shorter sleep duration and greater insomnia symptoms compared to those not reporting ISP. Importantly, the effect size for insomnia symptoms was 0.3, suggesting a particularly meaningful relationship between ISP and insomnia symptoms which may have clinical significance.

Table 1
Most common ISP prevention strategies, their perceived effectiveness, and category sub-themes.

Strategy used	Examples	*n* (%)[a]	Perceived effectiveness[b] M (SD)
1st response $n = 839$			
Sleep position		**254 (30.3)**[c]	**74.60 (27.84)**
Avoid sleeping on back	"Never sleep on my back"	117 (47.4)	78.28 (25.18)
Sleep on (unspecified) side	"Sleep on side"	66 (26.7)	70.06 (30.08)
Change position (exc. elevated position)	"Change sleep position"	13 (5.3)	50.77 (34.33)
Sleep patterns/tiredness		**151 (18.0)**[d]	**77.09 (24.46)**
Sleep regularly	"Regular sleep pattern"	43 (28.9)	79.95 (21.50)
Avoid naps	"Don't take naps"	40 (26.8)	87.98 (18.37)
Avoid being overtired/sleep deprived	"Avoid sleep deprivation"	19 (12.8)	74.95 (24.66)
Adjust environment		**77 (9.2)**[e]	**61.70 (34.93)**
Increase light/illumination	"Light on"	29 (38.2)	59.90 (36.23)
Sleep location	"Not sleep in an enclosed space"	9 (11.8)	76.11 (24.47)
Decrease temperature	"Remove duvet to cool down"	8 (10.5)	74.25 (23.52)
Substances		**54 (6.4)**[e]	**79.33 (25.38)**
Increased alcohol	"Drink alcohol, often to excess"	7 (13.2)	85.00 (25.33)
Decreased alcohol	"Limit alcohol consumption when going out"	7 (13.2)	80.00 (17.32)
Increased non-sleep medication	"Anti-anxiety medication"	7 (13.2)	92.00 (10.63)
Resisting falling asleep/wakeup		**44 (5.2)**	**69.88 (34.84)**
Wake up (unspecified)	"I try to wake up"	24 (54.5)	66.65 (38.93)
Avoid going back to sleep	"Try not to fall asleep again after the episode"	9 (20.5)	66.11 (31.00)
Get up	"Get up if I'm unable to sleep and do something else rather than lying there for hours"	7 (15.9)	89.29 (10.96)

Note. ISP = Isolated Sleep Paralysis; M = Mean; SD = Standard deviation. This table presents the most common prevention strategies in the first response in which $n > 5$ (to avoid emphasising multiple categories endorsed by very few). Primary analysis outcomes are presented by order of frequency of response in bold followed by the three most common secondary analysis outcomes where applicable (n > 5). For example, in the 1st response, the prevention technique "sleep position" was identified in the primary analysis and its subthemes (e.g., avoid sleep on back) were identified in the secondary analysis. Perceived effectiveness ranges from 0 to 100, with higher ratings indicating higher perceived effectiveness of technique.

[a] Refers to % out of subsample per response (in rows in bold) or to % out of subsample per sub-theme.
[b] Assessed as perceived % of time the technique works.
[c] In the secondary analysis, seven cases that were coded as reflecting multiple prevention strategies were removed.
[d] In the secondary analysis, two cases that were coded as reflecting multiple prevention strategies were removed.
[e] In the secondary analysis, one case that was coded as reflecting multiple prevention strategies was removed.

Table 2
Most common ISP disruption strategies, their perceived effectiveness, and category sub-themes.

Strategy used		Examples	*n* (%)[a]	Perceived effectiveness[b] M (SD)
1st response $n = 1694$				
Physical/bodily action			**744 (43.9)[c]**	**43.10 (39.96)**
Move (unspecified)		"Desperately try to move"	337 (48.4)	30.33 (38.04)
Move/wiggle fingers/hands		"Focus and try to move right index finger"	73 (10.5)	55.07 (35.94)
Move/wiggle toes/feet		"Try to move toes"	69 (9.9)	64.39 (33.60)
Make noise			**246 (14.5)[d]**	**29.53 (39.28)**
Scream		"Force myself to scream"	148 (62.7)	27.40 (37.87)
Call out/cry out (inc. for help)		"Cry out"	45 (19.1)	19.82 (34.29)
Speak		"Try to speak or ask for help"	25 (10.6)	32.64 (45.50)
Wake up/rouse the brain			**192 (11.3)[e]**	**42.66 (37.69)**
Force oneself awake/tell self to wake	up/arouse mind	"Convince myself to wake up"	176 (92.6)	39.86 (36.74)
Stay awake		"I don't go back to sleep"	7 (3.7)	82.86 (31.47)
Contextualisation				
Rationalisation			**133 (7.9)[f]**	**53.37 (35.44)**
Focus on object/body		"Explain to myself that I'm sleeping"	120 (90.9)	52.15 (35.13)
parts etc		"Focus on something in the room to bring myself back"	5 (3.8)	70.00 (44.72)
Breathing			**72 (4.3)[g]**	**61.82 (38.61)**
Breathing exercises		"I focus on my breathing"	38 (55.1)	57.66 (37.32)
Breathe deeply/heavily/slowly		"Deep breathing exercises"	15 (21.7)	60.33 (35.98)
Breathe rapidly		"Breathe quicker"	5 (7.2)	96.0 (8.94)

Note. ISP = Isolated Sleep Paralysis; M = Mean; SD = Standard deviation. This table presents the five most common disruption strategies in the first response in which $n > 5$ (to avoid emphasising multiple categories endorsed by very few). Primary analysis outcomes are presented by order of frequency of response in bold followed by the three most common secondary analysis outcomes where applicable ($n > 5$). For example, in the 1st response the disruption technique "make noise" was identified in the primary analysis and its subthemes (e.g., scream) were identified in the secondary analysis. Perceived effectiveness ranges from 0 to 100, with higher ratings indicating higher perceived effectiveness of technique.

[a] Refers to % out of subsample per response (in rows in bold) or to valid % out of subsample per sub-theme.
[b] Assessed as perceived % of time the technique works.
[c] In the secondary analysis, 47 cases that were coded as reflecting multiple prevention strategies were removed.
[d] In the secondary analysis, 10 cases that were coded as reflecting multiple prevention strategies were removed.
[e] In the secondary analysis, 2 cases that were coded as reflecting multiple prevention strategies were removed.
[f] In the secondary analysis, 1 case that was coded as reflecting multiple prevention strategies were removed.
[g] In the secondary analysis, 3 cases that were coded as reflecting multiple prevention strategies were removed.

The current findings corroborate evidence concerning the associations between ISP and various sleep disturbances [10,16]. In line with previous research [14], non-White participants were more likely to experience ISP than White participants. Women were more likely to experience ISP than men, and ISP tended to be more frequent in younger people compared to older. The effect size for the latter association was medium, suggesting a meaningful relationship that should be further investigated.

ISP was associated with distress. The majority of participants (76.0%) reported clinically significant (i.e., moderate or above) fear levels during their ISP episodes (i.e., they experienced fearful ISP episodes), and many participants (27.6%) suffered from recurrent fearful ISP. Regarding the causes, most people believed that ISP was the result of something in the brain and/or stress. A smaller percentage believed it to have supernatural origins. These self-reported aetiologies support previous research in which participants residing in Denmark were more likely to ascribe causes such as brain malfunctioning and reduced blood flow in the brain to their SP episodes rather than supernatural creatures [22]. Our findings provide quantitative evidence to categories previously identified.

4.1. Prevention and disruption strategies

Five strategies used to prevent and disrupt ISP episodes were identified using participants' open-ended responses. The three most common prevention strategies were changing sleep position, adjusting sleep patterns, and adjusting sleep environment. These findings are consistent with previous research that found changes to sleep patterns to be the most successful prevention technique [7]. In the current study, the prevention strategies were reported to be moderately effective, with all five having over 60.0% of perceived effectiveness. This supports their use in existing treatments for problematic cases of ISP (e.g., CBT-ISP) [25]. These techniques can also be more informally shared with ISP experiencers in addition to the use of psychoeducation about the broader nature of ISP. As noted in several sources, individuals may feel shame or experience distress given the unusual nature of ISP symptoms, especially hallucinations [2]. Results of the present study also indicate that a small percentage possess thoughts of a supernatural origin of ISP. Increased familiarity with both ISP and tendencies to endorse anomalistic aetiologies may serve to both reassure patients and provide scientific explanations for sleep paralysis. Our results are particularly noteworthy given the absence of clinically supported effective techniques for those suffering from ISP. These prevention strategies may also be useful for further developing fruitful and tailored interventions.

The five disruption strategies identified had overall less perceived effectiveness, with only two strategies (contextualisation and breathing) yielding an overall perceived effectiveness of at least 50.0% in the first response. Contextualisation (i.e., being conscious of the paralysis, positive thoughts etc) and breathing were reported to be the most effective strategies across all three responses. These findings can help enhance treatments for ISP patients as health-care providers can not only offer sympathy and understanding, but if these results are replicated, they may constitute actionable practices targeted at directly managing the condition as it is happening. Being able to disrupt an episode can offer significant relief to the experiencer as they may feel increased control over the episode [30]. This, in turn, can lead to a reduction in fear and anxiety that often co-exist with SP, especially when struggling to end it at one's will [10,25].

Results also indicate that a subset of individuals with recurrent episodes of ISP experience clinically significant life interference in the absence of clinically significant distress. Should these findings be replicated, this may point towards a need to reconsider current

criteria for recurrent ISP which, at present, only requires distress and/or anxiety associated with ISP episodes [1].

4.2. Limitations and future directions

This online study had a self-selected sample and findings may or may not generalize to the wider population. Relatedly, as the sample consisted of primarily White participants, replication with non-White samples is needed.

5. Conclusion

This study showed that various aspects of sleep (i.e., longer sleep onset latencies, shorter sleep duration, and greater insomnia symptoms) were more common in those reporting ISP (vs. non-ISP reporters). ISP episodes can cause high levels of fear and distress as they are happening. However, only a minority of participants reported significant distress or impairment as a result of episodes. People experience the latter without the former, which may imply a need to revise current diagnostic criteria. In terms of aetiology, most of the participants believed the episodes to be caused by something in the brain, and several SP-related prevention and disruption strategies were identified. These findings may contribute to successful intervention development aimed to decrease anxiety, distress as well as improve overall sleep quality in those who experience ISP.

Financial disclosure

The study was funded by a grant from WA Sceptics to AMG to support the work of BR.

Data availability statement

The data used in this study are from a larger study collecting variables on sleep and paranormal beliefs. Papers focusing on clinical features of exploding head syndrome and sleep and paranormal beliefs have been published previously. The data underlying this article are not currently publicly available due to data protection policies. Reasonable requests for access to data should be made to the corresponding author.

CRediT authorship contribution statement

Betul Rauf: Conceptualization, Software, Formal analysis, Writing – original draft, preparation. **Brian A. Sharpless:** Conceptualization, Data curation, Resources, Writing – review & editing. **Dan Denis:** Conceptualization, Data curation, Writing – review & editing. **Rotem Perach:** Methodology, Software, Formal analysis, Resources, Data curation, Supervision, Writing – review & editing. **Juan J. Madrid-Valero:** Validation, Resources, Visualization, Writing – review & editing. **Christopher C. French:** Supervision, Conceptualization, Data curation, Resources, Writing – review & editing. **Alice M. Gregory:** Funding acquisition, Supervision, Conceptualization, Data curation, Resources, Writing – review & editing.

Declaration of competing interest

AMG is an advisor for a project initially sponsored by Johnson's Baby. She is a consultant for Perrigo (2021+). She was previously a CEO of *Sleep Universal LTD (2022)*. She receives royalties for two books Nodding Off (Bloomsbury Sigma, 2018) and The Sleepy Pebble (Flying Eye, 2019). She has another contract with Lawrence King Publishers (publication due 2023). She is a regular contributor to BBC Focus magazine and has contributed to other outlets (such as The Conversation, The Guardian and Balance Magazine). She occasionally receives sample products related to sleep (e.g. blue light blocking glasses) and has given a paid talk to a business (Investec). She is a specialist subject editor at JCPP (sleep) for which she receives a small honorarium. She has contributed a paid article to Neurodiem. [NB//these are not all non-financial disclosures, some are financial].

Brian Sharpless receives royalties for three books published through Oxford University Press (*Sleep Paralysis*, 2015; *Unusual and Rare Psychological Disorders*, 2017; and *Psychodynamic Therapy Techniques*, 2019). He is currently under contract with Chicago Review Press for his fourth. He occasionally receives sample products related to sleep (e.g., blue light blocking glasses) and frequently gives paid public lectures on sleep disorders and other clinical topics.

All other authors declare no conflict of interest.

Acknowledgements

We would like to thank the participants of the study. We also acknowledge the support from BBC Science Focus Magazine especially Ellen Keld and Daniel Bennett - who initiated the study and provided support in kind (administrative support, financing the prize draw, and promoting the study). Thanks also to Isabella Badini who helped in the early stages of the study as well as to Matthew Hutton, Hannah Laurence, Kamila Pawlowska, Chloe Sergeant, and Ryan Stewart who contributed to the qualitative analysis of the data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2023.02.023.

References

[1] Sateia MJ. International classification of sleep disorders-third edition. Chest 2014;146(5):1387–94. https://doi.org/10.1378/chest.14-0970.
[2] D'Agostino A, Limosani I. Hypnagogic hallucinations and sleep paralysis. In: Goswami M, Thorpy MJ, Pandi-Perumal SR, editors. Narcolepsy: a clinical guide. Springer International Publishing; 2016. p. 81–93. https://doi.org/10.1007/978-3-319-23739-8_8.
[3] Bassetti CLA, Adamantidis A, Burdakov D, et al. Narcolepsy — clinical spectrum, aetiopathophysiology, diagnosis and treatment. Nat Rev Neurol 2019;15(9):519–39. https://doi.org/10.1038/s41582-019-0226-9.
[4] Sharpless BA, Barber JP. Lifetime prevalence rates of sleep paralysis: a systematic review. Sleep Med Rev 2011;15(5):311–5. https://doi.org/10.1016/j.smrv.2011.01.007.
[5] Cheyne JA, Rueffer SD, Newby-Clark IR. Hypnagogic and hypnopompic hallucinations during sleep paralysis: neurological and cultural construction of the night-mare. Conscious Cogn Int J 1999;8(3):319–37. https://doi.org/10.1006/ccog.1999.0404.
[6] Sharpless BA, McCarthy KS, Chambless DL, Milrod BL, Khalsa SR, Barber JP. Isolated sleep paralysis and fearful isolated sleep paralysis in outpatients with panic attacksb. J Clin Psychol 2010;66(12):1292–306. https://doi.org/10.1002/jclp.20724.
[7] Sharpless BA, Grom JL. Isolated sleep paralysis: fear, prevention, and disruption. Behav Sleep Med 2016;14(2):134–9. https://doi.org/10.1080/15402002.2014.963583.
[8] McNally RJ, Clancy SA. Sleep paralysis, sexual abuse, and space alien abduction. Transcult Psychiatr 2005;42(1):113–22. https://doi.org/10.1177/1363461505050715.
[9] Fukuda K, Miyasita A, Inugami M, Ishihara K. High prevalence of isolated sleep paralysis: kanashibari phenomenon in Japan. Sleep J Sleep Res Sleep Med 1987;10(3):279–86. https://doi.org/10.1093/sleep/10.3.279.
[10] Wing YK, Lee ST, Chen CN. Sleep paralysis in Chinese: ghost oppression phenomenon in Hong Kong. Sleep J Sleep Res Sleep Med 1994;17(7):609–13. https://doi.org/10.1093/sleep/17.7.609.
[11] Spanos NP, McNulty SA, DuBreuil SC, Pires M. The frequency and correlates of sleep paralysis in a university sample. J Res Pers 1995;29(3):285–305. https://doi.org/10.1006/jrpe.1995.1017.
[12] Stefani A, Högl B. Nightmare disorder and isolated sleep paralysis.

Neurotherapeutics 2021;18(1):100–6. https://doi.org/10.1007/s13311-020-00966-8.
[13] Olunu E, Kimo R, Onigbinde EO, et al. Sleep paralysis, a medical condition with a diverse cultural interpretation. Int J Appl Basic Med Res 2018;8(3):137–42. https://doi.org/10.4103/ijabmr.IJABMR_19_18.
[14] Paradis CM, Friedman S, Hatch M. Isolated sleep paralysis in african Americans with panic disorder. Cult Divers Ment Health 1997;3(1):69–76. https://doi.org/10.1037/1099-9809.3.1.69.
[15] Denis D, French CC, Gregory AM. A systematic review of variables associated with sleep paralysis. Sleep Med Rev 2018;38:141–57. https://doi.org/10.1016/j.smrv.2017.05.005.
[16] Denis D, French CC, Rowe R, et al. A twin and molecular genetics study of sleep paralysis and associated factors. J Sleep Res 2015;24(4):438–46. https://doi.org/10.1111/jsr.12282.
[17] Denis D, French CC, Schneider MN, Gregory AM. Subjective sleep-related variables in those who have and have not experienced sleep paralysis. J Sleep Res 2018;27(5):e12650. https://doi.org/10.1111/jsr.12650.
[18] Simard V, Nielsen TA. Sleep paralysis-associated sensed presence as a possible manifestation of social anxiety. Dreaming 2005;15(4):245–60. https://doi.org/10.1037/1053-0797.15.4.245.
[19] Sharpless BA, Kliková M. Clinical features of isolated sleep paralysis. Sleep Med 2019;58:102–6. https://doi.org/10.1016/j.sleep.2019.03.007.
[20] French CC, Santomauro J. Something wicked this way comes: causes and interpretations of sleep paralysis. Tall Tales Mind Brain Separating Fact Fict 2007:380–98. Published online.
[21] French CC, Stone A. Anomalistic psychology: exploring paranormal belief and experience. Macmillan International Higher Education; 2013.
[22] Jalal B, Simons-Rudolph J, Jalal B, Hinton DE. Explanations of sleep paralysis among Egyptian college students and the general population in Egypt and Denmark. Transcult Psychiatr 2014;51(2):158–75. https://doi.org/10.1177/1363461513503378.
[23] Sharpless BA. A clinician's guide to recurrent isolated sleep paralysis. Neuropsychiatric Dis Treat 2016;12:1761–7. https://doi.org/10.2147/NDT.S100307.
[24] Santomauro J, French CC. Terror in the night. Psychol 2009;22(8):672–5.
[25] Sharpless BA, Doghramji K. Sleep paralysis: historical, psychological, and medical perspectives. Oxford University Press; 2015.
[26] Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. Psychiatr Res 1989;28(2):193–213. https://doi.org/10.1016/0165-1781(89)90047-4.
[27] Morin CM, Belleville G, Bélanger L, Ivers H. The insomnia severity index: psychometric indicators to detect insomnia cases and evaluate treatment response. Sleep 2011;34(5):601–8. https://doi.org/10.1093/sleep/34.5.601.
[28] Bastien CH, Vallières A, Morin CM. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. Sleep Med 2001;2(4):297–307. https://doi.org/10.1016/s1389-9457(00)00065-4.
[29] George D. SPSS *for Windows Step by Step: A Simple Study Guide and Reference*, 17.0 Update. 10th ed. Pearson Education India; 2011.
[30] Denis D. Relationships between sleep paralysis and sleep quality: current insights. Nat Sci Sleep 2018;10:355–67. https://doi.org/10.2147/NSS.S158600.