BRIEF COMMUNICATION:

Exploding Head Syndrome: Clinical Features, Theories about Etiology, and Prevention Strategies in a Large International Sample

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Abstract

OBJECTIVE: Exploding head syndrome (EHS) is a benign sensory parasomnia characterized by the perception of loud noises or a sense of explosion in the head. Few studies have assessed clinical features and little is known about demographic differences or prevention strategies.

PATIENTS/METHODS: A cross-sectional study of 3286 individuals with and 2954 without lifetime EHS episodes was conducted via online questionnaires.

RESULTS: Those with EHS had shorter sleep durations, longer sleep onset latencies, poorer sleep quality, and less sleep efficiency, but effect sizes for these differences were small. Females were slightly more likely than males to endorse EHS. 44.4% of individuals with EHS experienced significant fear during episodes, but fewer reported clinically significant distress (25.0%) or interference (10.1%) as a result of EHS. Most sufferers believed it to be a brain-based phenomenon, but a small minority endorsed anomalous causes. Five prevention strategies with >50% reported effectiveness were identified.

CONCLUSIONS: EHS was assessed in the largest sample to date. Though associated with clinical impacts, no empirically supported interventions yet exist. The five prevention strategies may prove useful for treatment development.

KEYWORDS: Exploding head syndrome, episodic cranial sensory shocks, parasomnia, differential diagnosis, etiology.

1. Introduction

Exploding head syndrome (EHS), alternately termed "episodic cranial sensory shocks", is a sensory parasomnia characterized by perceptions of either a loud noise or sense of explosion in one's head during sleep transitions [1,2]. These episodes are associated with abrupt arousal but are not accompanied by significant pain. However, headache disorders and other conditions remain important considerations for differential diagnosis [3].

Though first documented in the 1800's, EHS received scant attention until the 1980s [e.g., 3,4]. This is despite its relative commonality and clinical importance. For example, lifetime episode prevalence rates range between 10% and 37% [e.g., 5-7]. EHS episodes can be upsetting, with average fear levels above moderate [7]. However, only a minority of people with a history of EHS experience clinically significant distress and/or impairment [7]. For these individuals, well-established treatment options are not available and it is currently unknown if behavioral or psychological procedures may help prevent episodes. One study found that a relatively small percentage of EHS sufferers (8.51%) made active attempts to prevent episodes through altering their sleep patterns or using hypnotics [8]. Unfortunately, the limited sample size ($N = 47$) precluded a substantive determination of the relative effectiveness of these methods. Regardless, a small evidence base is accruing on the correlates and associated features of EHS which may prove useful for developing interventions. Indeed, insomnia, life stress, anxiety, symptoms of depression, sleep position, and the presence of other sleep experiences (e.g., isolated sleep paralysis) have all been associated with EHS [5,7,8].

Basic questions about EHS remain. For example, differences in prevalence rates across groups have not yet been determined (e.g., sex differences) [1,3,5,7]. There are also unanswered questions about etiology with several proposed mechanisms of pathogenesis [9]. In addition, there are clinical reports that some sufferers attribute EHS to non-biological, anomalous causes (e.g., electromagnetic disturbances and/or use of directed energy weapons; [9]), but the actual prevalence of such beliefs is unknown.

The present study attempts to clarify these matters using an online questionnaire and the largest sample to date of participants reporting EHS. The purposes are to:

- Assess for differences in EHS prevalence according to demographics;
- Determine frequency, fear level, and overall clinical distress and interference associated with EHS episodes;
- Replicate associations between sleep disturbances and EHS;
- Catalogue the perceived etiologies of EHS;
- Catalogue attempts taken to prevent EHS episodes and their perceived effectiveness.

2. Methods

2.1. Procedure

The study was initiated by the British Broadcasting Corporation's (BBC) *Science Focus Magazine* and was publicized through that publication, popular press interviews with study authors (BAS, CCF, and AMG), and social media. Ethical approval was granted through Goldsmiths, University of London. Participation was restricted to those who agreed to the terms of the study, provided informed consent, and were at least 18 years old. UK nationals were permitted to enter a prize draw to receive gift cards.

2.2. Questionnaire Items

Sleep quality and efficiency were measured using the first four items of the well-validated and reliable *Pittsburgh Sleep Quality Index* (PSQI) [10]. Severity of insomnia symptoms was measured using the first five items of the reliable and valid *Insomnia Severity*

Index (ISI) [11], with the first three items collapsed into one. EHS was assessed using 11 items adapted from the *Exploding Head Syndrome Interview* (EHSI) [7], which assesses EHS symptoms using *International Classification of Sleep Disorders – Third Edition* criteria [1], inquires into perceived etiologies, and includes questions relevant for differential diagnosis. See Appendix A for further item information.

2.3. Qualitative Data

Participants were asked if they attempted to prevent EHS episodes and could list up to four prevention strategies and rate their perceived effectiveness (0-100%). Responses were coded using conventional content analysis without preconceived categories [12] as well as *a priori* consensus procedures [13]. This process was repeated to explore sub-themes. Coding was conducted by one postgraduate and five undergraduate raters trained and supervised by a psychology researcher (RP) experienced in qualitative procedures. Interrater agreement was good (Kappa = .81). In order to maintain independence of observations (i.e., to preclude the possibility that multiple responses from the same person were analyzed as belonging to a single strategy – hence skewing results), qualitative data were analyzed separately for each response given (i.e., whether the first, second, third or fourth response). Single responses that were coded as reflecting multiple prevention strategies were excluded.

2.4. Notes on Analyses

Non-parametric analyses were used when parametric assumptions were violated. As the removal of outliers did not alter any results as per sensitivity analyses (available upon request), the entire available sample was utilized for all analyses.

3. Results

3.1. Sample Composition

Figure 1 displays participant flow and exclusions. The final number of participants reporting at least one EHS episode was 3286 (52.7%). Participants classified themselves as White (92.3%), mixed ethnicity (2.7%), Asian (2.0%), or prefer not to say (1.0%), with the remaining Black, Arab, Roma, or "other". The sample was primarily female (66.0%) with a mean age of 47.0 (*SD* = 15.3; *range* = 18-89).

3.2. Demographic Differences

Minorities were not more likely to experience EHS than Whites ($p = .12$). Contrary to some recent studies [e.g., 5,7], but consistent with earlier reviews [3,14], women were marginally more likely to endorse EHS than men (53.5% vs 50.7%; $X^2(1, N = 6186) = 4.47$, $p = .036$, $\varphi = .027$). Participants with EHS (*M* = 46.0 years; SD = 14.8) were slightly younger than those without (*M* = 48.1; *SD* = 15.8), ($U = 4468351.00$, $p < .001$, $r = .07$).

3.3. EHS Frequency, Fear, Distress, and Impairment

EHS distributions can be found in Figure 2. Supplemental analyses indicated that increased frequency of episodes was associated with higher distress ($rs(3267) = .167$, $p < .001$) and greater impairment ($rs(3259) = .321$, $p < .001$) resulting from episodes.

3.4. Sleep and EHS

Considering sleep quality, participants with EHS reported longer sleep onset latencies (*M* = 30.3 minutes) over the past month than those without (*M* = 25.3 minutes) ($U = 2882454.50$, $p < .001$, $r = .11$). Similarly, sleep duration was shorter for those with EHS (*M* = 6:49:01, *SD* = 1:08:42) than without (*M* = 6:55:31, *SD* = 1:08:25, $F(1, 5467) = 12.21$, $p <.001$, partial $\eta 2 = .002$). Of note, the overall sample's sleep duration was brief overall (*M* = 6:52:06, *SD* = 1:08:38), but had a wide range (i.e., 1:30:00 – 14:30:00). Sleep efficiency was lower for those with EHS

(M = 84.1%, SD = 12.7) than those without (M = 84.9%, SD = 12.6%, $F(1, 5404) = 5.815$, p = .016, partial $\eta 2$ = .001).

The three ISI items were summed to assess insomnia symptoms (Cronbach's alpha = .89). ISI total was higher for those with EHS (M = 8.4 SD = 2.9) than without (M = 7.6, SD = 3.0; $F(1, 6203) = 117.78$, p <.001, partial $\eta 2$ = .019).

3.5. Self-Reported Etiologies

99.6% (N = 3273) of those reporting EHS answered questions about etiology. The most frequently endorsed causes were: "something in the brain" (N = 1982; 60.6%), "stress" (N = 1136; 34.7%), "medication side effects" (N = 235; 7.2%), "something supernatural" (N = 92; 2.8%), and "electronic equipment" (N = 75; 2.3%). Participants could endorse multiple causes.

3.6. Prevention Strategies

The six most common prevention strategies and perceived effectiveness ratings are found in Table 1. All except the last had mean ratings above 50%. An attempted internal replication of these findings (using responses 2 and 3; prevention strategies in response four had n ≤ 4 and are therefore not reported) can be found in Appendix B. The three most common strategies using the second response were among those identified using the first response, but there was some variability in the perceived effectiveness ratings (e.g., although adjusting sleep patterns/reducing tiredness replicated, mindfulness/breathing techniques did not).

4. Discussion

EHS episodes and their sequelae were assessed in the largest sample to date. Participants reporting EHS displayed only minor differences compared to those without. Specifically, EHS was associated with shorter sleep/poorer sleep quality across all comparisons, but these differences were likely not clinically meaningful (i.e., all effect sizes = small or below). Women were marginally more likely to report EHS, but this effect size was also quite small.

EHS was associated with negative clinical impacts. 44.4% reported clinically significant (i.e., moderate or above) levels of fear during EHS episodes. Fewer reported clinically significant levels of distress (25.5%) or impairment (10.1%) as a result of episodes, but this risk increased with episode frequency. A small percentage reported anomalous etiologies for EHS as well. Future work should examine how common this is in other medical sensory phenomena, as it may not be specific to EHS. Analysis of open-ended responses yielded five strategies reported to be effective in preventing EHS. These were consistent with an earlier report [8], displayed overlap with existing insomnia treatments [15-16], and may prove useful for developing effective interventions. Finally, as use of the EHS screener question alone yielded 12.0% false positives, it is recommended that researchers and clinicians include additional assessment items (esp., inquiries into pain).

4.1. Limitations

- EHS was not assessed via clinical interview.
- The sample was self-selected as indicated by a high percentage of participants reporting EHS and low overall sleep duration. Methods of advertisement may have led to an overrepresentation of sleep disturbances. Accordingly, our findings of minor group differences warrant additional research.
- Sub-themes identified in the qualitative analysis had relatively small sample sizes and should be interpreted with caution.

Highlights (85 characters max)

- EHS is associated with marginally poorer/shorter sleep
- EHS is often associated with clinically significant fear during episodes
- EHS can be associated with clinically significant distress and/or impairment
- EHS screeners without additional questions (e.g., pain) can lead to false positives
- Some EHS sufferers may hold unfounded anomalous beliefs about its etiology
- Five EHS prevention strategies may be useful for behavioral interventions

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