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Factors Associated With Initial Psychogenic Non Epileptic Seizures (PNES) Amongst Patients With/Without Epileptic Seizures (ES)

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Abstract

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by

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MSc, University of Phoenix 2013

BSc, DeVry University, 2000

Dissertation Submitted in Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

Psychogenic non-epileptic seizure (PNES) is an important individual and public health concern, but inconsistent results exist in the literature in terms of the circumstances surrounding the initial occurrence of PNES among patients without a prior diagnosis of epilepsy. The purpose of this study was to determine to what extent patient sex, number of medical comorbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic non-epileptic seizures among patients with or without PNES. In a clinical trial conducted by UCLA, involving 38 patients with PNES and a short follow-up period of 16 weeks, the authors observed that combined cognitive behavioral therapy with drug therapy was considered the best current practice, which resulted in a 59% reduction in seizures. The study was grounded in the Precaution Adoption Process Model (PAPM), exploring how individuals become aware of health risks and decide to adopt preventive behaviors. Secondary data from the University of California, Los Angeles (UCLA) adult video-EEG (vEEG) facility were analyzed using logistic regression to determine the predictive value of these factors in the onset of PNES. The results from analyzing the secondary data revealed PNES patients with depression at 0.51 [0.38, 0.64] sensitivity (95% CI) and 0.73 [0.63, 0.82] specificity (95% CI)., anxiety disorder at 0.51 [0.38, 0.64] sensitivity (95% CI) and 0.78 [0.69, 0.86] specificity (95% CI)., panic disorder at 0.25 [0.14, 0.37] sensitivity (95% CI) and 0.91[0.84, 0.96]specificity (95% CI)., traumatic experience and family history of seizure disorder 0.31 [0.20, 0.44] sensitivity (95% CI) and 0.85 [0.76, 0.92] specificity (95% CI). To promote positive health outcomes and prevent disease, it is important to devise optimal intervention programs that incorporate factors associated with initial psychogenic non epileptic seizure (PNES) amongst patients with/without epileptic seizure (ES).

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Dedication

This dissertation is dedicated to my spouse Grace Ogork, whose unwavering support, encouragement, and love have been the foundation of my journey. To my kids Tresor Bunkur and Shasha Ogork, your belief in me has given me the strength to persevere through challenges and the motivation to achieve my dreams. To my entire family, friends, colleagues and advisors, your guidance and inspiration have shaped my academic and personal growth in countless ways. Finally, to those who have walked this path before me and those who will follow, may this work contribute in some way to the pursuit of knowledge and progress.

Acknowledgments

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

Epilepsy and seizure disorders constitute a complex realm of neurological conditions that impact millions of individuals worldwide. Psychogenic non-epileptic seizures (PNES) represent a particularly intricate and challenging facet among the diverse spectrum of seizures. PNES are paroxysmal episodes that resemble epileptic seizures but are not caused by abnormal electrical discharges in the brain (Cengiz et al., 2023; Lopez & LaFrance, 2022). Instead, they are primarily of psychological origin, often linked to underlying emotional distress, trauma, or psychological factors. From a public health standpoint, it is important to understand PNES given the far-reaching impact on health care resources, patient quality of life, and the associated societal costs of misdiagnosis and treatment inefficiencies. PNES contributes to increased healthcare expenses, emotional distress for patients, and challenges for clinicians navigating diagnostic uncertainty. Addressing the factors that influence the onset of PNES offers an opportunity to improve early intervention and prevention strategies, making this a public health priority.

The diagnosis and management of PNES present a formidable clinical task, as distinguishing these episodes from true epileptic seizures can be difficult (Tilahun & Bautista, 2022). While considerable research has been devoted to elucidating the characteristics, diagnostic criteria, and therapeutic strategies for PNES, a critical area remains relatively uncharted: the circumstances surrounding the initial occurrence of PNES among patients without a prior diagnosis of epilepsy (Liampas et al., 2021; Toffa et al., 2020). In the journey of a patient's life, the first experience of a psychogenic non-epileptic seizure marks a pivotal and perplexing moment. This initial presentation often triggers a cascade of medical evaluations,

diagnostic uncertainty, and emotional distress. Despite the challenges posed by these episodes, the specific factors contributing to their onset in patients without pre-existing epilepsy have received limited attention in the existing literature.

Recent studies have shown significant advances in understanding the diagnosis, neurobiology, and treatment of PNES. These seizures are now recognized as the most common functional neurological disorder/conversion disorder subtype (Lopez & LaFrance, 2022). The focus in this study is on a diverse patient population, capturing variations across key demographics and conditions. PNES is known to predominantly occur in females, and the median onset is observed in the mid-to-late 20s, though it can also affect children, adolescents, and older adults (Sawchuk et al., 2020). The inclusion criteria for this study will include patients experiencing their initial PNES episodes, both with and without prior diagnoses of epilepsy. This ensures a broad and representative sample to investigate the factors contributing to the onset of PNES. Although evidence is mixed for treating PNES, psychotherapeutic modalities remain a powerful instrument to empower patients and reduce seizures (LaFaver et al., 2020). A multidisciplinary, holistic approach is beneficial. While seizure freedom in all patients may not be the achieved endpoint in this chronic paroxysmal disorder, quality of life can be improved with treatment (LaFaver et al., 2020). The management of PNES is divided into four stages: making the diagnosis, presenting the diagnosis, initiating treatment, and maintaining treatment (Tilahun & Bautista, 2022; Toffa et al., 2020). Clinical features of events are often not sufficiently sensitive or specific to definitively distinguish epileptic seizures from PNES, and confirmatory video electroencephalography (video EEG) remains the gold standard test required to supplement the history (Xiang et al., 2019). While there has been significant progress in

understanding and managing PNES over recent years, there is still much to learn about this complex condition. Further research is needed to understand better the factors contributing to their onset in patients without pre-existing epilepsy and to develop more effective treatments for these patients.

Background

Epilepsy and seizure disorders are complex neurological conditions that have long been the focus of medical research and clinical practice. These conditions encompass various manifestations, ranging from brief absence seizures to convulsive tonic-clonic seizures (Anzellotti et al., 2020; Lopez & LaFrance, 2022). Among the diverse array of seizure types, psychogenic non-epileptic seizures (PNES) represent a particularly intricate and challenging subset. PNES are paroxysmal episodes that closely resemble epileptic seizures in their outward appearance, often involving convulsions, loss of consciousness, and other seizure-like behaviors (Xiang et al., 2019). However, they are fundamentally different from epileptic seizures in that they are not driven by abnormal electrical discharges in the brain. Instead, PNES have their roots in psychological factors, often associated with unresolved emotional distress, trauma, or psychosocial stressors (Lopez & LaFrance, 2022). The diagnosis and management of PNES present significant clinical challenges. Distinguishing these episodes from true epileptic seizures can be difficult, as they share many clinical features. The diagnostic process typically involves comprehensive clinical evaluations, video-EEG monitoring, psychological assessments, and careful differentiation from epileptic seizure (Tilahun & Bautista, 2022). While substantial research has been conducted on PNES, with a focus on diagnostic criteria and therapeutic approaches, an important aspect of this condition has remained relatively unexplored: the

circumstances surrounding the initial occurrence of PNES in patients who have not received a prior diagnosis of epilepsy.

The first-time experience of a psychogenic non-epileptic seizure represents a pivotal and perplexing moment in a patient's journey. It often triggers a cascade of medical evaluations, diagnostic uncertainties, and emotional distress. Despite the challenges posed by these episodes, the specific factors contributing to their initial onset in patients without a history of epilepsy have received limited attention in the existing literature. The literature has primarily emphasized the importance of accurate diagnosis, the role of psychological factors in PNES, and the challenges of differentiation from epileptic seizures (Lopez & LaFrance, 2022; Toffa et al., 2020). However, it has not comprehensively addressed the unique challenges of initial PNES episodes in patients without prior epilepsy diagnoses. This research aims to bridge this significant gap in the literature by investigating the potential predictors and associations related to the occurrence of initial psychogenic non-epileptic seizures among patients without epilepsy. By examining patient sex, the number of medical comorbidities, sleep deprivation, head injury history, and the act of closing one's eyes during seizures, the researcher sought to uncover factors that may contribute to the onset of these episodes in this specific population. Understanding the triggers and risk factors for the first-time occurrence of PNES in patients without a prior epilepsy diagnosis holds immense clinical significance. It can lead to earlier diagnosis, more targeted interventions, and ultimately improved patient care. Furthermore, this research aligns with the broader goals of public health by contributing to the reduction of the disease burden associated with PNES and enhancing the overall well-being of affected individuals and communities. In the following chapters, I will delve into the methodology, data analysis, findings, and discussions aimed at

uncovering the associations between patient conditions and the occurrence of initial psychogenic non-epileptic seizures among patients without epilepsy. This study represents a significant step toward addressing the complex challenges posed by PNES and advancing knowledge in the field of neurological disorders.

This researcher sought to address a significant gap in knowledge within the discipline in the public health sector. which pertains to the lack of comprehensive research into the specific factors contributing to the onset of initial psychogenic non-epileptic seizures (PNES) in individuals without a prior diagnosis of epilepsy. The existing body of research on PNES predominantly concentrates on diagnostic criteria, differentiation from epileptic seizures, and psychological aspects (Brown & Reuber, 2016; Dhamija et al., 2019). However, it lacks specific exploration into the circumstances leading to the first-time occurrence of PNES in patients who do not have a history of epilepsy. This gap leaves clinicians and researchers with limited insights into the triggers and risk factors associated with the onset of initial PNES episodes. Moreover, existing literature often groups PNES patients together, regardless of whether they have a prior epilepsy diagnosis. This approach overlooks the potential differences in the factors contributing to the onset of PNES between patients with and without pre-existing epilepsy. Understanding these distinctions is crucial for tailoring diagnostic and therapeutic approaches to the unique needs of each group.

Furthermore, there is a lack of comprehensive examination of specific patient conditions that may predict the occurrence of initial PNES in patients without epilepsy. The potential role of variables such as patient sex, number of medical comorbidities, sleep deprivation, head injury history, and the act of closing one's eyes during seizures in this context remains largely

unexplored. A critical gap also exists concerning the translation of research findings into clinical practice. Understanding the predictive factors for initial PNES in patients without epilepsy has the potential to significantly impact early diagnosis, intervention, and treatment strategies. However, without this knowledge, healthcare providers may continue to face challenges in effectively managing these patients. Lastly, the broader public health implications of identifying and addressing the factors contributing to initial PNES in patients without epilepsy remain largely unexamined. Reducing the burden of disease associated with PNES and improving the overall quality of life for affected individuals is a fundamental goal of public health. By addressing this knowledge gap, research in this area can contribute to achieving these objectives. In conclusion, this study sought to address a significant gap in knowledge revolving around the factors influencing the onset of initial psychogenic non-epileptic seizures in individuals without a prior epilepsy diagnosis. The research aims to fill this gap by investigating specific patient conditions and their potential predictive roles, ultimately contributing to improved diagnostic and therapeutic strategies, as well as enhanced public health outcomes in the field of seizure disorders.

Problem Statement

Despite the extensive body of research on psychogenic non-epileptic seizures (PNES), a significant gap exists in understanding the specific factors and conditions that contribute to the initial occurrence of PNES in individuals who have not previously received a diagnosis of epilepsy (Liampas et al., 2021; Toffa et al., 2020). This knowledge gap hinders early diagnosis, intervention, and the development of targeted treatment strategies for this particular population, thereby necessitating a comprehensive investigation into the potential predictive factors

associated with the onset of initial PNES episodes in patients without epilepsy. Patients diagnosed with PNES have over twice the mortality risk as the general population. Younger people with PNES have even higher relative risks of death: 8.6-fold for those under age 30 and 7.2-fold for those 30 to 39 (Carlson, 2023). Moreover, recent data suggest that people with PNES have a mortality risk 2.5 times that of the general population, similar to the elevated risk of people with drug-resistant epilepsy. The misdiagnosis of PNES as epileptic seizures can lead to unnecessary medical evaluations, diagnostic uncertainties, emotional distress, and increased healthcare costs (Toffa et al., 2020). Misdiagnoses can lead to extreme antiepileptic drug escalade, unnecessary resuscitation measures, needless biologic and imaging investigations, and prolonged hospitalization or increase of unhelpful antiepileptic drug therapy (Toffa et al., 2020). Furthermore, the healthcare sector has seen a significant increase in expenses in recent years.

Psychogenic non-epileptic seizures (PNES) are the most common Functional Neurological Disorder/Conversion Disorder subtype. Significant advances have been made related to diagnosis, neurobiology, and treatment. Although evidence is mixed for the treatment of PNES, psychotherapeutic modalities remain a powerful instrument to empower patients and reduce seizures (Lopez & LaFrance, 2022). A multidisciplinary, holistic approach is beneficial. A multidisciplinary, holistic approach provides a more rounded and effective treatment strategy, addressing the multifaceted nature of PNES and aiming to improve the overall quality of life for patients (Lopez & LaFrance, 2022). While seizure freedom in all patients may not be the achieved endpoint in this chronic paroxysmal disorder, quality of life can be improved with treatment (Cao et al., 2021; Sancho et al., 2010).

PNES consists of paroxysmal, time-limited alterations in motor, sensory, autonomic, cognitive, and emotional functions that can mimic epileptic seizures (ES) but do not have epileptiform activity (Dhamija et al., 2019). Instead, according to Lopez and LaFrance (2022), PNES is associated with psychological underpinnings and is classified as a functional neurologic (conversion) disorder in DSM-51. Among patients referred to outpatient epilepsy centers, 5 to 15% have PNES (Lopez & LaFrance, 2022). In comparison, 25 to 40% of patients evaluated for intractable epilepsy in inpatient seizure monitoring units (SMUs) are diagnosed with PNES. Over the past decade, several advances have been made in diagnosing PNES, understanding the neurobiological correlations, facilitating the understanding of this entity, and offering better evidence treatments. In a clinical trial of 38 patients with PNES (or PNEA) with a short follow-up period of 16 weeks, the authors observed that combined cognitive behavioral therapy with drug therapy (i.e., sertraline), considered the best current practice, resulted in a 59% reduction in seizures (Asadi-Pooya, 2019). Despite these advances, there is still a significant gap in understanding the specific factors and conditions that contribute to the initial occurrence of PNES in individuals who have not previously been diagnosed with epilepsy. This knowledge gap hinders early diagnosis, intervention, and the development of targeted treatment strategies for this particular population. Therefore, further research is needed for patient's refractory to current treatment.

Purpose of the Study

The purpose of this quantitative study is to determine to what extent the patient sex, number of medical comorbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic non-epileptic seizures among patients with or without

PNES. The researcher will also explore the association between patient sex, number of medical comorbidities, sleep deprivation, head injury in the past, and eyes closed during seizures in predicting initial psychogenic non-epileptic seizures among patients with or without PNES, utilizing UCLA Adult Video-Electroencephalographic Monitoring (VEM) data (Sirven et al., 2022; Tilahun et al., 2021). The independent variables in this study, which are the factors being observed for their impact on the outcome, include patient sex, number of medical comorbidities, sleep deprivation, past head injuries, and whether the patient's eyes were closed during seizures. The dependent variable, or the outcome that the study aims to predict or explain based on changes in the independent variables, is the occurrence of initial PNES among patients. In summary, this quantitative study aims to determine how well certain variables can predict the initial occurrence of PNES and assess their associations. The independent variables include patient sex, number of medical comorbidities, sleep deprivation, past head injuries, and whether eyes were closed during seizures. The dependent variable is the occurrence of initial PNES. Covariate variables were included in the analysis to control for potential confounding factors. These included age, socioeconomic status, psychiatric history and medication use.

Research Questions and Hypotheses

The research questions are as follows:

RQ1. To what extent do patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic non epileptic seizures amongst patients without epilepsy.

The alternative hypothesis (H1) is:

H_a1. Patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic non epileptic seizures amongst patients without epilepsy.

The null hypothesis (H0) is:

H_01: Patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures do not predict initial psychogenic non epileptic seizures amongst patients without epilepsy.

RQ2. Can the combination of patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures predict the initial occurrence of PNES among patients without epilepsy?

The alternative hypothesis (H1) is:

H_a2: The combination of patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures does predict the initial occurrence of PNES among patients without epilepsy.

The null hypothesis (H0) is:

H_02: The combination of patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures does not predict the initial occurrence of PNES among patients without epilepsy.

RQ3. How do patient behaviors, insurance status, and healthcare source, and their interactions with patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures, influence the prediction of initial psychogenic non-epileptic seizures among patients without epilepsy?

The alternative hypothesis (H1) is:

H_a1. Patient behaviors, insurance status, and healthcare source, and their interactions with patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures, do influence the prediction of initial psychogenic non-epileptic seizures among patients without epilepsy.

The null hypothesis (H0) is:

H_01: Patient behaviors, insurance status, and healthcare source, and their interactions with patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures, do not influence the prediction of initial psychogenic non-epileptic seizures among patients without epilepsy.

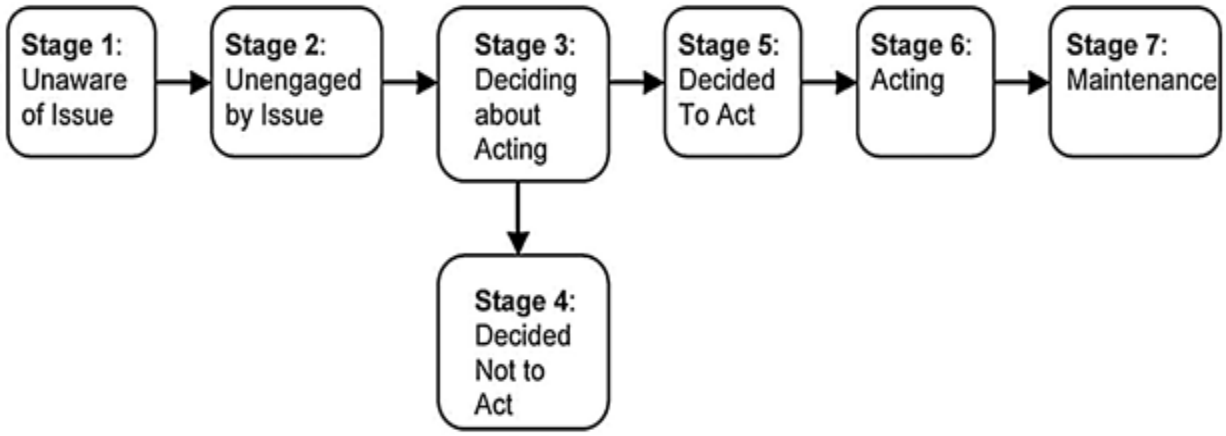
Theoretical Framework of the Study

The study is grounded in the Precaution Adoption Process Model (PAPM), a theory developed by Neil D. Weinstein, a prominent researcher in the field of health psychology (Weinstein et al., 2020). Introduced in the late 1980s, the PAPM provides a framework for understanding how individuals perceive and respond to health-related risks and make decisions regarding preventive behaviors (Weinstein et al., 2020). The PAPM is a stage theory that seeks to explain the adoption of new health-protective behaviors. It asserts that progress toward behavior change is best explained in terms of a sequence of qualitatively different stages. The model proposes that individuals progress through a series of distinct stages when contemplating and ultimately adopting preventive behaviors. Initially, individuals are unaware of the risk or preventive behavior. Once they become aware of the risk, they may remain unengaged or unconcerned. As they recognize the risk, they start to contemplate whether or not to take

preventive action. Some individuals may decide against taking preventive action even after considering it. However, others decide to take preventive action. These individuals then put their

Figure 1.

*Stages of PAPM (*Weinstein et al., 2020*)*



decision into practice and engage in preventive behavior. After adopting the preventive behavior, they continue to practice it over time, which is referred to as the maintenance stage.

Figure 1 above shows the stages one goes through when adopting a behavior. These stages provide a structured framework for exploring how patients' awareness and decision-making regarding PNES may vary and how these variations relate to their risk factors. It's important to note that individuals can move back and forth between these stages, and not everyone will pass through all stages.

The PAPM does not provide a specific set of variables that differentiate between stages, nor does it provide a mechanism for progression from one stage to another. Instead, the progression between stages is propelled by the individual's own health beliefs, such as perceived susceptibility, severity, barriers, benefits, and self-efficacy (Maier et al., 2023; Weinstein et al., 2020). Weinstein's work on the PAPM has significantly impacted the understanding of health-related behaviors. It has been widely cited and applied in various research studies, particularly in

the context of health promotion, risk communication, and public health interventions. The model provides valuable insights into the cognitive and emotional processes that influence individuals' decisions to take preventive actions, such as getting vaccinated, undergoing screenings, or adopting healthier lifestyles.

The Precaution Adoption Process Model (PAPM) serves as the theoretical foundation for this study as it provides a framework for understanding how individuals progress through discrete stages when adopting preventive behaviors, from unawareness to maintaining a behavior. This model is used to examine how patients respond to health-related risks, specifically initial psychogenic non-epileptic seizures (PNES) among those without epilepsy (Weinstein et al., 2020). The research questions of this study revolve around predicting the occurrence of initial PNES episodes in patients without epilepsy and understanding the associations between specific patient conditions and PNES. The PAPM is relevant because it offers a structured framework for exploring how patients' awareness and decision-making regarding PNES may vary and how these variations relate to their risk factors (Weinstein et al., 2020). The PAPM provides a theoretical basis for understanding both predictive and descriptive aspects of the study. It allows the researcher to predict how patients at different stages of awareness and decision-making may behave in terms of PNES onset. Additionally, it helps describe the progression of patients through these stages and how they relate to the studied risk factors.

By applying the PAPM, the study informed the development of tailored interventions and strategies for patients at different stages of PNES awareness. For example, understanding which patient conditions are more strongly associated with PNES at specific stages can guide healthcare professionals in offering targeted support and education. In summary, the PAPM

theory provides a structured framework for examining how patients' awareness and decision-making regarding PNES are related to specific patient conditions. It aligns with the study's approach and research questions by offering insights into the stages of behavior change and their relevance to predicting and understanding initial PNES episodes among patients without epilepsy.

Nature of the Study

This quantitative retrospective cohort design was chosen for this study due to its suitability for investigating the predictive relationships between patient conditions and initial psychogenic non-epileptic seizures (PNES) among patients without epilepsy. The retrospective cohort design is ideal for this study as it allowed me to utilize extensive historical data, which is readily available from the University of California, Los Angeles (UCLA) adult video-EEG (vEEG) facility. This rich dataset contains comprehensive information about patients' conditions and their seizure experiences over a prolonged period, making it suitable for in-depth retrospective analysis. The primary aim of the study is to determine how specific patient conditions such as patient sex, medical comorbidities, sleep deprivation, head injury history, and eyes closed during seizures predict the occurrence of initial Psychogenic Non-Epileptic Seizures (PNES). The retrospective cohort design is particularly suited for this purpose as it will allow for the assessment of these predictive relationships by comparing historical patient data. Another advantage of this design is that it enables researchers to control for potential confounding variables, thereby enhancing the study's internal validity. By capturing data at a specific point in time and retrospectively analyzing it, the design facilitates the isolation of the effects of independent variables on the dependent variable, in this case, initial PNES. Furthermore, this

design allows for a comparative analysis between patients with and without PNES, as well as an examination of various patient conditions within these groups. This comparative analysis is crucial for understanding differences and associations. Thus, the retrospective cohort design is a powerful tool for examining associations and predicting outcomes in this context.

The study's key variables include independent, dependent, and covariate variables. The independent variables are patient sex, number of medical comorbidities, sleep deprivation, history of head injury, and whether eyes were closed during seizures. These variables are examined to determine their relationship with the occurrence of initial psychogenic non-epileptic seizures (PNES) among patients without epilepsy. The dependent variable is the occurrence of initial PNES. This binary variable categorizes patients into those who have experienced initial PNES and those who have not. It is the central outcome variable of interest in the study. Covariate variables are additional variables included in the analysis to control potential confounding effects. They are not the primary focus of the study but are considered to ensure the accuracy of the results. While specific covariates may vary based on the analysis, they commonly include factors like age, demographic characteristics, and potentially other medical or clinical variables that could influence the relationship between the independent variables and the dependent variable. The covariates for this study will include age, socio economic status and mental health conditions. These key study variables collectively form the foundation for examining the associations, predictions, and relationships related to initial PNES among patients without epilepsy. In conclusion, the retrospective cohort design was selected for its suitability in examining predictive relationships and associations related to initial PNES among patients

without epilepsy. It leverages historical data and offers control over confounding variables, aligning well with the research objectives and available data resources.

Definition of Terms

Psychogenic Non-Epileptic Seizures (PNES): In the context of this study, PNES refers to seizures that resemble epileptic seizures but are not caused by abnormal electrical activity in the brain. They are considered to have a psychological origin, often related to emotional or psychological stressors (Liampas et al., 2021).

Medical Comorbidities: Medical comorbidities are additional medical conditions or diseases that coexist with the primary medical condition under consideration. In this study, the term specifically relates to concurrent medical conditions experienced by patients alongside their seizure disorder (Richardson et al., 2020).

Sleep Deprivation: Sleep deprivation refers to the condition of not having enough sleep, typically less than the recommended amount for a given age group. In the study, it is explored as a potential factor influencing the occurrence of initial PNES (Blackwelder et al., 2021)

Head Injury in the Past: This term indicates a history of physical trauma to the head that occurred at some point before the study. It is examined to assess if a prior head injury is associated with the occurrence of initial PNES (McInnes et al., 2019).

Eyes Closed During Seizures: In the context of this study, it refers to the behavior of closing one's eyes during a seizure episode. This behavior is investigated to determine if it is predictive of initial PNES (Widyadharma et al., 2021).

Covariates: Covariates are additional variables included in the analysis to control potential confounding effects. They are considered alongside the main independent variables to

enhance the accuracy of the research findings by accounting for sources of variability or bias (Variyath & Brobbey, 2020).

Assumptions

In this study, several critical assumptions are made to ensure the meaningfulness of the research, despite the presence of limitations or unverifiable factors. Firstly, there is an assumption of data accuracy. The study relies on historical data collected at the University of California, Los Angeles (UCLA) adult video-EEG (vEEG) facility. It is assumed that the recorded information, including patient medical histories and seizure episodes, is reliable and free from significant errors or omissions. Any inaccuracies in the data could potentially impact on the study's findings. Secondly, there is an assumption of representativeness. The study utilizes a specific dataset from a single medical facility, which may not fully represent the broader population of patients without epilepsy who experience initial psychogenic non-epileptic seizures (PNES). There is an assumption of causality since the study aims to identify associations and predictors of initial PNES among patients without epilepsy. Fourthly, there is an assumption of missing data handling. In dealing with instances of missing data in retrospective studies, it is assumed that factors not explicitly documented in clinical records do not significantly impact patients' overall medical history or the occurrence of initial PNES. Lastly, there is an assumption of ethical data use. The study assumes that the data obtained from the UCLA adult vEEG facility has been collected and used ethically, with proper patient consent and privacy protection measures in place. These assumptions provide the foundation for data analysis and interpretation. However, it's important to recognize their limitations, and that the study's findings are contingent on these assumptions holding true to a reasonable degree.

Scope and Delimitations

The study addresses specific aspects of the research problem related to internal validity by focusing on the following key elements:

Patient Conditions and Initial PNES: The study specifically investigates the association between patient conditions, including patient sex, number of medical comorbidities, sleep deprivation, head injury in the past, and eyes closed during seizures, and the occurrence of initial psychogenic non-epileptic seizures (PNES) among patients without epilepsy. The selection of these variables is driven by the research problem's focus on understanding potential predictors of initial PNES. By examining these factors, the study aims to contribute valuable insights into the internal validity of the research problem.

Data Source and Historical Analysis: To enhance internal validity, the study utilizes data from the University of California, Los Angeles (UCLA) adult video-EEG (vEEG) facility. This choice of data source aligns with the research problem's focus on capturing historical information related to patients' medical conditions and seizure experiences. The data's historical nature allows for retrospective analysis, enabling the investigation of associations with initial PNES.

Statistical Control for Confounding Variables: To address potential sources of bias and enhance internal validity, the study employs statistical techniques, including multivariate piecewise-linear logistic regression, to control for confounding variables. By considering covariates and conducting separate regression analyses for different patient groups (patients with PNES and those with epileptic seizures), the study seeks to strengthen the internal validity of the findings.

Boundaries of the Study (External Validity)

Population Inclusions and Exclusions: The study's focus is on adult patients who have received video-electroencephalographic monitoring (VEM) at UCLA. It includes patients diagnosed with initial PNES as well as patients without PNES, including individuals with alternative seizure types or those without any seizure disorder. The study boundaries are defined by this specific population, and findings may not necessarily generalize pediatric patients or populations outside the UCLA facility.

Uninvestigated Theories/Conceptual Frameworks: While the study incorporates the Precaution Adoption Process Model (PAPM) as its conceptual framework, it does not investigate other theories or frameworks that may be relevant to the area of study. For example, other theoretical frameworks related to psychogenic seizures or psychological factors influencing seizure disorders are not explored. This choice of focus defines the external validity boundaries of the study, emphasizing the investigation of associations within the PAPM framework.

In summary, the study addresses specific aspects of the research problem related to internal validity by focusing on patient conditions and employing data analysis techniques to control potential bias. It also defines the boundaries of the study by specifying the included and excluded populations and the chosen conceptual framework, which impacts the study's external validity. These choices ensure that the study's findings are applicable within the defined context and contribute to the understanding of initial PNES among the chosen population.

Limitations

The study has several limitations that could potentially affect its validity and reliability. These limitations stem from design and methodological weaknesses, which can impact internal

and external validity, construct validity, and the presence of confounding variables. Additionally, biases that could influence the study outcomes need to be considered. One of the key limitations is the representativeness of the sample, which affects the external validity of the findings. The study utilizes data from a single institution (UCLA) for a specific time frame. This limits the generalizability of the findings as the sample may not fully represent the diversity of patients without epilepsy experiencing initial PNES in broader populations. To mitigate this, the researcher acknowledged this limitation and emphasize the need for further studies in different settings.

Another limitation was missing data, which can affect internal validity. The study assumes that factors not explicitly mentioned in clinical records do not significantly impact patients' overall medical history. This assumption introduces potential bias in data analysis. Sensitivity analyses can be conducted to assess the impact of missing data on the results, and multiple imputation techniques may be applied to address missing values. The study also relies on data from a specialized medical facility (UCLA), which could limit external validity as the patient population at this facility may have unique characteristics. Researchers can highlight these characteristics and discuss their potential implications for generalizability. While the study controls for known covariates, there may be unmeasured confounding variables that influence the relationship between independent variables and initial PNES. Sensitivity analyses can be performed to assess the impact of potential unmeasured confounders.

The accuracy and reliability of historical data, including patient histories and seizure episodes, may vary. Inaccurate data could affect construct validity. Sensitivity analyses can evaluate the impact of data reliability on the study's findings. The study includes patients who

have sought care at a specialized medical facility, which may introduce selection bias as patients with more severe or specific conditions may be overrepresented. I can acknowledge this potential bias and discuss its implications. Finally, ethical considerations are crucial to ensure data integrity and privacy protection. In the study, assuming that the data obtained from UCLA have been collected and used ethically, with proper patient consent and privacy protection measures in place. I should clearly state these ethical considerations and safeguards implemented in their study. In summary, the study has limitations related to representativeness, missing data, data source, potential confounders, data reliability, selection bias, and ethical considerations. To address these limitations, I can employ sensitivity analyses, discuss potential biases openly, and emphasize the need for future research in diverse settings. These measures can help enhance the study's internal and external validity and strengthen the overall robustness of the findings.

Significance

This study has the potential to make significant contributions to both field of public health, particularly within the subdomains of mental health and neurology and the practice/policy domains. In terms of advancements in the discipline, the study addresses a critical knowledge gap by investigating the predictors of initial psychogenic non-epileptic seizures (PNES) among patients without epilepsy. This contributes to our understanding of the factors that influence the onset of PNES, shedding light on a complex medical and psychological phenomenon. The study also extends the use of the Precaution Adoption Process Model (PAPM) beyond its traditional application in preventive behaviors, demonstrating its versatility in explaining health-related behaviors in the context of PNES. Furthermore, the study employs advanced statistical techniques, such as multivariate piecewise-linear logistic regression, to explore associations and

predictors of PNES. The application of these methods may provide insights into their utility in the field of seizure disorders and enhance methodological approaches in similar research areas. In terms of advancements in practice and policy, findings from the study may inform clinical practice by helping healthcare providers better understand the risk factors associated with initial PNES. This knowledge could lead to improved diagnostic assessments and more tailored interventions for patients without epilepsy who experience PNES. The study aligns with the principles of public health by addressing conditions that affect the well-being of individuals and communities. The identification of predictors and associations related to PNES may have broader public health implications, potentially guiding preventive strategies and intervention approaches to reduce the burden of the condition. Policymakers in the healthcare sector may benefit from the study's findings when considering policies related to the management and care of patients with PNES. Evidence-based insights into the factors influencing initial PNES can inform policy decisions to improve patient outcomes and resource allocation. In summary, this study has the potential to advance knowledge within the discipline by exploring predictors of initial PNES, applying the PAPM in a novel context, and utilizing advanced statistical techniques. Additionally, it may contribute to practice and policy domains by informing clinical assessments, public health strategies, and healthcare policies related to managing PNES among patients without epilepsy.

Summary

Chapter 1 of the study provides a comprehensive overview of the research problem and sets the stage for the entire research endeavor. It introduces epilepsy and seizure disorders, highlighting their prevalence and the intricate nature of psychogenic non-epileptic seizures

(PNES). The chapter emphasizes the challenges in diagnosing and managing PNES, which often mimic epileptic seizures but have psychological origins. It points out the diagnostic uncertainties and emotional distress associated with PNES. The central focus of the chapter is the identification of a critical gap in knowledge: the circumstances surrounding the initial occurrence of PNES among patients without a prior epilepsy diagnosis. It highlights that this specific aspect has received limited attention in existing research. The chapter acknowledges recent advances in understanding the diagnosis, neurobiology, and treatment of PNES. I mention that psychotherapeutic modalities have shown promise in reducing seizures and improving the quality of life for patients. Despite these advances, the need for further research into the factors contributing to the initial onset of PNES in patients without epilepsy is emphasized. The lack of early diagnostic and intervention strategies for this population is a significant issue. The chapter outlines the purpose of the quantitative study, which is to determine the extent to which specific patient conditions predict the occurrence of initial PNES and the associations between these conditions and PNES among patients with or without a prior PNES diagnosis. The independent and dependent variables are introduced. The Precaution Adoption Process Model (PAPM) is introduced as the theoretical framework grounding the study. The PAPM's stages of behavior change are explained and related to the research questions. The chapter explains the choice of a quantitative retrospective cohort design, highlighting its suitability for investigating predictive relationships and associations based on historical data. Overall, Chapter 1 serves as the foundation for the entire study, framing the research problem, justifying its significance, and introducing the key variables and theoretical framework that will guide the investigation. It also

acknowledges recent developments in PNES research while underscoring the need for a deeper understanding of the initial occurrence of PNES in patients without epilepsy.

Chapter 2: Literature Review

In this chapter, I provide an overview of literature relevant to the proposed study. There has been increasing recognition of the importance of PNES and ES in terms of overall health status. Current literature on PNES demonstrates that differentiating nonepileptic events such as PNES from ES is complicated, especially for individuals with diagnoses of both PNES and ES (Toffa et al., 2020). PNES patients have reported experiencing health complications and gambling to what extent PNES is characterized by abrupt paroxysmal changes in behavior without characteristic electrical discharge (Dewit et al., 2022). Because PNES is commonly diagnosed after evaluation of symptoms that are medication resistant or evaluation of atypical seizures utilizing video-electroencephalographic monitoring (VEM), low-cost objective score has the potential to assist in early identification of patients with PNES (Kerr et al., 2017). Self-reported psychopathology accounts for early differential diagnosis of PNES and ES, although self-reported psychopathology is often elevated in patients with PNES (Lloyd et al., 2022). The problem is that there is a lack of consensus on public health issues related to PNES as well as clinical care for PNES, including the use of suggestion techniques for recording PNES and optimal PNES terminology (Kotwas et al., 2021). According to past research, self-reported psychopathology scores are not accurate enough to raise the suspicion of PNES in clinical settings (Wang et al., 2019).

PNES is an important individual and public health burden. It is important that further discussion provides insight into frequent hospital visits by patients with PNES and the associated impact on public health. There is a lack of research regarding factors associated with initial prognosis of PNES among patients with or without ES seeking treatment. Deleuran et al. (2019)

said that PNES is known to be associated with significant costs for healthcare services. As Dhamija et al., (2019) pointed out, because many patients suffering from PNES rely on welfare benefits, PNES diagnosis poses great costs to the individual and society. According to Dhamija et al., (2019), however, the incidental nature of the disease makes diagnosis difficult, and the time between onset of seizures and correct diagnosis can be up to several years. Deleuran et al. (2019) noted that video-EEG (vEEG) monitoring offers a valid way of distinguishing PNES from ES, but access to epilepsy monitoring units (EMUs) is often limited, and suspicion of an improper diagnosis is necessary for referral to be made. Kerr et al. (2021) stated that although there is wide variation, studies have shown that individuals with PNES experience long diagnostic delays of 2–7 years, which result in delay of appropriate treatment (Carton et al., 2003), high costs for health services (Seneviratne et al., 2019), and increased risk of death due to external causes such as suicides.

There is a need for further understanding and exploration of factors associated with PNES with or without epilepsy. I seek to investigate the relationship between clinical factors (physical health status and PNES), care access and quality factors (insurance status and source of health care status), and sociodemographic factors (sex, race, age, marital status, education, and economic status), as well as behaviors among patients with PNES, to understand how patients with PNES perceive their use of healthcare and decisions in seeking help.

Literature Search Strategy

My strategy for locating sources to support this research was based on a search of English-language publications using the following key terms to identify relevant articles: *seizures, psychogenic nonepileptic seizures, psychological trauma, poor quality of life, seizures*

in adults, recurrent seizures, absence seizures, and psychogenic nonepileptic attack disorder. I used the U.S. National Library of Medicine, Google Scholar, PubMed Central, and JSTOR to obtain peer-reviewed literature and articles published from 2019 to 2023. I also used references published before that period to support key ideas and theories related to PNES behaviors among patients with PNES, as well as addressing the conceptual foundation that I used to determine the factors that I would investigate.

Conceptual Foundation

The conceptual framework for this study was the precaution adoption process model (PAPM), which was developed to explain the process by which people adopt preventive behaviors to protect against a risk (Barnard et al., 2017). The PAPM includes seven discrete stages: being unaware, becoming unengaged, being undecided about acting, deciding not to act, deciding to act, acting, and maintaining the behavior. The theory underlying the PAPM has been tested by Weinstein et al. (1998) in the context of home radon testing.

The amalgamation of both individual-level and social-capital-level interventions is needed to achieve substantial changes toward improving community health and health behaviors. According to the previous studies educating people to make healthy choices when their communities are not supportive will result in weak and short-term effects because there is no guarantee that people will make use of those resources (Wind & Villalonga-Olives, 2019). The PAPM is different from other models in that the community and health contexts of behavior are incorporated within the social capital construct. The social capital feature that facilitates action and cooperation for mutual benefit is essential for reducing social isolation and loneliness (Putnam, 2000). For my research, I started with the seven critical PAPM constructs, grounded on

the knowledge that a patient being unaware of PNES, becoming unengaged, being undecided about acting, deciding not to act, deciding to act, acting, and maintaining the behavior predict the association of PNES among patients with or without epilepsy. Because significant and dynamic interrelationships exist between these different levels of health determinants, interventions are most likely to be effective when they address determinants at all levels. Thus, the PAPM is appropriate for the effort to understand the impact of PNES behaviors among patients with PNES and their association with clinical, access, quality of care, and sociodemographic factors.

Precaution Adoption Process Model: Historical and Theoretical Background

De Vet et al. (2008) described the PAPM as an important theoretical framework that explains a person's decision-making process to avoid health threats through precautious behaviors. Baral et al. (2013) noted that researchers in social sciences and public health frequently use the PAPM to develop strategies, guidelines, and interventions to change behavior mechanisms based on the theory's comprehensive concepts and approaches to behavior change. Targeting behavior change is an important factor in reducing serious health conditions and preventing health burdens (Baral et al., 2013; Glanz et al., 2008). Thus, effective health behavior interventions are multilevel efforts focused on individuals who exhibit target behaviors and social capital conditions that lead to health behaviors.

Applications for Precaution Adoption Process Model in Health Research

The PAPM, with its seven concepts involving health promotion, is an important framework that explains a person's decision-making process to avoid health threats through precautious behaviors (De Vet et al., 2008). Compared with the behavior change stage model, the PAPM is more applicable for individuals with low awareness of health behaviors because it adds

decisional stages that do not recognize health behavior (Stages 1 and 2, unaware and unengaged by the issue, respectively) and a stage wherein no action is decided upon (Stage 4, decided not to act; Jin et al., 2021). Individuals' beliefs, self-efficacy, and knowledge influence the movement of the stage toward the adoption of health behaviors (Marlow et al., 2018). In the context of PNES, PAPM has been used to identify individuals' decisional stages related to breast cancer (Jin et al. 2021). The PAPM has been adopted by researchers investigating many health behaviors, and it provides a useful framework for achieving a better understanding of factors and barriers that impact PNES behavior.

Deleuran et al. (2019), seeking a direct correlation between PNES and ES, used the results of their retrospective study to inform policy making and health promotion efforts intended to improve quality of life for patients with PNES. An association was also found between seizure rate and number of healthcare contacts. The effect of intervention on seizures was comparable to that seen in meta-analysis (Calson et al., 2017), which demonstrated that the effect of psychotherapy was sustained at 1- and 2-year follow-up and seemed to be solid, as opposed to that seen in studies without any intervention (Reuber et al., 2003). One of the advantages of the use of the PAPM in such research is that it simultaneously focuses on different levels of influence, which permits broadening of the options for effective interventions.

Shin et al. (2023) conducted a cross-sectional study utilizing Korean female university students aged 20–29 years through an online survey. The main outcome from the study involved the decisional stage of cervical screening adoption (Shin et al., 2023). Employing the PAPM, Shin et al., (2023) suggested that the use of the health belief model based on educational interventions improved the knowledge and beliefs of female university students regarding

cervical screening. Additionally, participants in the preadoption stage preferred vaginal sampling compared to cervical sampling, which could be considered an effective method to engage nonparticipants.

For this study, I developed a PAPM approach that considers multiple levels of influence on the patient care behavior of patients with PNES, as well as the interaction between the different levels. The independent variables include patient sex, which is a categorical variable with two levels: male and female. The number of medical co-morbidities is a numerical variable that can take any non-negative integer value. Sleep deprivation, past head injury, and eyes closed during seizures are all categorical variables with two levels: yes and no. Patient behaviors, insurance status, and healthcare sources are also categorical variables, but the levels would depend on the specific behaviors, insurance statuses, and healthcare sources you're interested in studying. The dependent variable in your study is the occurrence of initial Psychogenic Non-Epileptic Seizures (PNES) among patients without epilepsy. This is a categorical variable with two levels: yes, if the patient had an initial PNES, and no, if the patient did not have an initial PNES.

The levels of influence based on PAPM, a person's decision-making process plays a role in avoiding health threats through precautious behaviors (De Vet et al. 2008), these factors include those within the individual system. In my research, I will utilize six PAPM constructs which are classified into three groups: (1) The pre-adoption stage group, which included stages 1 (unawareness; uninformed regarding PNES), 2 (unengaged; aware of PNES but has not provided serious thoughts regarding PNES), and 3 (undecided, considered but has not decided to undergo PNES treatment; (2) The refusal stage group, which included stage 4 (decided not to act; decided

to undergo PNES treatment); and (3) The adoption stage group, which included stages 5 (decided to act; decided to undergo PNES treatment) and stage 6 (acting; underwent PNES treatment). These social ecologies are interconnected in their respective relationships within an individual's psychological well-being. Including variables related to multiple social systems in the same analysis allows me to explore how they may be interrelated (Guo, Hopson, & Yang, 2018). The predictors of individuals with PNES and their PNES behavior (emergency visits, forgoing care, and delay in care) that I analyzed include clinical factors (physical health status and mental health status), access and quality of care factors (insurance status and source of health care status), and sociodemographic factors (sex, race, age, and education).

PAPM for seizure behavior among patients with PNES provides a potentially comprehensive framework for organizing risk and protective factor knowledge. Considerations for delivery of a multi-level approach can provide a framework to better understand how upper-level stages may moderate the influence of lower-level stages, and vice versa. The first stage identifies individual-level influences that may increase or decrease seizure behavior among individuals with PNES. Within the clinical stages, these are the physical health status of the patient which examines the general health condition and chronic health condition. Within the access and quality of care stages, it is the insurance status of the patient, specifically whether the patient was uninsured in the past 12 months. Within the sociodemographic factors, sex, race, age, and education, is when the patients were examined. The second stage examines close relationships that may affect the seizure behavior of individuals with PNES. Within the clinical factors, the mental health status of the patient, specifically seizure patients with emotional health conditions, were looked at how a person's closest social circle-peers, partners and family

members influence his or her behavior. The third stage explores the settings in which social relationships occur and seeks to identify the characteristics of these settings that are associated with seeking help. Within the access and quality of care factors, it is the source of health care for the patient, specifically the patients' source and difficulty of health care access. The fourth stage looks at the broad societal factors that help create a climate in which seizure behavior is encouraged or inhibited. Within the access and quality of care factors, it is the insurance status of the patient, specifically whether the insurance covers emergency visits. An understanding of which factors are related to seizure behaviors among those with PNES may be useful in designing targeted strategies for optimizing utilization and addressing the barriers to quality healthcare among those with PNES. Although the model contextualizes individuals' behaviors using dimensions such as intrapersonal, community and public policy to provide a framework for describing the interactions between these stages, no one model can describe all risk factors across these diverse domains. For example, in the higher order social and structural levels (e.g., community, policy) represent factors outside of the control of any individual person. And even though policy makers tend to target interventions at individual level, in a substantial proportion, PNES are disabling with poor long outcomes and high economic cost (Senf-Beckenbach et al. 2022). It is therefore important to note that factors can span through stages and the boundaries between stages may be understood as porous rather than distinct.

Literature Review Related to Concepts and Key PNES Variables

Emotional well-being and positive mental and physical health play an important role in a patient's overall health status. Based on Singh et al. (2022), "evidence shows that patients with PNES are more vigilant to emotional stimuli and have more attentional biases toward negative

emotional stimuli (angry faces) in comparison to positive emotional stimuli (happy faces)". Dworetzky (2015) said, PNES is a relatively large subgroup of functional neurologic disorders which is also responsible for the huge healthcare expenses estimated at approximately $900 million annually. Research on PNES has reported the existence of emotional triggers such as stress, getting upset, and traumatic memories amongst patients with PNES (Shakibaei et al. 2021., Benbadis, 2005a., 2005b).

Healthcare professionals have mixed opinions regarding whether psychotherapy is a recommendation for PNES patients or electroencephalography (EEG) as a diagnostic tool for PNES (Varone et al. 2020., Wang et al. 2019., Cianci et al. 2011., & Bodde et al. 2009). Bodde et al. (2009) argued that PNES with its underlying psychological problems, seizures appear on the boundaries of medical and personality traits. Sadeghia et al. (2021), Mojtabai (2011) and Murphy et al. (2004) argued that depression and anxiety are common psychological disorders which are increasing at an alarming rate. Functional Neurological Disorder (FND) is a problem with how the brain receives and sends information to the rest of the body. Symptoms that may affect other brain functions may include (speech difficulties, problems with seeing or hearing, pain, extreme slowness and fatigue and numbness or inability to sense or touch) (Muhrer, 2021; Nicholson et al., 2020). The exact cause of FND is unknown. A FND patient can function normally but during an episode, they just cannot function at that moment. Their brain is unable to send and receive signals properly and there is a disconnection in the function of the lobes and emotional processing (Zhu, A., & Burke, M. 2022). Although both the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V), and International Classification of Diseases, Tenth Revision, Clinical Modifications (ICD-11) use FND disorder as an indicator of

severity, as a qualifier of other symptoms and as an individual symptom, from which inconsistencies exist between the two systems in their use of FND for diagnosis of PNES. For example, Functional Neurological Symptom Disorder is diagnosed as a criterion for PNES in the DSM-5 but is classified as a "functional" referring to an impairment of normal bodily functioning that can be used to describe complex patients which are admitted for one condition, then experience another condition during admission as well as concurrent illness ICD-11(Asadi-Pooya et al., 2020; Varlam et al., 2022). Also, Functional Neurological Symptom Disorder is included in the determination of depressive disorder severity in the DSM-V, but is not an indicator of the severity of depressive disorder in the ICD-10-CM. Despite the discrepancies between DSM-5 and ICD-11 operationalization of FND, the inclusion of "disorder" as a diagnostic criterion by both systems show its clinical relevance to seizure diagnosis.

Reports from current literature indicate that PNES patients are less likely to be diagnosed from onset and more likely to be diagnosed with PNES years later (Kotwas et al 2021., Myer et al 2021 & Kerr et al. 2018.) The phenomenon has worse health outcomes compared to seizure patients diagnosed with onset. Using data from the Epilepsy Monitoring Unit (EMU) from January 1 to December 31, 2016, with follow-up until August 31, 2020, Ramamurthy et al. (2021) found that readmissions and emergency department visits after discharge with a diagnosis of PNES were more likely to have worse health outcomes. Mcllvennan et al. (2015) and Jencks et al. (2009) found that PNES patients were more likely to have worse health events such as unplanned hospital readmissions which can negatively impact a patient's overall health and quality of life. In addition, according to the Medicare Payment Advisory Commission (2021)

PNES patients present formidable challenges to the health care system because of the cost and patient outcomes.

LaFrance & Benbadis (2006) found that epilepsy misdiagnosis may lead to treatments with antiepileptic drugs (AEDs), posing the risk of elevated cost and iatrogenic morbidity for the healthcare system. The gold standard for PNES diagnosis is the visual examination of clinical events (Gasparini et al. 2019., Cianci et al. 2011., & Baslet et al. (2010) which is captured during video EEG, either occurring spontaneously or provoked by suggestion techniques. Since PNES is a major public health issue globally and has been associated with misdiagnosis and an increased risk of mortality, minimizing this association is not only part of reducing PNES misdiagnosis but also a larger public health goal on improving life expectancy (Varone et al., 2020; Lanoye et al., 2016).

Prevalence of PNES

Previous research in PNES also indicates that long-term outcome of patients with PNES is of importance given the disabling symptoms and tendency to affect patients early in their productive years (Salinsky et al. 2016). Health care utilization (HCU) indicators Salinsky and colleagues used included emergency department visits and hospitalizations during the 6 months following PNES diagnosis, compared with the 6 months preceding diagnosis and 6-12 months hospitalization visits. Salinsky et al. (2016) and Begley et al. (2005) compared patients with PNES to patients without PNES with respect to utilization of health care services, health care access and functional indicators. Emergency department visits, hospitalizations, outpatient clinic visits and radiology procedures were more frequent with PNES patients compared to patients without PNES. Patients with PNES were twice as likely to experience delays in care compared to

those without PNES (Salinsky et al. 2016). The study done by Salinsky and colleagues is like the report published by Begley et al. (2005) which indicates that patients with PNES are more likely to be misdiagnosed. Pain complaints, rather than seizures, were the most common symptoms in patients with PNES, both before and after Epilepsy Monitoring Unit admission. Selwa et al. (2000) also found that patients with PNES who had a more recent onset of seizures mostly within one year were much more likely to have remission of spells after diagnosis than their counterparts without PNES. Both studies used data that were able to report health care patterns and utilizations which is generalizable to the U.S. patient population and to suggest the importance of expanding the need for early intervention which could be valuable for PNES patients.

Antiepileptic drugs (AEDs)

AEDs are used to treat and prevent epilepsy or convulsions by controlling abnormal electrical activity in the brain. Because only Epilepsy Seizures (ES) respond to AEDs, failing to diagnose PNES or the coexistence of ES and PNES, may lead to unnecessary modifications and/or escalation of AEDs regimens to the point that patients with frequently recurring episodes may be totally sedated (Baroni et al. 2016). With such practical relevance, the occurrence is surprising for the event that such association is of uncertain prevalence with reported figures varying from 5.3 to 50% of patients with confirmed PNES (Altalib et al. 2016 & LaFrance et al. 2013). The factors associated with the co-occurrence of ES and PNES are far from clear (Baroni et al. 2016).

The analysis of sensorimotor rhythm (SMR) values for the treatment of PNES revealed significant progress in the reduction of PNES (Shakibae et al. 2021). Although findings related to

EEG biofeedback treatment for seizure behaviors that lack epileptiform activity are limited, increasing SMR might be also useful for PNES attacks (Lambos and Stark 2006; Swingle 1998). Also, it is proposed that the use of EEG biofeedback protocol acts through thalamocortical regulatory systems and increases cortical excitation thresholds (Mayer and Arns 2016; Morales-Quezada et al. 2019; J. K. Reddy and Sneha 2019; M. B. Sterman 2000). Since patients with pseudo-seizure represent higher levels of psychiatric problems, it is revealed that these types of seizures might have psychiatric origins for PNES patients (Milán-Tomás et al. 2018; Viarasilpa et al. 2020).

Correlates and Predictors of PNES

In addition to AED treatment and assessment, an individual's ability to cope with PNES may depend on access and quality of care factors, clinical factors, and sociodemographic factors that individualize vulnerability to seizure. Jina et al. (2021) said it is unclear what factors are associated with patients' stages in decision making and what factors may close the gap between patients' knowledge regarding their risk, engagement, and benefits. Therefore, the key to making a decision depends on whether to seek help is a perception of need. Previous studies have shown that about one-third of PNES patients can experience early improvement in seizure burden after video-electroencephalography confirmation and learning of their diagnosis, in most cases without receiving any additional intervention (McKenzie et al. 2010., & Selwa et al. 2000). On the other hand, some individuals may not perceive the need to seek help because they are not aware of the kind of help that is available, they may not recognize the problem as a health issue, they may believe that treatment will not solve the problem, they may not know the availability of appropriate assistance, they may be embarrassed about seeking help, and complete fear of

stigmatization (Weissman et al., 2017). Based on these uncertainties, perceived need can be influenced by the decisions individuals make and social context in response to symptoms. Having a better understanding of how perceived need for professional assistance relates to different variables can help in structuring programs that lead to appropriate medical assistance for those who need it the most (Weissman et al., 2017).

Factors Affecting PNES Behavior

Generally, psychological therapy is considered the treatment of choice for psychogenic nonepileptic seizures (Gillian et al. 2014) but reliable identification of clinical features that might distinguish PNES from ES is of value for diagnosis, understanding and management of both conditions. (Cardena et al., 2020, & Myer et al 2019). Although researchers have found that patients with PNES also report feelings of uncertainty, longer duration and negative emotion about recovery, their optimism for the future varies widely (Green et al., 2004). One of the most significant variables influencing PNES tendencies is linguistic barriers. When patients and relatives of patients with PNES describe episodes, they are more likely to describe contextual details rather than subjective seizure symptoms. They provide less detail, resist focusing on individual seizures, use more negation, unclear descriptions of unconsciousness, amnesia and differ in the metaphors to describe the seizures (Plug et al. 2009 & Schwabe et al. 2008). With regards to treatment and diagnosis needs, patients who identify with a psychological understanding of their health condition have a better appreciation of the rationale for therapy (Thompson et al. 2008., & Dickinson et al. 2011). Seeking help with a health issue is a complex process with multiple decision points, and at each point, a range of factors can accelerate or regress progress. For example, research on illness perspectives has found an important link

between a patient's illness perceptions, the way the patient copes with the illness, and eventual outcome (Hagger & Orbell., 2003). Most neurologists for decades where certain ictal behaviors occur reliably and in a similar order during the patient's seizures (Vogrig et al. 2019). Recent studies indicate that stigma is an obstacle to seeking help because self-stigma and the public reactions create embarrassment about seeking help (Clement et al., 2015; Schnyder et al., 2017). Patients with PNES feel most frequently stigmatized compared with ES patients and exhibit higher stigma levels (Karakis et al. 2020). The choice of terminology in public health is not only academic but also affects patients' response, understanding of their diagnosis, and their ability to navigate the health care systems. The debate about the term pseudo seizure began approximately 35 years ago when doctors were concerned about the negative connotations to patients and requested for name change (Duncan 2020). In the case of PNES, clinicians treat patients with complex personal narratives, values, and systems of meaning not diagnoses; but diagnoses can facilitate or obstruct that process (Wardrope et al. 2021). For patients living with PNES, finding a common consensus name may be an important step in sharing with their community and their clinicians what the condition is in relation to ES.

Comorbidities are positively related to seizure behaviors and PNES patients are often characterized with psychiatric comorbidities such as depression (Walsh et al. 2018). Although the exact nature of the relationship between medical illnesses and PNES is not clear; however, they could have a complex relationship (Asadi-Pooya & Homayoun, M. 2020). The existence of psychiatric comorbidities conditions allows for previous seizure experiences with medical providers that may lead to fewer barriers to seeking help for patients, especially if the experience has been a successful one. Popkirov et al. (2019), meanwhile, examined the relationship between

PNES and ER use among patients with medical comorbidity. Patients with medical comorbidity and PNES were more likely to use the ER compared to patients with medical comorbidity and no PNES. This is consistent with previous studies indicating that PNES is positively associated with ER use among the general population (Asadi-Pooya & Homayoun, 2020., Popkirov et al. 2019., & Asadi-Pooya et al. 2016). Although health professionals and practitioners recognize PNES as having a psychological origin, the use of appropriate terminology in ER has always been a challenge (Raulings & Reuben, 2018). Lack of appropriate naming can lead to confusion, multiple, and unclear terminology while in ER. Researchers showed that patients with PNES were more likely to avoid doctor's visits due to the thought of having complicated health issues, which may lead to ER visits (Kholi & Vercueil 2020). Considering that treatment of PNES in the ER is very expensive (Tyson et al, 2020), there is a need to develop health policy programs targeting those with PNES and ES.

Evaluating several factors that affect PNES behavior is important for understanding PNES behavior among individuals with PNES to provide an evidence-based recommendation on the feasibility and the potential content for PNES behavior. In this study I examined the relationship between clinical factors, comorbidities, chronic pain, physical identification and psychosocial characteristics, sociodemographic factors such as sex, race, age among patients with PNES, and other health Issues.

Clinical Factors

The concerns of PNES diagnosis as opposed to other functional neurological symptoms have always been a challenge or unknown. PNES is caused by psychological factors, while Functional neurological disorder (FND) is a condition characterized by neurological symptoms,

which cannot be explained as a neurological disease or other medical conditions (American Psychiatric Association, 2013., Hallett, 2011). The two most common neurological symptoms are PNES and functional motor symptoms, but the reason why a patient would present with one symptom rather than another is unclear (Huepe-Artigas et al. 2021). Information regarding the extent of physical pain and stress may help medical providers strategize on ways to effectively provide PNES patients with coping mechanisms to overcome the stress and to implement a wide range of alternative community support. Edwards et al. (2013)., Parees et al. (2012)., and Stone et al. (2017) argued that functional symptoms are dependent on the patient's idea of disease and by expectations of how the brain and body work, which may vary depending on their clinical history. These results derived from my dimensional approach on PNES may help medical providers check for specific signs of an underlying medical condition that may need treatment.

Comorbidities

There is a pressing need for new and validated screening instruments and guidelines to help with the burden of comorbidities amongst PNES patients. Many diseases, such as anemia, renal disorder, hypercholesterolemia, rheumatologic disorder, hypertension, cancer, asthma, cardiac disease, diabetes mellitus, depression, anxiety and respiratory disorders are more common in people with PNES and epilepsy than in the general population. It has been speculated in the research community that epilepsy may contribute to the risk for developing PNES not only through biologic mechanisms but also by providing an opportunity for model learning (Reuber, 2009). Medical comorbidities can greatly affect how patients react to diseases and if not addressed, it can eventually worsen the symptoms of the diseases. Considering the underlying mechanisms of comorbid association between physical diseases and PNES is still unknown, it is

imperative to know the existence of these associations. Asadi-Pooya & Homayoun (2020) showed that medical conditions such as thyroid disorder, depression, hypercholesterolemia, anemia, rheumatologic disorder, renal disorder, hypertension, cancer, anxiety and migraine have profound effects on the rate and severity of PNES. The presence of thyroid disorder often adversely affects the course of chronic disease and complicates its treatment. Being diagnosed with a medical illness could be a stressor for many patients. Individuals with high biological susceptibility to stress-related pathology, even mildly or moderately stressful experiences may precipitate PNES (Popkirov et al. 2019). In fact, Myer et al. (2013) reported that the prevalence of alexithymia in PNES was estimated to be approximately 36.9% with a significant correlation between alexithymia and Anxious Arousal. A considerable high prevalence rate of PNES can be found among adult epileptic patients. Epileptic patients suffering from social problems, and/or depression are more vulnerable to PNES especially during the last two years of treatment or above (Hussien et al. 2021). The existence of medical comorbidities and PNES conditions may complicate the physical health issues, as well as complicate the management of the diseases, exacerbate the burden of comorbid conditions, and alter the natural history of the comorbid conditions (Walsh et al. 2018., Asadi-Pooya & Emami. 2013).

The presence of PNES among patients with anxiety has been associated with anxiety disorders, such as rapid heart rate, chest pain, and palpitations (Myers et al. 2020., Kobau & Zack, 2019). Patients may also be at an increased risk of high blood pressure and heart disease. Per multivariable logistic regression, anxiety is the only consistent predictor of PNES across all race strata and sex (Myers et al. 2020). Patients with anxiety disorder who experience disruptive symptoms, such as muscle aches, stomachaches or unexplained pains are at increased risk for

major depression (Rawlings, Brown & Reuber., 2017). Green, Norman and Reuber (2017) analyzed data from 23 patients with PNES and 72 with epilepsy from July 2014-February 2015 at the Sheffield Teaching Hospitals and Chesterfield Royal Hospital NHS Foundation Trusts in the United Kingdom to understand the psychopathology levels in patients with PNES and those with epilepsy. Green et al. (2017) found that patients with PNES reported higher levels of anxiety and depression and lower health-related quality of life (HRQoL) than those with epilepsy. With attachment style and relationship quality the authors found larger amounts of variance in depression (45%) and anxiety (60%) in patients with PNES than those with epilepsy (16% and 13%). The clinical cut-off for depression (i.e., ≥ 10 on PHQ-9) was exceeded by 60.9% of participants with PNES and 43.1% of patients with epilepsy. This is consistent with existing literature that shows that patients with PNES suffer increased depression and anxiety, and lower HRQoL, than patients with epilepsy (Jones et al. 2016).

Myer et al. (2019) and Rawling, Brown, and Rauber (2017) examined patients with depression for evidence of PNES. Their studies on PNES and depression indicated that, although the majority of patients exhibited the ability to cope daily with psychological burden resulting from knowing their diagnosis, the treatment or management of the disease varies with different types of depression. For example, although lifetime rates of psychiatric disorders such as depressive disorders with 10-15%, anxiety disorder 10–44% and personality disorder 15–40% patients with epilepsy have lower rates than patients with PNES (Myers et al. 2019). Volbers et al. (2022) examined and assessed long-term follow-up outcomes in PNES patients, and their relevance in prognostic factors and daily life. A total of 99 patients were included and 69% were females; the researchers found that improvement in quality of life (QoL) for PNES patients was

not possible by PNES treatment alone but by alleviating the distress and frustration associated with the disease. For example, a study in patients with depressive disorder indicated that selective serotonin reuptake inhibitors (SSRIs) and serotonin-norepinephrine reuptake inhibitors (SNRIs) are known as first line treatment for primary depression (Ribot et al. 2017). Previous studies on depression have shown that 30–50% of patients with epilepsy may be symptomatic for more than one year before any treatment is suggested, irrespective of the severity of the symptoms (Kanner, Kozak & Frey, 2000., and Wiegartz et al. 1999). Analysis of data from a survey by the District of Columbia Area Survey (DCAS) indicated that selection bias could lead to under- or overestimation of low institutional trust and depressive symptoms (Ghanbari et al. 2022). This shows that family and friends are perceived as a support system for PNES patients, as well as health professionals, and demonstrates the importance of both depression and PNES to the health of individuals and communities.

As a result, Schmutz (2013) presented a critical review and perspective of dissociative seizures, which focuses on some relevant problematic issues that might account for a still unsatisfactory research knowledge state. Although research and publication on PNES is high, advances in knowledge and insight seem only moderate in recent years. The general tendency to deal with PNES or dissociative seizures as a sole symptom of an underlying psychiatric disorder has been one of the major root causes for PNES patients. Instead of adding to the comprehensive summary of research literature in PNES, Schmutz (2013) approach was directed towards the precarious position of dissociative seizures between neurology and psychiatry. The author argued that a general tendency to deal with dissociative seizures or PNES as a disorder and not as a sole

symptom might explain some of the obstacles to be overcome with a view to better understanding and research.

Considering that the psychiatric community is in denial of the problem of psychogenic symptoms Benbadis (2005), accessed the empirical findings as well as clinical experience as an ongoing disregard of the psychiatric mainstream in matters pertaining to dissociative seizures and other conversion symptoms. A review of the 2012 and the 2013 annual meeting program of the American Psychiatric Association (APA) illustrated the denial symptoms (APA 165th annual meeting, Philadelphia, (2012), and APA 166TH annual meeting, San Francisco, (2013). In both annual meetings, mainstream themes like mood disorders or psychosis, conversion and somatoform disorders were ranked at the very bottom of the hot topic list of current psychiatry. The scientific discussion about the proper naming of PNES seems to emerge in current literature as consensus regarding the appropriate diagnostic term (Sethi, 2013., and O'Hanlon et al. 2013). Panayiotopoulos (2010) agrees on the basis that "medical diagnosis is the identification of a disease by investigation of its symptoms and history, which provides a solid basis for the treatment and prognosis of the individual patient". From a clinical point of view, there are some psychiatric disorders where PNES, along with other conversion symptoms, characteristically may occur as one of the pathognomonic symptoms (Schmutz, 2013). The question of terminology should not be as trivial as it might seem. The use of the term PNES or similar constructs should focus on the main differentiation between epileptic and nonepileptic seizures, with psychogenic seizures forming a subgroup of the nonepileptic seizures (Schmutz, 2013).

Comorbid epilepsy and PNES occur in 12–22% of cases among patients with comorbidity and patients with PNES-only are most likely to have reported antecedent minor

head trauma as immediately preceding the first PNES than epileptic patients (Massot-Tarrus et al. 2022). Although there has been much research in epilepsy characteristics, psychiatric comorbidities and basic demographics associated with PNES, a systematic review concluded that due to uncertainty of comorbid epilepsy and the heterogeneity of the variables explored, the associated variables could not consistently distinguish patients with PNES-only from patients with PNES plus epilepsy (Baroni et al. 2016). The length of the seizures is an important characteristic to identify cases of PNES or epilepsy. Reports of seizures longer than 2 min had been pointed out before as suggestive of PNES (Cardena et al. 2020). This seems to indicate that the coexistence of neurological comorbidity as migraine or chronic pain and asthma may point to PNES-only (Baroni et al. 2016). Massot-Tarrus et al. (2022) investigated the baseline characteristics that may help distinguish patients with PNES-only from those with comorbid epilepsy. The study population included 194 patients with PNES-only, 30 with PNES plus possible or probable epilepsy and 47 with PNES plus definite epilepsy were included and 73.8% were female. Considering that risk factors for epilepsy are not uncommon in patients with PNES and can contribute to the development of the functional neurological disorder by causing disability, head trauma, or mood disorders Yon et al. (2020), some patients seem to have a consistent predictive value for comorbid epilepsy.

Finally, Gupta et al. (2020) found that the prevalence of PNES is higher among females with major depression conditions. This is significant because depression is common and often co-occurs. Factors associated with PNES included family history of epilepsy, interpersonal conflict, low education including literate/illiterate status, and presence of psychiatric comorbidity (Massot-Tarrus, Yu, ALKhateeh, & Mirsattari, 2022., Walsh, Levita & Reuber, 2018., Wiegartz,

Seidenberg, Woodard, Gidal, & Hermman, 1999). With a growing amount of evidence from prospective studies linking PNES to the increased incidence of depression such as diabetes, hypertension, and heart disease, it is important to consider that failure to early diagnosis and treatment of PNES may contribute to higher rates of some diseases.

Chronic Pain

PNES can be challenging to diagnose, but the presence of certain clinical features can help to distinguish PNES from ES (Gazzola et al. 2012). Chronic pain is a complex and multidimensional condition that affects a high percentage of older adults (Zimmer et al. 2020) and greatly impacts their functioning and well-being (Peng, Bao, Xie, Zhang, Huang, Liu, et al. 2020, and Welsh, Yang, & Makris. 2020). Gazzola, Carlson, Rugino, Hirsch, Starner and Devinsky (2012) conducted a case-controlled, retrospective analysis to examine pain medication use in 85 PNES patients versus an active control group of 85 patients with idiopathic generalized epilepsy (IGE). Compared to the active control group, chronic pain was more frequent among PNES patients than active control group and use of prescription pain medication was higher among PNES patients versus active control group (Gazzola et al. 2012). The leading medication of choice was opioid, while the results corroborate prior findings related to chronic pain and PNES, the Positive Predictive Value (PPV) of prescription pain medications for PNES was 76.9%. Which very closely resembled previous studies of 75% PPV of chronic pain and fibromyalgia for PNES (Benbadis, R., 2005).

Physical identification and psychosocial characteristics

There is insufficient data to understand the complexity and effect of sociodemographic variables on the incidence of PNES. The diagnosis of PNES can often be delayed due to the

identification process. Higher incidence in females and lower education groups have been reported in some studies, while others have not found such differences in these patient groups (Bora, Taskapilioglu, Seferoglu, Kotan, Bican, Ozkaya, & Akkaya, 2011., and Galimberti, Ratti, Murelli, Marchioni, Manni, & Tartara., 2003). The sociodemographic and psychosocial characteristics for the patient groups include sex, race, age, marital status, education, economic status, English proficiency and occupation, disability benefits, current smoker, current alcohol use, current illicit drug use, insurance, associated physical illness and associated psychiatric illnesses respectively (Nemade, Shivkumar, Ferguson, Singh, & Shah, 2020., and Cardena, Pick, & Litwin, 2020). I defined PNES in terms of sensitivity and specificity for various studies conducted for depression, anxiety disorder, panic disorder, traumatic experience, and family history of seizure disorder. The systematic review point score based on symptoms identified PNES patients with depression at 0.51 [0.38, 0.64] sensitivity (95% CI) and 0.73 [0.63, 0.82] specificity (95% CI)., anxiety disorder at 0.51 [0.38, 0.64] sensitivity (95% CI) and 0.78 [0.69, 0.86] specificity (95% CI)., panic disorder at 0.25 [0.14, 0.37] sensitivity (95% CI) and 0.91[0.84, 0.96]specificity (95% CI)., traumatic experience and family history of seizure disorder 0.31 [0.20, 0.44] sensitivity (95% CI) and 0.85 [0.76, 0.92] specificity (95% CI) (Schramke et al. 2010). The diagnostic point score ranged from 1 to 2, a score of 1 provides a sharp demarcation of seizures diagnosis. Patients were classified as having seizures if their score was equal or greater than one (Sheldon et al. 2002). Possible responses included a high number of losses of consciousness, head turning to one side during loss of consciousness, loss of consciousness with stress and unresponsiveness during loss of consciousness (Nemade et al. 2020).

Using historical criteria to summarize outcomes for symptom-based criteria for detecting PNES, six studies used historical criteria, all involving PNES and epilepsy seizure groups: one study focused on trauma and psychiatric history (Arnold & Privitera., 1996); two studies presented combined history-based scores (Schramke, J., Kay, A., Valeriano, P., & Kelly, M. 2010., Bozorg & Benbadis, 2009)., and three studies focused on comorbidities; (Benbadis, 2005., Dixit, Popescu, Bagić, Ghearing, & Hendrickson, 2013., Satpute, Chen, & Franks, 2014). In the study of Satpute et al. study, 50% sensitivity/75% specificity was realized for PNES patients. They also found between-group differences in rates of PTSD (in both PTSD and mTBI (sensitivity = 41.3%/specificity = 87.5%) and clinical diagnosis by psychiatrist; sensitivity = 63%/specificity = 81.3%), although Arnold and Privitera found lower PTSD rates in a general epilepsy monitoring unit (EMU) population. But rates of panic disorder and depression did not differ significantly between PNES and ES groups, which is consistent with findings from Schramke et al., who found panic disorder, depression, and anxiety disorder to be more prevalent in PNES, though only the latter with (sensitivity = 50%, specificity = 78%).

In contrast, three studies evaluated historical criteria other than comorbidities. Arnold and Privitera study found a history of traumatic experience concerning sexual or physical abuse which predicted PNES (sensitivity = 86%, specificity = 67%). A retrospective review of historical criteria was conducted by a psychologist at the epilepsy monitoring unit (EMU) facility (Schramke et al. 2010). They found that childhood abuse or neglect significantly predicted PNES (sensitivity=57%, specificity=88%). Marital instability, psychotropic medication uses, and a family history of seizure disorder or alcohol abuse were significantly associated with PNES.

Features in the study not predictive of a diagnosis included head injury, healthcare background, a history of antisocial behavior, pending litigation or disability claims.

A sample survey designed to provide estimates for PNES patients with other medically unexplained symptoms (MUS) and assessment of their long-term contribution to ill-health and unemployment including employment, healthcare utilization, and seizure outcomes records (McKenzie et al. 2016). When examining all patient groups at the time of diagnosis, PNES outcome for all 120 patients reported a 100% having seizures and were attending both primary and secondary care. While at 5–10 years, only 41/120 patients (34.2%) were accessing medical.

Care for seizures, 24/51 patients (47.1%) reported a date of last seizure that was more than 6 months before and 23/51 patients (45.1%) reported being free of seizures. The outcome for MUS patients at the time of diagnosis, 85/120 patients (70.8%) had active MUS, while at 5–10 years, 42/120 patients had active MUS (35.0%). Of those 42 patients with MUS at 5–10 years, 36 had MUS at baseline. Also, at the time of diagnosis, only 25/120 patients (20.8%) were employed, while at 5–10 years, only 11 of those patients were still employed. 9 additional patients described themselves as housewives, 3 were employed at 5–10 years. An additional Nine patients described themselves as students at the time of diagnosis, of whom 4 were employed at 5–10 years. The results indicated a significant long-term burden of non-PNES functional symptoms in patients with PNES (McKenzie et al. 2016).

To examine the trend in years, Mckenzie et al. used the completed computerized healthcare records and employment information of the patients to compare with the results of MUS patients. The findings were congruent in that MUS patients do not contribute independently to unemployment in the population with PNES, but psychiatric morbidity appears

to do so. Furthermore, psychiatric morbidity and MUS persist in the long term for the minority of patients with PNES. However, if MUS were to contribute significantly to the discrepancy between seizure outcome and economic inactivity, a predictive effect of MUS on employment, either as a binary logistic regression or as a single factor, should have been detected (McKenzie et al. 2016). Both results are congruent in that the analysis of the results underscores the difficulty of obtaining consistent long-term outcome data in this patient population. Performing face-to-face follow-up visits with patients is rarely achieved over the long term (McKenzie et al. 2016).

Duncan et al. (2014) examined the characteristics of PNES using postal questionnaires of 221 patients with PNES and compared the responses with information obtained from family doctors. The study by Duncan and colleagues showed that there is a wide variation in what patients considered as “free of attacks”. The authors suggested that PNES outcomes based on asking patients about their health condition such as, “are you free of attacks” should be interpreted with caution. Studies of medically unexplained symptoms and PNES suggest a strong relationship among outcome, social security payments, and employment status (Reuber et al. 2003McKenzie et al. 2010., Duncan et al. 2014).

Sociodemographic factors

Sociodemographic factors are also commonly assessed in PNES and ES studies, including sex, race, age, education, ethnicity, and income level. A consistent finding in the literature is that females have a more positive attitude towards seeking psychological help than males (Koydemir-Ozden, & Erel, 2010; Nam et al., 2013; Rose, & Rudolph, 2006). Igwe and colleagues performed a cross-sectional descriptive and questionnaire-based study to assess the health-seeking behavior

for pediatric epilepsy among caregivers in Southeast Nigeria and the associated sociodemographic factors. They found that strengthening the primary and secondary levels of care through continuous medical education of health workers in effective management of epilepsy is needed (Igwe et al. 2022). Sirven and colleagues (2021) performed a retrospective cohort study to better understand the role of social determinants of health in both treatment delays and treatment gaps for individuals with epilepsy and reported comparable results: treatment gaps and treatment delays were experienced, and factors predicted to impact treatment delays included care setting and education. Researchers have also shown that it is fundamental to determine new etiologies as rapidly as possible, with the hope of using the information to improve diagnosis and treatment in the future and ultimately even prevent ES (Nott et al. 2023).

The studies also indicated the empowerment of patients' involvement in their diagnosis and treatment: which means involving the patient in his/her self-care and being part of the disease process (Francina et al. 2021). Patients with ES and PNES when attending group health education sessions, not only hope for knowledge and management of the disease and crisis but also hope to share their experiences with other patients, professional emotional support and know the treatment options and social resources (Salord et al. 2021). Most studies indicated no association between income and PNES. A possible explanation for this finding might be that income as an indicator is not sensitive enough to detect socioeconomic differences in the use of health care services. In a cross-sectional observational study to understand the coping mechanisms of patients, Sawant & Umate (2021) found that improving the understanding of the various risk factors of PNES will help in sensitizing the neurologists, the psychiatrists, and patients to enquire into the history of PNES. Researchers have also shown that the coping

strategies used to deal with a particular stressor tend to change and PNES may itself represent a dissociative coping mechanism in which the appearance of the pseudo seizure reduces anxiety (Sawant, 2020). Goldstein et al. (2000) in their study found a higher means for accepting responsibility as a coping mechanism by PNES patients as compared to other studies. To improve the difficulties in education, it is necessary to identify the knowledge needs of patients in relation to their disease (Salord et al. 2021). The study also indicates that the variety of disease experiences presented allows patients to consider their own challenges with the disease results which is in line with other health educational studies such as that by Breuning et al., (2020) which summarized that the variety of disease experiences presented allows patients to consider their own challenges with the disease.

While linguistic barriers, comorbidities and sociodemographic factors facilitate PNES behavior, vulnerabilities have also been considered to inhibit PNES from both a diagnostic and therapeutic point of view (Gigliotte et al. 2023). Indeed, Winterdahla et al. (2017) reported women with a history of sexual abuse have been associated with neuropeptide Y (NPY) which is resilient to stress indicating that NPY could be a potential biomarker of PNES.

Other Health Issues

PNES is a predictor of depression, anxiety, quality of life and has a synergistic effect on patients' health status (Tilahun et al. 2021., Yon et al. 2020., Cardena et al. 2020., Ribot et al. 2017). Tilahun, Thompson, Sankary, Laryea, Trunick, and Jehi (2021) obtained retrospective patient reported outcomes (PRO) data from patients treated with Cognitive Behavioral Therapy-informed psychotherapy (CBTip) from January 2015 to January 2020 in an outpatient tertiary care epilepsy center. Compared to the second treatment analysis, there were significant

improvements in primary and secondary outcomes for patients treated longer than 3-months. CBTip and prior randomized controlled trials (RCT) were effective in reducing seizure burden and improving secondary outcomes such as psychological distress and quality of life. Other studies have documented that even when PNES symptoms resolve, most patients do not return to their premorbid level of functioning and stay disabled (Lempert., & Schmidt., 1990).

Myers et al. (2020) compared Spanish-speaking American patients with PNES to Spanish-speaking American patients with epilepsy on measures of depression, anxiety, and other clinical variables. The results indicated that Spanish-speaking American patients with PNES were significantly more depressed and anxious and reported greater exposure to sexual trauma as compared with patients with epilepsy. Also, patients with PNES tend to report more prediagnosis utilization of mental health services than patients with epilepsy (Myers et al. 2020). Myers and colleagues also looked at the educational levels of both study groups and identified a significant difference in education with the patients with epilepsy having completed more years of education on average. Considering that only 18% of patients with PNES experienced their seizure episodes for the first time during their school years and nearly 50% of patients with epilepsy experienced their seizure disorder during their school years (Myers et al. 2020). It might be speculated that psychiatric comorbidities and other life adversities in those with PNES contributed to the results. Comparisons of English-speaking PNES and epilepsy patients' groups have yielded similar findings regarding equivalent seizure frequency yet differing ages of onset (Myers et al. 2019). A Colombian study also reported late onset in a PNES-alone patient group as compared with a dually diagnosed PNES/epilepsy patient group (Jaramillo-Jimenez et al. 2019).

Summary

PNES is an important public health and patient burden. Although many studies have been conducted on PNES to demonstrate non-epileptic events such as psychogenic non-epileptic seizures from epileptic seizures, there remains a lack of understanding of the factors associated with the initial PNES amongst patients with or without epileptic seizures. Asadi-Pooya (2017) said the diagnosis of PNES can often be delayed by failure to consider the events as non-ictal in nature. Which can lead to inappropriate use of anti-epileptic drugs with possible serious side effects, in addition to the socioeconomic impact of an inappropriate diagnosis. PNES was positively associated with significant costs of healthcare services. Reuber et al. (2002) said the incidental nature of PNES makes diagnosis difficult and time between onset of seizures and correct diagnosis can be up to several years.

While it is known that patient health choices affect perceptions of the need to seek help, a large gap in the literature exists in PNES diagnosis. In particular, the relationship between clinical factors, comorbidities, chronic pain, physical identification, psychosocial characteristics, sociodemographic factors, and other health issues must be further explored. Supportive PNES diagnosis and targeting approaches may be important mechanisms in initial diagnosis of PNES in patients with or without epilepsy; however, there is a lack of research regarding factors associated with initial prognosis of PNES among patients with or without ES seeking treatment. Addressing these health issues requires an understanding of both the magnitude and role of clinical factors, comorbidities, and other health issues so that targeted strategies can be developed to address barriers to quality healthcare and optimize diagnosis among patients with PNES.

In Chapter 3, I discussed the mechanisms behind these important findings by providing an overview of my study methodology, including my research questions and hypotheses, research design and rationale for choosing that design, and a detailed overview of data sources. I clearly define variables and statistical methods as well as threats to study validity and ethical procedures.

Chapter 3: Research Method

In this section I expand on the research method and design chosen in completing the study. The purpose of this quantitative study is aimed at determining to what extent do patient sex, number of medical co morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic non epileptic seizures among patients with or without PNES as well as the association between patient sex, number of medical comorbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic non epileptic seizures among patients with or without PNES utilizing UCLA adult- Video-Electroencephalographic Monitoring (VEM) data (Sirven et al., 2022; Tilahun et al., 2021). The objective was to explore the associations between these variables and the occurrence of initial psychogenic non-epileptic seizures within the diverse population studied. I used secondary data from the University of California, Los Angeles (UCLA) adult video-EEG (vEEG) facility, employing a retrospective cohort design to address the research questions comprehensively (Tilahun et al. 2021).

Research Design and Rationale

The research design for the current study is a retrospective cohort design (Benchimol et al., 2015), characterized by its approach to exploring the relationships between patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures, and their predictive impact on initial psychogenic non-epileptic seizures (PNES) among patients, both with and without PNES.

The study delves into the extensive dataset sourced from UCLA adult video-EEG (vEEG) facility, renowned for its specialized electroencephalogram services for adults with seizures.

Drawing upon two distinct patient cohorts—retrospective data from January 2006 to April 2015 and prospective data from May 2015 to November 2016—the research will have a sample of 1375 adult patients with one cohort having 688 patients and another having 687, expertly diagnosed through clinical evaluations and diagnostic imaging. Each cohort will be analyzed separately to allow for a comparison of the results between the two groups. This approach will provide insights into any differences in the findings between the retrospective and prospective cohorts, enhancing the robustness and comprehensiveness of the study.

Given the nature of the research question and the availability of historical data, the retrospective cohort design emerged as the most fitting approach for the study. This methodological choice will allow the researcher to examine the relationships between the independent variables and the dependent variable, i.e., the presence of initial psychogenic non-epileptic seizures. By capturing data at a specific point in time and retrospectively examining the factors influencing initial presentations, this design offers unique insights into the associations under investigation.

The study's quantitative approach leverages a multivariate piecewise logistic regression method to facilitate individual-level predictive statistics (Kerr et al., 2018). Through this statistical analysis, the researcher skillfully assessed the individual contributions of each historical factor, ensuring rigorous control over the potential confounding effects of other variables. The separate regression analyses for patients with PNES and those with epileptic seizures enable independent evaluations of the predictive values for these distinct seizure types, bolstering the study's comprehensiveness.

To manage the instances of missing data in retrospective studies, the researcher will adopt a prudent assumption like assuming that factors not explicitly discussed in clinical notes do not significantly impact the overall patient history. Nonetheless, I acknowledged the potential for bias while interpreting the results, to maintain the study's integrity. To populate my findings, the researcher used the nonlinear effects of patient sex, age of seizure onset, and delay to video-electroencephalographic monitoring. Leveraging piecewise-linear logistic regression and linear analysis (Kerr et al., 2021), the researcher explored the relationship between these variables and the likelihood of PNES versus epileptic seizures. Additionally, Cohen's Kappa statistics was skillfully employed to assess the connection between neurologists and trained pre-medical students during diagnostic assessments, adding a layer of reliability assessment to the study. In conclusion, the retrospective cohort design forms the foundation of this research, enabling an in-depth examination of the predictive relationships between historical factors and initial psychogenic non-epileptic seizures among the diverse patient population under scrutiny.

Methodology

The target population for this study comprises adult patients who have received video-electroencephalographic monitoring (VEM) at UCLA. The study purposefully targets patients diagnosed with psychogenic non-epileptic seizures (PNES) and extends to patients who do not present with PNES, also including individuals diagnosed with alternative seizure types or even those without any seizure disorder.

Sample Population and Data Source

The study utilizes data from UCLA's adult video-EEG (vEEG) facility, which offers specialized electroencephalogram services for adults with seizures. The dataset comprises two subsets of patients: one group with data collected retrospectively from January 2006 to April 2015 and another with data collected prospectively from May 2015 to November 2016. In total, the dataset consists of 1375 adult patients with VEM-confirmed diagnoses.

Research Question 1 (RQ1), which specifically focuses on predicting initial psychogenic non-epileptic seizures (PNES) among patients without epilepsy, a refined sample population and data source selection are paramount. This entailed the identification and inclusion of patients who do not have a concurrent diagnosis of epilepsy and who exclusively exhibit PNES. Patients with a history of epilepsy or any epileptic seizures, as determined by expert clinical opinion and thorough evaluation, will be excluded from this particular analysis. The selection of patients without epilepsy aligns with the scope of RQ1. Consequently, the dataset for RQ1 will consist exclusively of patients who have been accurately diagnosed with PNES and do not exhibit any form of epilepsy. By isolating this subgroup, the analysis yielded insights specifically tailored to predicting PNES occurrence among patients without epilepsy. This focused approach enhanced the precision and applicability of the findings in addressing the distinct challenges and dynamics associated with this patient population.

Research Question 2 (RQ2) seeks to understand whether a combination of factors can predict the initial occurrence of PNES among patients without epilepsy. This requires a comprehensive analysis of multiple variables, including patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and whether eyes were closed during seizures.

The dataset for RQ2 will consist of patients who have been accurately diagnosed with PNES and do not exhibit any form of epilepsy. By examining these variables in combination, the analysis will provide insights into the complex interplay of factors that may contribute to the onset of PNES in this patient population.

Research Question 3 (RQ3) expands on RQ2 by also considering patient behaviors, insurance status, and healthcare source, and their interactions with the other variables. This requires a more nuanced analysis that not only considers each variable individually, but also how they interact with each other. The dataset for RQ3 will again consist of patients who have been accurately diagnosed with PNES and do not exhibit any form of epilepsy. By examining these additional variables and their interactions, the analysis will provide a more holistic understanding of the factors that influence the prediction of initial PNES among patients without epilepsy. This comprehensive approach will enhance the applicability of the findings in addressing the distinct challenges and dynamics associated with this patient population.

Data Analysis

To analyze the data and examine the predictive value of the identified risk factors, the researcher employed a multivariate piecewise- logistic regression method. This statistical technique was well-suited for assessing the individual-level predictive statistics, which are crucial in understanding the influence of each specific risk factor on the likelihood of PNES (Maragos & Theodosis, 2020). The choice of this methodology is based on its capacity to handle binary dependent variables (in this case, the occurrence of PNES) while accounting for the complex interplay between predictor variables (Jing-Nan et al., 2024).

The piecewise logistic regression model allowed for the assessment of non-linear relationships between predictor variables and the outcome (Jing-Nan et al., 2024). For instance, the influence of medical comorbidities or sleep deprivation may not follow a linear pattern across all patients, and this method can capture such nuances by dividing the data into segments and analyzing them separately. Additionally, the model will explore potential interactions among predictor variables, such as how the effects of head injury might differ by patient, sex, or age.

The piecewise logistic regression model allows the researcher to account for non-linear effects of the risk factors and their potential interactions in predicting the occurrence of PNES (Jing-Nan et al., 2024). The rationale for using a multivariate logistic regression model is grounded in its flexibility and statistical power for analyzing associations between multiple independent variables and a binary dependent variable. This approach enables the researcher to quantify the strength and direction of relationships for each predictor while controlling for potential confounders. The inclusion of the piecewise approach ensures that the analysis accommodates non-linear effects, providing a more comprehensive understanding of how these variables collectively influence the onset of PNES. By considering each predictor variable's influence across different segments of the patient population, this approach enables a more nuanced understanding of how the identified factors collectively contribute to the occurrence of PNES specifically among patients without epilepsy. The researcher will use Statistical Package for the Social Sciences (SPSS), version 28 or SAS or Statistical Analysis System (SAS) for data management, data cleaning, and basic statistical analyses.

Research Questions and Hypotheses

The research questions are as follows:

RQ1. To what extent do patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic non epileptic seizures amongst patients without epilepsy.

The alternative hypothesis (H1) is:

H_a1. Patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic non epileptic seizures amongst patients without epilepsy.

The null hypothesis (H0) is:

H_01: Patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures do not predict initial psychogenic non epileptic seizures amongst patients without epilepsy.

RQ2. Can the combination of patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures predict the initial occurrence of PNES among patients without epilepsy?

The alternative hypothesis (H1) is:

H_a2: The combination of patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures does predict the initial occurrence of PNES among patients without epilepsy

The null hypothesis (H0) is:

H_02: The combination of patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures does not predict the initial occurrence of PNES among patients without epilepsy.

RQ3. How do patient behaviors, insurance status, and healthcare source, and their interactions with patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures, influence the prediction of initial psychogenic non-epileptic seizures among patients without epilepsy?

The alternative hypothesis (H1) is:

H_a1. Patient behaviors, insurance status, and healthcare source, and their interactions with patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures, do influence the prediction of initial psychogenic non-epileptic seizures among patients without epilepsy.

The null hypothesis (H0) is:

H_01: Patient behaviors, insurance status, and healthcare source, and their interactions with patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures, do not influence the prediction of initial psychogenic non-epileptic seizures among patients without epilepsy.

Handling Missing Data

To address this issue prudently, the researcher will make certain assumptions about the unrecorded factors in the clinical notes. Specifically, I will assume that factors not explicitly mentioned in the clinical records are unlikely to significantly impact the overall patient history (Panagioti et al., 2019). This approach acknowledges the limitations of historical medical records and mitigates the potential for erroneous imputations and minimizes potential bias in the study's findings.

Ethical Considerations

I will strictly adhere to ethical guidelines and maintain patient confidentiality throughout the study. Since the data is obtained from the UCLA adult video-EEG facility, patient privacy and consent have been ensured during data collection. I will also consider the potential implications of the study findings and how they may contribute to patient care, well-being, and treatment decisions. Moreover, I will seek approval from the Walden University Institutional Review Board (IRB) to ensure that all research activities are conducted ethically and responsibly. I will also consider the potential implications of the study findings and how they may contribute to patient care, well-being, and treatment decisions.

Summary

In summary, the study uses a retrospective cohort design to explore the relationships between patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures, and their predictive impact on initial psychogenic non-epileptic seizures (PNES) among patients, both with and without PNES. The data is sourced from UCLA adult video-EEG (vEEG) facility and includes two distinct patient cohorts. A multivariate piecewise-linear logistic regression method is used to facilitate individual-level predictive statistics. The study also takes a prudent approach to handling missing data by assuming that factors not explicitly discussed in clinical notes do not significantly impact the overall patient history. The findings are populated using the nonlinear effects of patient sex, age of seizure onset, and delay to video-electroencephalographic monitoring valuable insights to the field of seizure disorders and improve patient care and treatment outcomes.

Chapter 4: Result

Introduction

The purpose of this quantitative study was to examine to what extent patient sex, number of medical comorbidities, sleep deprivation, previous head injury, and having eyes closed during seizures predicted early psychogenic non-epileptic seizures (PNES) in patient cohort with and without PNES. Using logistic regression as the analytical method, the study aimed to clarify the role of these variables in the initial presentation of PNES to facilitate earlier detection and targeted intervention. The dependent variable, occurrence of PNES, represented the outcome the study sought to predict, with the broader goal of supporting more precise public health strategies. By identifying these predictive characteristics, the study intended to inform early intervention approaches, ultimately aiming to reduce health risks associated with PNES and improve public health outcomes.

While existing research has explored PNES extensively, few studies have examined the specific causes and contributing conditions in patients without previous epilepsy diagnoses (Liampas et al., 2021; Toffa et al., 2020). This study aims to address this gap by identifying early predictors associated with PNES onset in patients who have not been diagnosed with epilepsy. Such insights are critical for enhancing clinical awareness and early intervention strategies, which can improve diagnostic precision, public health response, and patient care quality for this vulnerable population.

The study's analysis was guided by the following research questions (RQ):

RQ1: To what extent do patient sex, number of medical co-morbidities, sleep deprivation, head injury in the past, and eyes closed during seizures predict initial psychogenic nonepileptic seizures amongst patients without epilepsy.

RQ2: Can the combination of patient sex, number of medical co-morbidities, sleep deprivation, past head injury, and eyes closed during seizures predict the initial occurrence of PNES among patients without epilepsy?

This chapter presents the data analysis and results presented and discussed in the previous chapter of the research method. This chapter covers the study's findings, beginning with a summary of the participants' demographic details. It then provides descriptive statistics for the study's primary variables, followed by an investigation of statistical assumptions using binomial logistic regression. The organization of the chapter is organized into four major sections: 1) Introduction, which sets the setting for the study; 2) Data Collection, which describes the methods used to collect data; 3) Results, which present the findings from the data analysis; and 4) Summary, which provides a succinct review of the results and their significance.

Data Collection

This study's target sample included adult patients who had undergone video-electroencephalographic monitoring (VEM) at the University of California, Los Angeles. The study specifically targeted both patients with PNES and those who did not have PNES. This broader category included those with alternate seizure types as well as those who did not have a seizure disorder. The study drew on data from UCLA's adult video-EEG (vEEG) research facility, which provided specialist electroencephalogram services to individuals experiencing

seizures. The dataset consisted of data acquired retrospectively between January 2006 and April 2015.

There were some inconsistencies in the data collection and evaluation plan presented in Chapter 3. Some of the independent variables that were supposed to be used as controlling variables were absent from the secondary data. These included physical health status, mental health status, insurance status, healthcare provider status, and education. So RQs that were going to use these variables were not conducted.

The original secondary data (representing the Retrospective and Prospective Data) that was publicly available consisted of 1,449 records, with 53.8% (n = 780) of these records of persons who experienced epileptic seizures. The sample size decreased to 699 (46.2%) after these individuals had been excluded from the study. There were also records belonging to individuals who were not adults (under the age of 18), which were taken out as well (n = 23, 3.4%), resulting in a total of 646 data points for analysis. This was sufficient if the recommended computed minimum sample size of 113 was used.

The study included a total of 646 participants, with 27.1% (n = 175) enrolled in the prospective cohort and 72.9% (n = 471) in the retrospective cohort (See Table 1). The sample was almost evenly divided by sex, with 49.7% (n = 321) identifying as female and 50.3% (n = 325) identifying as male.

Table 1

Demographic Characteristics (N = 646)

	n	***%***
Cohort		
Prospective	175	27.1
Retrospective	471	72.9
Patient Sex		
Female	321	49.7
Male	325	50.3
Employed		
No	423	65.5
Yes	223	34.5
	M	***SD***
Age	40.4	15.6
Age of Onset of Seizures	29.4	18.2

Note: M = Mean; SD = Standard Deviation

Employment status indicated that a majority of participants (65.5%, n = 423) were not employed, while 34.5% (*n* = 223) were employed. The mean age of participants was 40.4 years (*SD* = 15.6), indicating a middle-aged sample with considerable variability in age. The mean age

of onset of seizures was 29.4 years (*SD* = 18.2), suggesting that, on average, participants began experiencing seizures in early adulthood, though there was substantial variation in the age of onset among the sample.

Results

Descriptive Statistics

The descriptive statistics for the main variables in the study are presented in Table 2. The sample was evenly split by sex, with 49.7% (*n* = 321) female and 50.3% (*n* = 325) male. A majority of participants (83.1%, *n* = 537) did not experience sleep deprivation, while 16.9% (*n* = 109) reported sleep deprivation. Regarding head injuries, 44.0% (*n* = 284) had a history of head injury, whereas 56.0% (*n* = 362) did not. Additionally, most participants (91.2%, *n* = 589) did not close their eyes during seizures, while 8.8% (*n* = 57) did. The number of medical co-morbidities had a median of 2, with an interquartile range (*IQR*) of 1.0 to 4.0, indicating that half of the participants had between 1 and 4 medical co-morbidities, with 2 being the midpoint of the distribution. This highlights the variability in the number of medical conditions among the participants.

Assumption Analysis

The study looked at the relationship between patient sex, number of medical comorbidities, sleep deprivation, previous head injury, and eyes closed during seizures, specifically their impact on early PNES in patients with and without PNES among adult patients who had undergone video-electroencephalographic monitoring (VEM) at the University of

Table 2

Descriptive Statistics of Main Variables

	n	***%***
Patient Sex		
Female	321	49.7
Male	325	50.3
Sleep Deprivation		
No	537	83.1
Yes	109	16.9
Head Injury in the Past		
No	362	56.0
Yes	284	44.0
Eyes Closed during Seizures		
No	589	91.2
Yes	57	8.8
	Mdn	***IQR***
Number of Medical Co-Morbidities	2	1.0 - 4.0

Note: Mdn = Median; IQR = Inter-quartile Range

California in Los Angeles. The purpose was to determine how these factors affected the onset of PNES in this specific cohort. Binomial logistic regression analysis was used to determine whether there was a statistically significant relationship between patient sex, number of medical comorbidities, sleep deprivation, previous head injury, eyes closed during seizures, and PNES prevalence. However, a few presumptions must always be satisfied in order to apply binomial logistic regression analysis definitively and obtain appropriate results. Even if the binomial logistic regression analysis is very reliable, it is usually a good idea to assess the degree of divergence from these assumptions in order to gauge the quality of the results.

Assumption 1: Dichotomy of the Dependent Variable

This assumption states that the dependent variable must be binary, with two different, unrelated categories (Laerd Statistics, n.d.). In this study, the dependent variable indicated whether a participant was diagnosed with PNES or not. This category variable reported whether or not there was any PNES prevalence.

Assumption 2: Nature of Independent Variables

The assumption was that there were at least two independent variables, which could be continuous or categorical (Laerd Statistics, 2018). This study included 5 variables in both formats: the sole continuous independent variable was the number of medical co-morbidities, with the remaining variables being binary (yes/no) responses (patient sex, sleep deprivation, previous head injury, and eyes closed during seizures).

Assumption 3: Independence of Observations

Each data point must be independent of the others, which means that the outcome of one observation has no bearing on another (Laerd Statistics, n.d.). This study ensured independence

through analyzing data from individual participants at the University of California, Los Angeles. The dataset included data collected retrospectively between January 2006 and April 2015. Every participant was treated as a separate entity.

Assumption 4: Minimum Case Requirement

A data stability recommendation suggests at least 15, and ideally up to 50, cases per independent variable to ensure robust estimates and avoid model convergence problems (Laerd Statistics, n.d). With five independent variables, a minimum of 75 data points was recommended. This study exceeded this criterion by roughly 646 instances.

Assumption 5: Linearity in the Logit

This principle asserts that each continuous independent variable has a linear relationship with the log odds (logit) of the dependent variable occurrence (Laerd Statistics, n.d.). This is the most essential assumption, and the linearity assumption states that every one-unit increment in a continuous independent variable result in a constant increase in the value of the dependent variable's log odds (logit). For example, in my study, for every one-percentage increase in the number of medical co-morbidities, the log odds (logit) of having PNES increased by a fixed amount. I used the Box-Tidwell test to evaluate the assumption of linearity, specifically if the relationship between the continuous independent variable (number of medical co-morbidities) and the dependent variable's log odds (PNES) was linear (Lipovac & Lipovac, 2020). I accomplished this by multiplying the continuous independent variable (number of medical co-morbidities) by its natural logarithm, resulting in an interaction term. I next conducted the logistic regression model, which included the original continuous variable, its interaction term,

and four additional independent variables (patient sex, sleep deprivation, prior head injury, and eyes closed during seizures).

Table 3

Variables in the Equation for the Box-Tidwell Linearity Test

	B	***S.E.***	***Wald***	***Sig.***
Patient Sex				
Female		Reference		
Male	.822	.195	17.698	.000
Number of Medical Co-Morbidities	-.521	.988	.278	.598
Number of Medical Co-Morbidities by Natural Log Number of Medical Co-Morbidities	.123	.274	.201	.654
Natural Log Number of Medical Co-Morbidities	***1.017***	***1.123***	***.820***	***.365***
Sleep Deprivation				
No		Reference		
Yes	-.041	.255	.026	.872
Head Injury in the Past				
No		Reference		
Yes	.090	.196	.209	.647
Eyes Closed during Seizures				

No	Reference			
Yes	.698	.342	4.152	.042
Constant	-.269	.948	.080	.777

Note: *B* = Unstandardized coefficient; *S.E.* = Standard Error; Wald = Wald Test Statistics; *p* = Significance at .05 level

The model was evaluated to determine the coefficient of the interaction term for the continuous variable. If the coefficient is significantly different from zero, it means that the relationship between the variable and log odds is not linear. In my investigation, the interaction term was not statistically significant (p =.365), indicating that the linearity assumption had not been violated (see Table 3).

Assumption 6: Avoidance of Multicollinearity

Data should not exhibit multicollinearity, which occurs when two or more independent variables have a strong correlation (Laerd Statistics, n.d.). The Variance Inflation Factor (VIF) was used to test the assumption that the data did not show multicollinearity, implying that the two independent variables were not related. According to the VIF, multicollinearity increases the variance of the predicted regression coefficient for an independent variable. A VIF score of 1 implies no multicollinearity between the variables, but a value of 10 or above indicates strong multicollinearity, and the assumption is not met. The study's VIF for the independent variables varied from 1.020 to 1.113, demonstrating that this assumption was not violated (see Table 4).

Table 4

Collinearity Statistics

	Tolerance	VIF
Patient Sex	.883	1.133
Number of Medical Co-Morbidities	.980	1.020
Sleep Deprivation	.974	1.027
Head Injury in the Past	.911	1.097
Eyes Closed during Seizures	.969	1.032

Assumption 7: Significant Outliers

The seventh and final assumption was that there should be no significant outliers (Laerd Statistics, n.d.). Outliers were identified via casewise diagnostics. The casewise list table shows cases with standardized residuals greater than ±2.5 standard deviations. The casewise plot was not generated since no outliers were discovered, indicating that the assumption was not violated.

Research Questions

The results of the univariate and multivariate analyses predicting initial psychogenic non-epileptic seizures (PNES) among patients without epilepsy are presented in Table 5. The findings from the univariate analysis showed that male patients had significantly higher odds of experiencing PNES compared to female patients (OR = 2.444, 95% CI [1.782, 3.354], $p < .001$). Similarly, patients who closed their eyes during seizures had significantly higher odds of PNES

(OR = 2.642, 95% CI [1.450, 4.814], $p = .002$). Sleep deprivation was associated with a lower likelihood of PNES (OR = .646, 95% CI [.426, .979], $p = .039$), while the number of medical co-morbidities and past head injuries were not significant predictors.

In the multivariate analysis, male patients continued to show significantly higher odds of PNES (OR = 2.333, 95% CI [1.664, 3.273], $p < .001$), and patients who closed their eyes during seizures also had significantly increased odds (OR = 2.219, 95% CI [1.196, 4.115], $p = .011$). However, sleep deprivation and past head injuries were no longer significant predictors in the multivariate model. The number of medical co-morbidities remained non-significant (OR = 1.038, 95% CI [.979, 1.102], $p = .212$). These results suggested that male sex and closing eyes during seizures were significant predictors of initial PNES among patients without epilepsy, even after controlling for other variables.

Table 5

Prediction of Initial Psychogenic Non-Epileptic Seizures amongst Patients Without Epilepsy

	Univariate Analysis 95% CI						Multivariate Analysis 95% CI					
	OR	**Lower**	**Upper**	**S.E.**	**Wald**	**p**	**OR**	**Lower**	**Upper**	**S.E.**	**Wald**	**p**
Patient Sex												
Female			Reference			.000			Reference			.000
Male	2.444	1.782	3.354	.161	30.676		2.333	1.664	3.273	.173	24.095	
Number of Medical Co-Morbidities	1.054	.995	1.116	.029	3.212	.073	1.038	.979	1.102	.030	1.557	.212
Sleep Deprivation												
No			Reference			.039			Reference			.194
Yes	.646	.426	.979	.212	4.246		.750	.485	1.158	.222	1.687	
Head Injury in the Past												
No			Reference			.302			Reference			.573
Yes	.849	.622	1.158	.159	1.068		1.102	.786	1.545	.172	.317	
Eyes Closed during Seizures						.002						.011
No			Reference						Reference			
Yes	2.642	1.450	4.814	.306	10.075		2.219	1.196	4.115	.315	6.397	

Note: CI = Confidence Interval; OR = Odds Ratio; S.E. = Standard Deviation; Wald = Wald Test Statistics; p = Significance at .05 level

Summary

The purpose of this study was to investigate factors associated with the initial occurrence of PNES among patients without epilepsy, with an emphasis on identifying predictors that could guide early intervention and public health strategies. This analysis examined the relationships between patient demographics, clinical characteristics, and seizure-related behaviors with PNES occurrence to improve community health outcomes. The findings revealed that patient sex and certain seizure-related behaviors were significant predictors of PNES. Specifically, male patients were more likely to experience PNES compared to female patients, and patients exhibiting eye-closing behavior during seizures showed a higher likelihood of PNES. These associations remained robust even after adjusting for other variables in the multivariate model.

While factors such as the number of medical comorbidities, sleep deprivation, and previous head injuries were explored, they did not consistently predict PNES in the adjusted

analysis. Although sleep deprivation showed a protective effect in the univariate analysis, this association did not remain significant in the multivariate model. Similarly, a history of head injury did not serve as a reliable predictor of PNES in this context.

These results highlight the need to consider sex and specific seizure-related behaviors in PNES risk assessments among patients without epilepsy. By focusing on these predictive factors, healthcare providers can develop more targeted early intervention and management strategies for PNES. Ultimately, this knowledge can contribute to improved diagnostic practices, better resource allocation, and enhanced public health outcomes by reducing the long-term impacts of PNES in this population.

The purpose and scope of this quantitative study will be discussed in Chapter 5. In Chapter 5, the findings will be discussed, interpreted, and evaluated. The study's shortcomings will be acknowledged. The merits of the study will also be discussed in Chapter 5, along with recommendations for further research. Chapter 5 also discusses the implications for positive social change, as well as the conclusion.

Chapter 5

The purpose of this quantitative study was to determine the extent to which patient sex, medical comorbidities, sleep deprivation, past head injuries, and eye closure during seizures predict the initial occurrence of psychogenic non-epileptic seizures (PNES) among patients with or without a prior diagnosis of epilepsy. This study aimed to address a significant gap in existing literature regarding the specific factors and conditions contributing to the initial development of PNES in individuals who have not previously been diagnosed with epilepsy. The key findings from the analysis in Chapter 4 revealed that several variables had a significant association with the onset of PNES. Specifically, male patients were more likely to experience PNES compared to female patients. Additionally, the behavior of eye-closing during seizures was strongly associated with PNES, even after controlling other factors in the multivariate analysis. In contrast, the number of medical comorbidities did not consistently predict PNES in the adjusted models. Similarly, while sleep deprivation showed a protective effect in the univariate analysis, this relationship did not hold true in the multivariate model. Lastly, a history of head injury was not found to be a reliable predictor of PNES. Chapter 5 presents an interpretation of the study's findings, discussion of the limitations of the research, and offers recommendations for future studies and practical implications based on the results.

Interpretation of the Findings

To What Extent Do Patient Sex, Number of Medical Co-Morbidities, Sleep Deprivation, Head Injury in the Past, and Eyes Closed During Seizures Predict Initial Psychogenic Non-Epileptic Seizures Amongst Patients Without Epilepsy?

The findings based on the first research question revealed that male sex and eyes closed during seizures were significant predictors. Specifically, male patients had more than twice the odds of experiencing PNES compared to female patients, as demonstrated by the odds ratio of 2.333 (95% CI [1.664, 3.273], $p < .001$). Similarly, individuals who exhibited eye-closed behavior during seizures were more than twice as likely to experience PNES (OR = 2.219, 95% CI [1.196, 4.115], $p = .011$). However, other variables, such as the number of medical comorbidities, sleep deprivation, and past head injuries were not significant predictors in the multivariate analysis, even though sleep deprivation showed some protective effect in the univariate analysis.

These findings corroborate, supplement, and, in some instances, refute prior research. The identification of eyes closed during seizures as a significant predictor is consistent with other studies, including Lopez and LaFrance (2022) that underscored the role of behavior indicators in distinguishing PNES from epileptic seizures. This constancy stresses the use of specific behavioral data in the evaluation of patients to diagnose PNES. In expanding previous work like Sawchuk et al. (2020), it is noteworthy that male sex was shown to be a significant predictor of PNES, while the disorder has been noted to be more common among females. The disparity indicates that the early cases of PNES in patients with no epilepsy might be different in terms of demographic and behavioral characteristics, more specifically in the gender of the patient. Notably, the observations insinuate that further investigation should be given to diagnose patterns, as male patients may have different presentation patterns than their female counterparts in PNES. However, the function of sleep deprivation is incongruent with previous studies. For instance, a study conducted by Toffa et al. (2020) indicated that lack of sleep makes a person

vulnerable to PNES because psychosocial factors such as coping mechanisms and stress resistance are compromised. While there was an association in the unadjusted analysis in the current study, it did not reach significance in the adjusted analysis, suggesting that any such association may be explained or conditioned by other factors. The discrepancy thus underlines the complexity of PNES etiology and the need for a differentiated understanding of how different risk factors interact in influencing seizure occurrence.

The findings, viewed through the lens of the Precaution Adoption Process Model, revolve around the dimension of awareness and resultant behavioral responses in health matters. As noted from the PAPM, individuals progress through stages of gaining awareness and making decisions in relation to health risks. On this basis, the above-mentioned behavioral predictor, the closing of the eyes throughout the seizures, may very well indicate the unconscious reaction to psychological discomfort, within early stages of PAPM and when the patient happens to be non-committal or non-enthusiastic about the entire possible psychological roots of the issues concerned. Similarly, the relevance of male sex as a predictor may be related to demographic and psychosocial determinants involved in the progression through the stages of the PAPM. For instance, male patients may have dissimilar patterns of enrollment or responsiveness to PSFs, which can raise the chances of PNES. By focusing on the analysis of behaviors within a framework, it simplifies the understanding of the demographic and behavioral factors that lead to PNES

Can the Combination of Patient Sex, Number of Medical Co-Morbidities, Sleep Deprivation, Past Head Injury, and Eyes Closed During Seizures Predict the Initial Occurrence of PNES Among Patients Without Epilepsy?

The second research question focused on examining the prediction of initial PNES occurrence, which required assessing the characteristics of patients, including patient sex, number of medical comorbidities, sleep deprivation, past head injury, and eyes closed during SEs. The results shown by multivariate logistic regression analysis in the study identified that the independent effect of some variables was expected to be directly associated with the occurrence of PNES, but the results also indicated that the overall predictive power of the included variables emphasized the fact that the cause of PNES is multifactorial. The multivariate analysis reaffirmed that the male gender and the behavior that involves the closing of eyes during seizures were predisposing factors for PNES among patients without epilepsy. Further, sex maintained a significant influence with an odds ratio of 2.333 (95% CI [1.664, 3.273], $p < .001$) which evidenced that male patients were more likely to experience PNES than female patients. Similarly, the observed behavior of closing eyes during seizures was also documented to have an increased odds ratio of PNES with an odds ratio of 2.219 (95% CI [1.196, 4.115], $p = 0.011$). Nonetheless, medical comorbidities, sleep deprivation, and past head injuries were not significantly associated with sport-related concussions in the combined model. These findings imply that the product of several factors does not contribute further to the prediction of PNES than the effects of sex and seizure behaviors alone.

The results of this study contribute to and enrich the body of knowledge in the field while also questioning some of its postulates. The status of male sex as an influential factor corresponds with the work of Toffa et al. (2020), which posited that differences between male and female patients' PNES may stem from disparities in psychosocial risk factors or diagnostic bias. However, this finding builds on the prior literature by showing that it applies in the case of

patients who do not have epilepsy. These findings regarding behavioral predictors like eyes closed during seizures align with Lopez and LaFrance (2022), who noted that behavioral markers play a vital role in discerning PNES from epileptic seizures. This finding supports researchers to continue practicing observational behavior when diagnosing patients. On the other hand, the no significance of medical comorbidities and previous head injuries does not align with the works of Liampas et al. (2021) where they discussed the relevance of the overall disease burden in predetermining PNES. The difference could be due to variations in the population samples used in the studies or exclusion of patient cohorts with epilepsy, which changes the dynamics of comorbid factors.

This finding can also be further conceptualized using the PAPM that focuses on perceiving, deciding, and adopting behavior (Weinstein et al., 2020). The findings of this study indicate that an investigation should be done using other variables to influence patients' status with the male sex and eyes closed when seizures occur, using especially the awareness and decision stages of the PAPM. For example, eye closure in seizures can symbolize responses of psychological stress related to the initial state of PAPM, that is a state of unawareness or indecision. However, the insight that male sex is a risk factor for PNES can be placed within the thematic of the demographic and psychosocial factors. Male patients might therefore present with variations in their level of compliance or response to psychological stressors as they move through stages of behavioral change. This finding is consistent with the theoretical framework of the PAPM, which posits that personal and contextual factors are jointly responsible for determining health-related outcomes.

Limitations of the Study

Several limitations were noted when conducting this study. One of the limitations was that the scope of generalizing the results of the study was limited because the data obtained was collected solely at the University of California, Los Angeles (UCLA) adult video-EEG facility. In this study, the dataset offered rich detail of the study sample, however, the results based on the patients in the specialized clinic might not be generalizable to all those who suffer from psychogenic non-epileptic seizures (PNES) in other settings. The exclusion of adult patients further narrows down the generalization of the results to children or elderly patients. In addition, since the dataset is retrospective and was collected from records between 2006–2015, certain recent developments in diagnostics or changes in the demographics of PNES patients may be overlooked.

There are several factors that limit the internal validity of the study. First of all, the methodology employed in this study limits the use of secondary data meaning that there was a bias in clinical records because some information might be missing or incomplete. For instance, there are some variables that were supposed to have been included in the study but were missing such as physical health status, mental health status, and insurance status. The lack of these controlling variables can result in residual confounding, which may alter the identified associations between the variables and PNES occurrence. Therefore, while the study used statistical adjustments for the measured confounders in the analysis, the failure to control unmeasured factors including specific psychological comorbidities or socioeconomic differences could potentially compromise the causal conclusions. In addition, analyzing the binomial logistic regression model entails some assumptions, including linearity in the logit and independence of

observations that were carefully examined. However, any variations from these assumptions, despite their negligible implications in this study, could cause biases in the parameters' estimation, hence influencing the research credibility.

The second key limitation involves the reliability of the data analyzed within the study. Given the clinical record-based study, the information on the patients' medical history, seizure description, and diagnosis results relies on how complete and accurate the documentation was at the time of data collection. Any inconsistency in measuring variables, such as a number of medical co-morbidities or behaviors during seizures, may affect the validity of the findings. Furthermore, the absence of standardized data collection protocols across different periods during the timeframe of the dataset may have led to unwanted variability that could not be captured.

Although these limitations introduce challenges, the strong sample size used for this study and advanced techniques of multivariate logistic regression employed would help assure, within their defined scope, the reliability and validity of the results. To improve the generalizability and validity of future studies, more effort should be invested in further diversifying samples, prospective data gathering, and controlling residual confounding effects as suggested by Schneeweiss and Patorno (2021). These efforts will enable better identification of the antecedents in the development of PNES and the characterization of inter-relationships as functions of demographic and clinical variables. By acknowledging these limitations, this study contributes to the literature on PNES but more research is needed to overcome such limitations and generalize the results of this study to other diverse samples and settings.

Recommendations for Further Research

Recommendations for future research studies aimed at uncovering further details about the subject and improving clinical and public health outcomes for PNES are suggested based on the results and limitations of this investigation. This study included variables such as patient sex, number of medical comorbidities, sleep, past head injury, and whether the eyes were closed at the time of the seizure as predictors of PNES start-up. However, due to the extensive and diverse nature of PNES, other psychosocial and environmental factors may contribute to the development of the disease. Future studies should assess other potential mediating factors like psychiatric comorbidities including depression, anxiety and trauma related disorders as suggested by Liampas et al. (2021). These factors are commonly associated with PNES but could not be incorporated into the current analysis because of the constraints in the data set. Furthermore, examining environmental stressors like adverse childhood experiences, social support systems, and ongoing psychosocial stress can help to develop a more comprehensive understanding of the underlying mechanisms of the PNES. These additional predictors may improve our ability to predict the models or tailoring clinical interventions based on individual patients' psychological and social context. Exploring these predictors might offer more in-depth knowledge of the psychological and social factors related to PNES and could enhance the models used to predict seizures.

This study was based on a sample from the University of California, Los Angeles (UCLA), which although statistically powerful, may not generalize well to other populations at large. It is important to note that the patients treated in this specialized clinic might not necessarily represent the full spectrum of PNES cases across the entire population, taking into

consideration geographic, cultural, and healthcare system differences. Future studies should recruit more participants and include cohorts from multiple centers with more diverse demographics and clinical characteristics. Including datasets from different centers would increase external validity given that the characteristics and predictors of PNES might be different in different types of population like children, elderly, individuals from different SES backgrounds etc.

The retrospective nature of this study made it difficult to establish a temporal relationship between the predictors and any observed occurrence of PNES. To overcome this limitation, future studies should use cross-sectional or prospective designs to observe participants' changes over time and determine the sequential relationships of potential risk factors to the development of PNES. The use of cross-sectional or prospective design approaches would offer a better premise for establishing causal conclusions and allowing for the design of proper prevention programs.

Recommendations for Practice

The findings of this research are of significant value in understanding the causative factors for psychogenic non-epileptic seizures (PNES) in patients without a diagnosis of epilepsy. The conclusions pointed towards interventions that may benefit clinical and public health processes and outcomes. From these findings, two specific recommendations for practice are offered, with the first addressing early identification of patients and the second addressing patient-focused interventions. The results of the study determined that the male sex and the behavior of closing eyes during seizures were independently associated with first PNES in patients with nonepileptic seizures. It is recommended that these variables should be included in

early screening processes within clinical settings. Healthcare providers, especially those in epilepsy monitoring units and emergency departments, should incorporate behavioral assessment tools that evaluate eye-closing patterns during seizures as part of the standard clinical examinations. Further, focusing on specific demographic features like the male sex may facilitate the identification of patients requiring further evaluation due to the increased risk for PNES (Lanzillotti et al., 2021). The focus would help enhance diagnosis accuracy, decrease the time to diagnosis, and prevent mismanagement that comes with the labeling of PNES as epilepsy. Responsible training programs that address the needs of neurologists and other healthcare professionals should focus on these predictors to achieve higher diagnostic precision and velocity when it comes to PNES.

Given the variability in the presentation and predictors of PNES, the treatment should be more individualized. Potential interventions for male patients or those who have eye closure during a seizure could include the provision of specific psychosocial and behavioral risk factors to healthcare providers and the formulation of education and intervention strategies to address these findings. Such approaches included the involvement of neurologists, psychologists, and behavioral therapists to address the core psychological issues and behavioral tendencies that were related to PNES. Cognitive-behavioral therapy (CBT), found in this study to be beneficial in diminishing PNES episodes, could be fine-tuned depending on the specific age, gender, and comorbid behavioral patterns of patients. Implementing these recommendations in healthcare practice can help enhance the identification, diagnosis, and management of PNES hence assisting in reducing the general public health cost related to this condition.

Implications

Positive Social Change

The findings of the study offer information on the early warning signs of PNES diagnosis among patients who have no epilepsy; thus, serving to promote positive social change at personal, domestic, corporate, and societal levels. At the individual level, the results underscore the need to address sex and specify certain behaviors during the seizures like having eyes closed as the part of initial screening for PNES. This knowledge helps the healthcare provider identify abnormal conditions earlier and more accurately, thereby decreasing the patient's anxiety and uncertainty experienced when undergoing lengthy diagnostic procedures. More accurate diagnoses translate to the enhancement of the well-being of patients and families and prevent issues like incorrect analysis and the administration of antiepileptic drugs to those who do not require them (Tilahun & Bautista, 2022).

Based on insights derived from this study, healthcare institutions at the organizational level can adjust their clinical guidelines and training curriculums. The integration of behavioral predictors into diagnosing models also guarantees the optimal management of medical resources such as video-EEG and eliminates instances where patients stay in the hospital for extended periods due to delayed diagnosis (Tatum et al., 2022). These improvements are congruent with societal objectives of cutting costs within healthcare and efficiently distributing resources, especially to groups that are ignored or misidentified.

On the societal level, these results are consistent with the establishment of effective PNES awareness campaigns and interventions. Higher awareness of PNES and its risk factors can result in less prejudice and enhanced support for those who have this condition (Coey et al.,

2023). The information gathered by policymakers can help intervene by implementing additional training in primary and emergency care environments for better diagnosis and management of PNES.

Methodological Implications

The results of this study highlight the importance of using appropriate statistical models in the health context, including binomial logistic regression analysis to test the prediction of multiple variables. In terms of study design and methodology, this research serves as a noteworthy model of how retrospective data can be collected and analyzed with a large sample group, paving the way for similar efforts dedicated to studying PNES and other functional neurological disorders. The findings of this present research support the importance of using diverse databases that incorporate psychosocial and behavioral entities in attempts to analyze intricate disorders like PNES.

Theoretical Implications

Following the Precaution Adoption Process Model (PAPM) as the theoretical framework, this study aims to expand the understanding of the model by applying it to functional neurological disorders. The conclusion corroborates the theoretical significance of the PAPM for aspiring to explicate health-related behaviors by mapping out one's individual qualities and actions like sex and seizure-related behaviors in relation to the progression of the health awareness and response phases. In this respect, the findings of the research supplement the

theoretical body of knowledge by associating the demographic and behavioral predictors with the model's conceptualization of stages of preventive behavior in the context of PNES.

Empirical Implications

The findings of this study contribute to the existing body of knowledge as they establish male sex and eye closure during the seizures as strong significant predictors of first PNES among patients without epilepsy. The significance of these predictors in the diagnosis of the condition is evident from the results of the study, and hence, the study affirms their value in clinical decision-making processes. Moreover, the focus of the study on behavioral predictors brings the attention to the fact that the diagnosis of PNES should be based not only on clinical examinations. In addressing these implications, the study contributes towards the improvement of individual and public health goals. They shall contribute significantly to early diagnosis, management, and resource distribution besides improving the quality of the health services offered to patients.

Conclusion

The purpose of this quantitative study was to determine the extent to which patient sex, medical comorbidities, sleep deprivation, past head injuries, and eye closure during seizures predict the initial occurrence of psychogenic non-epileptic seizures (PNES) among patients with or without a prior diagnosis of epilepsy. The results of this study established that the antecedent of PNES included male sex and eye closure during seizures, indicating demographic and behavioral risk factors in the development of the dysfunction. Other variables such as medical comorbidity count, sleep deprivation, and prior head injuries were not significant in the multivariate analysis, emphasizing the fact that PNES is a multifaceted and relatively complex condition.

The findings of this study offer beneficial insights for enhancing diagnostic performance and employing appropriate intervention measures. Therefore, incorporating the predictors into the clinical evaluation, including male sex and seizure-related behaviors will lead to better diagnostic accuracy, less misdiagnosis, and hence, better outcomes. This research also benefits theory by extending the use of the Precaution Adoption Process Model (PAPM) in the context of functional neurological disorders, specifically within the PNES population, to enhance our understanding of health behaviors. This study has contributed to explaining PNES onset in patients without epilepsy and highlighted the need for more studies with certain limitations. Other future research directions include integrating additional psychosocial and environmental factors into the study and conducting more prospective studies with larger samples from multiple centers to increase the validity of the results and improve the models. Finally, focusing on the implications for practice, it is crucial to stress the value of a multiprofessional approach to PNES diagnosis and management, as well as the potential for making a positive social impact by enhancing the quality of care for individuals with PNES and promoting efficient allocation of resources in healthcare organizations.

References

Asadi-Pooya, A. A. (2019). Pathophysiology of psychogenic nonepileptic attacks. *Journal of the American Medical Association (JAMA)*, *322*(13), 1315. https://doi.org/10.1001/jama.2019.11485

Asadi-Pooya, A. A., Brigo, F., Mildon, B., & Nicholson, T. R. (2020). Terminology for psychogenic nonepileptic seizures: Making the case for "functional seizures." *Epilepsy & Behavior*, *104*, 106895. https://doi.org/10.1016/j.yebeh.2019.106895

Blackwelder, A., Hoskins, M., & Huber, L. (2021). Effect of inadequate sleep on frequent mental distress. *Preventing Chronic Disease*, *18*. https://doi.org/10.5888/pcd18.200573

Brown, R. J., & Reuber, M. (2016). Psychological and psychiatric aspects of psychogenic non-epileptic seizures (PNES): A systematic review. *Clinical Psychology Review*, *45*, 157–182. https://doi.org/10.1016/j.cpr.2016.01.003

Cao, L., Huang, X., Wang, N., Wu, Z., Zhang, C., Gu, W., Cong, S., Ma, J., Wei, L., Deng, Y., Fang, Q., Niu, Q., Wang, J., Wang, Z., Yin, Y., Tian, J., Tian, S., Bi, H., Jiang, H., … Tang, B. (2021). Recommendations for the diagnosis and treatment of paroxysmal kinesigenic dyskinesia: An expert consensus in China. *Translational Neurodegeneration*, *10*(1). https://doi.org/10.1186/s40035-021-00231-8

Carlson, C. A. (2023). Psychogenic nonepileptic seizures—high mortality rate is a 'wake-up call.' *Journal of Personalized Medicine*, *13*(6), 892. https://doi.org/10.3390/jpm13060892

Cengiz, O., Jungilligens, J., Michaelis, R., Wellmer, J., & Popkirov, S. (2023). Dissociative seizures in the emergency room: Room for improvement. *Journal of Neurology, Neurosurgery & Psychiatry*. https://doi.org/10.1136/jnnp-2023-332063

Coey, P., Craith, I. N., McQuaid, L., D'Alton, P., & O'Connor, C. (2023). Does explaining psychogenic nonepileptic seizures using either a biomedical or biopsychosocial framework affect young people's illness representations? An experimental vignette study. *Epilepsy & Behavior*, *142*, 109186. https://doi.org/10.1016/j.yebeh.2023.109186

Dhamija, K., Chaudhry, N., & Puri, V. (2019). Psychogenic nonepileptic seizures (PNES): A Review. *MAMC Journal of Medical Sciences*, *5*(1), 1. https://doi.org/10.4103/mamcjms.mamcjms_57_18

How to perform a Binomial Logistic Regression in SPSS Statistics | Laerd Statistics. (n.d.). https://statistics.laerd.com/spss-tutorials/binomial-logistic-regression-using-spss-statistics.php

Jing-Nan, Y., Yu-Zhu, T., Yue, W., & Chun-Ho, W. (2024). Multiple-response logistic regression modeling with application to an analysis of cirrhosis liver disease data. *Computational Statistics*. https://doi.org/10.1007/s00180-024-01575-1

LaFaver, K., LaFrance, W. C., Price, M. E., Rosen, P. B., & Rapaport, M. (2020). Treatment of functional neurological disorder: Current state, future directions, and a research agenda. *Central Nervous System* (*CNS) Spectrums*, *26*(6), 607–613. https://doi.org/10.1017/s1092852920002138

Lanzillotti, A. I., Sarudiansky, M., Lombardi, N. R., Korman, G. P., & D´ Alessio, L. (2021). Updated review on the diagnosis and primary management of psychogenic nonepileptic seizure disorders. *Neuropsychiatric Disease and Treatment*, 1825-1838. https://doi.org/10.2147/NDT.S286710

Liampas, A., Markoula, S., Zis, P., & Reuber, M. (2021). Psychogenic non-epileptic seizures (PNES) in the context of concurrent epilepsy – making the right diagnosis. *Acta Epileptologica*, *3*(1). https://doi.org/10.1186/s42494-021-00057-x

Lipovac, A., & Lipovac, V. (2020). Logistic regression based in-service assessment of mobile web browsing service quality acceptability. *EURASIP Journal on Wireless Communications and Networking, 2020*(1), 1-21. https://doi.org/10.1186/s13638-020-01708-2

Lopez, M. R., & LaFrance, W. C. (2022). Treatment of psychogenic nonepileptic seizures. *Current Neurology and Neuroscience Reports*, *22*(8), 467–474. https://doi.org/10.1007/s11910-022-01209-3

Maier, A., Hayes, E., & Munday, L. (2023). Using the precaution adoption process model and the health belief model to understand Radon Testing and mitigation: A pre-post quasi-experimental study. *BioMed Central (BMC) Public Health*, *23*(1). https://doi.org/10.1186/s12889-023-15752-2

McInnes, K., Friesen, C. L., MacKenzie, D. E., Westwood, D. A., & Boe, S. G. (2019). Correction: Mild traumatic brain injury (mtbi) and chronic cognitive impairment: A scoping review. *PLOS ONE*, *14*(6). https://doi.org/10.1371/journal.pone.0218423

Muhrer, J. (2021). Functional neurological disorder: Overview and a case study. *The Journal for Nurse Practitioners*, *17*(10), 1221–1225. https://doi.org/10.1016/j.nurpra.2021.08.020

Nicholson, T. R., Carson, A., Edwards, M. J., Goldstein, L. H., Hallett, M., Mildon, B., Nielsen, G., Nicholson, C., Perez, D. L., Pick, S., Stone, J., Anderson, D., Asadi-Pooya, A., Aybek, S., Baslet, G., Bloem, B. R., Brown, R. J., Chalder, T., Damianova, M., …

Tinazzi, M. (2020). Outcome measures for functional neurological disorder: A review of the theoretical complexities. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *32*(1), 33–42. https://doi.org/10.1176/appi.neuropsych.19060128

Richardson, S., Hirsch, J. S., Narasimhan, M., Crawford, J. M., McGinn, T., Davidson, K. W., Barnaby, D. P., Becker, L. B., Chelico, J. D., Cohen, S. L., Cookingham, J., Coppa, K., Diefenbach, M. A., Dominello, A. J., Duer-Hefele, J., Falzon, L., Gitlin, J., Hajizadeh, N., Harvin, T. G., … Zanos, T. P. (2020). Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with covid-19 in the New York City area. *JAMA*, *323*(20), 2052. https://doi.org/10.1001/jama.2020.6775

Sawchuk, T., Asadi-Pooya, A. A., Myers, L., Valente, K. D., Restrepo, A. D., D' Alessio, L., Homayoun, M., Bahrami, Z., Alessi, R., Paytan, A. A., Kochen, S., Taha, F., Lazar, L. M., Pick, S., Nicholson, T. R., & Buchhalter, J. (2020). Clinical characteristics of psychogenic nonepileptic seizures across the lifespan: An international retrospective study. *Epilepsy & Behavior*, *102*, 106705. https://doi.org/10.1016/j.yebeh.2019.106705

Schneeweiss, S., & Patorno, E. (2021). Conducting real-world evidence studies on the clinical outcomes of diabetes treatments. *Endocrine Reviews*, *42*(5), 658-690. https://doi.org/10.1210/endrev/bnab007

Tatum, W. O., Mani, J., Jin, K., Halford, J. J., Gloss, D., Fahoum, F., & Beniczky, S. (2022). Minimum standards for inpatient long-term video-EEG monitoring: A clinical practice guideline of the international league against epilepsy and international federation of clinical neurophysiology. *Clinical Neurophysiology*, *134*, 111-128. https://doi.org/10.1016/j.clinph.2021.07.016

Tilahun, B. B., & Bautista, J. F. (2022). Psychogenic nonepileptic seizure: An empathetic, practical approach. *Cleveland Clinic Journal of Medicine*, *89*(5), 252–259. https://doi.org/10.3949/ccjm.89a.21109

Toffa, D. H., Poirier, L., & Nguyen, D. K. (2020). The first-line management of psychogenic non-epileptic seizures (PNES) in adults in the emergency: A practical approach. *Acta Epileptologica*, *2*(1). https://doi.org/10.1186/s42494-020-00016-y

Variyath, A. M., & Brobbey, A. (2020). Variable selection in multivariate multiple regression. *PLOS ONE*, *15*(7). https://doi.org/10.1371/journal.pone.0236067

Varlam, C. I., Dumitrache, A. M., Itu, A., Andreea, G., Rogojină, R., Bedreagă, I., Dragomir, R., Bădescu, A., & Patrichi, B. (2022). Functional neurological symptom disorder in a prolonged grief disorder or in depression? *European Psychiatry*, *65*(S1). https://doi.org/10.1192/j.eurpsy.2022.1175

Weinstein, N. D., Sandman, P. M., & Blalock, S. J. (2020). The precaution adoption process model. *The Wiley Encyclopedia of Health Psychology*, 495–506. https://doi.org/10.1002/9781119057840.ch100

Widyadharma, I. P., Soejitno, A., Samatra, D. P., & Sinardja, A. M. (2021). Clinical differentiation of psychogenic non-epileptic seizure: A practical diagnostic approach. *The Egyptian Journal of Neurology, Psychiatry and Neurosurgery*, *57*(1). https://doi.org/10.1186/s41983-021-00272-w

Xiang, X., Fang, J., & Guo, Y. (2019). Differential diagnosis between epileptic seizures and psychogenic nonepileptic seizures based on semiology. *Acta Epileptologica*, *1*(1). https://doi.org/10.1186/s42494-019-0008-4