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EDITORIAL

Dear Colleagues,

Social aspects are remarkable among the studies conducted in the field of epilepsy and the studies published in our journal. The problem of stigmatization and the level of disability of individuals with epilepsy who appear to be physically healthy are noteworthy. Driving license is one of the most important among these issues.

Whether or not people with epilepsy can get a driver's license has been on our agenda for many years. Until recently in Türkiye, individuals with epilepsy could not get a driver's license under any circumstances. In the modern world, we knew and learned that this was not the case. We were learning about the low risks of epilepsy causing serious accidents while driving. Finally, the struggle was resolved with a seemingly reasonable regulation. Patients who certify that they have been seizure-free for three years, take one or at most two anti-seizure medications and have regular check-ups every 6 months will be able to get or renew their driver's license. However, the disorganization and unsystematic nature of our healthcare system has exhausted neurologists. The pressure on physicians to obtain a driver's license by unregistered patients has made our colleagues rebel from time to time. However, I think this situation is temporary. Our duty is to bring up the issue frequently in patient education events and social media so that patients can learn the necessary conditions for a driver's license and manage the process in a healthier way.

I wish my dear colleagues a good summer period.

S. Naz Yeni, M.D., Prof.
Editor-in-Chief

Archives of Epilepsy

Review

The Presence of Epilepsy on Social Media Platforms - A Systematic Review of Cross Sectional Studies

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Abstract

On December 18th, 2024, 24 papers evaluating social media posts concerning epilepsy and people living with it were found with a search on Web of Science and PubMed. One paper referred to Facebook, two to Instagram, one to Pinterest, two to Reddit, two to TikTok, three to Twitter 'X', and 10 to YouTube. In three papers, the evaluation was not restricted to a special platform but rather to the language of the posts. Misinformation was often found. Perhaps the highest amount of misinformation was found on TikTok, with 55% of videos claiming to show an epileptic seizure rated as showing a psychogenic non-epileptic seizure. The highest amount of derogatory posts was found on Twitter 'X' with 41% of all tweets. More than 40% of the papers focused on YouTube videos. Only four papers used standardized scores to evaluate the posts. According to these scores, only the reliability of videos about cannabidiol oil in the treatment of epilepsy was clearly more than modest. It is an open question how social media posts on epilepsy, or people living with it, should be evaluated.

Keywords: Derogatory comments, YouTube, self presentation, cannabidiol

INTRODUCTION

When taking social media into account, the question arises how people with epilepsy present themselves or are presented without participation in a standardized survey. It will be difficult to analyse this because there is a tremendous amount of data. A study using an advanced machine-learning empowered methodology to analyse open-source digital conversations about epilepsy found 222,000 such conversations, although limiting the search to 12 months and including only conversations originating from US internet protocol addresses.[1] Therefore, studies on the knowledge about epilepsy and attitudes towards people with epilepsy as presented in social media will have to focus on special sources, timeslots, and questions to avoid being overwhelmed by a large amount of data, which is difficult to analyze. In the following review, we will present the studies on epilepsy in social media published until December 18th, 2024, and concerning posts about epilepsy on the platforms Facebook, Instagram, Pinterest, Reddit, TikTok, Twitter 'X', and YouTube. The kinds of posts, the goals, the groups of authors, and the quality of the posts as reported in the papers will be evaluated.

On December 18th, 2024, we launched a Web of Science and a PubMed search with the terms "epilepsy" AND "social media". We excluded duplicates, papers concerning epilepsy in dogs, studies using social media to post their own survey and studies where social media were only mentioned but not evaluated.

The search yielded 181 results in the Web of Science and 165 in PubMed. After excluding 114 duplicates, the remaining abstracts were screened, and after excluding 208 papers according to the criteria mentioned above, 24 papers were considered as relevant.

EVALUATION OF SINGLE SOCIAL MEDIA PLATFORMS

Evaluation of Facebook

In 2017, a higher number of pages and accounts was found on Facebook than on Twitter 'X' that were related to epilepsy, which just failed to reach significance (p=0.056).[2] Accounts of "non-profit foundations" were most common (47%) followed by "patients and caregiver support groups" (36%). No further evaluation was performed.

Evaluation of Instagram

When Baxendale[3] in November 2020 searched for the hashtag #epilepsy on Instagram more than 500,000 posts were found. She analysed the 100 most popular (liked or commented on) memes labelled with this hashtag and classified them into 9 broad categories: Seeking advice, raising awareness, inspirational quotes, celebrations of seizure milestones, living with epilepsy, sharing the diagnosis, experience of seizures, mediation, doctor/patient interactions. She delivers examples of the pictures but does not quantify the occurrence of memes in the different categories. Popoola-Samuel et al.[4] performed a standardized analysis of 431 posts on Instagram found in December 2022 with the hashtags #seizure, #seizures, #seizureawareness, #seizurefree and #seizuredisorder. Most of them were posted by the health and wellness industry (35.0%), followed by survivors or individuals affected by the disease (32.7%). The content of the posts was classified as true according to the actual definitions of seizures and epilepsy, at 76.8%. No content was regarded as false. All content was evaluated with the Global Quality Score (GQS)[5], which was developed to evaluate the information on websites about Crohn's disease or ulcerative colitis. This is a five-point Likert scale score with one point for poor quality and five points for excellent quality. On this score, more than half of the posts on Instagram were categorized as not useful or as providing only limited use to the patients. The mean score was 2.26. The reliability of the posts was evaluated with the modified DISCERN score.[6] This is an abridged version of the original score,[7] which was developed to evaluate health consumer information for treatment choices for myocardial infarction, endometriosis and chronic fatigue syndrome. In the abridged version, five questions have to be answered with "yes" or "no," resulting in one point for each "yes" and a maximal score of five points if all questions have been answered with "yes." The authors noted that clear aims were formulated in only 39.4% of posts, and that information was presented in a balanced and unbiased manner in only 28.3% of posts. Only 0.5% referred to areas of uncertainty. This resulted in a mean score of 2.11.

Evaluation of Pinterest

In 2017 a study concerning status epilepticus related pins on Pinterest was published.[8] Fifty-five pins were evaluated, of which 74.5% were based on scientific evidence and delivered accurate information. The purpose was in 67.3% educational. Just 1.8% of posts were negative in tone. However, only 12.7% of posts were used for advocacy purposes.

Evaluation of Reddit

On June 1st, 2022, the 50 most popular posts of adult authors within subreddits pertinent to neurosurgical concerns were identified and then analysed.[9] In the subreddit "epilepsy", 47 posts were found. About 70% of them were asking for social or health advice. Fifty posts were found in the subreddit "seizures," with 94% of them asking for social or health advice. Just 27.7% of the posts in the subreddit "epilepsy" and 18% of the posts in the subreddit "seizures" contained treatment-related questions. On October 9th, a similar screening of posts on Reddit was performed; was restricted to patients younger than 18 years, pregnant women, and relatives or close friends of patients younger than 18 years.[10] Here, 50 posts in the subreddit "epilepsy" and 24 in the subreddit "seizures" were selected. Just 17.6% of the posts were from patients younger than 18 years. 33.8% of posts were from relatives or close friends concerned with a patient in middle childhood (i.e, 6-12 years old). This was the largest subgroup of posts. The authors state that they did not find any obvious misinformation in any of the posts.

MAIN POINTS

- Up to 55% of posts provide misinformations like showing a psychogenic non-epileptic seizure instead of an epileptic seizure.
- Up to 41% of posts are derogatory.
- Only four papers used standardized scores to evaluate the posts.

Evaluation of TikTok

The top 109 videos found with the key word "epilepsy" on TikTok on December 18th, 2022, were evaluated.[11] The videos were classified as educational, personal experience, or event. Event videos showed seizures. Of 47 event videos, 26 (55%) were rated as showing psychogenic non-epileptic seizures. However, they had only 39% of the views of the event videos. The event videos showing epileptic seizures were more often viewed. Researchers classified 51 videos as "personal experience," featuring patients and family members describing opinions about epilepsy. They were not regarded as presenting any misinformation. Videos concerning first aid in generalized tonic-clonic seizures apart from a clinical setting were searched for in June 2024 with the search term "seizures first aid".[12] 19 videos were selected. The videos were evaluated with a 21-item checklist, created by the author based on English-language guidelines. The author noticed that the items of his checklist were not sufficiently dealt with in 71.2% of the videos on average. For example, the removal of eyeglasses during the seizure was not mentioned in 94.7% of the videos. Additionally, opening the airways once the seizure ended was missed in 94.7% of the videos. According to the author, 47.4% of the videos contained superfluous instructions. He regarded putting the person on the side as adequate only when the seizure has stopped. Additionally, he found 360 comments containing misinformation.

Evaluation of Twitter 'X'

In 2023, a study analysed all tweets posted in English or Spanish between 2007 and 2023 concerning six neurological diseases.[13] Epilepsy was in second place in Spanish posts and in third place in English posts. Since further evaluations were performed without distinguishing between the different diseases, no further information is given specific to the tweeds concerning epilepsy. This was done by the same authors in a second paper.[14] Here they stated that in 24.18% of the Spanish tweets concerning epilepsy, the disease was trivialized. According to a figure in the paper, the portion trivializing epilepsy was a little bit lower but also well above 20% in English tweeds. Epilepsy was regarded as not treatable in 54.45% of the English tweets and in 43.43% as treatable with professional help. From April 15th to April 21st, 2011, Twitter 'X' was searched for tweets concerning "seizure" or "seizures".[15] 1504 tweets were selected for analysis and classified into seven categories (e.g. "Metaphorical", "Informative", "Ridicule/Joke", "Personal Accounts", "Opinion", "Miscellaneous"). 32% were classified as "Metaphorical" describing analogies to "seizure-like" movements. 31% were "Personal accounts" describing personal experience

with having or witnessing a seizure. No other category included more than 12% of the tweeds. 8% of tweeds classified as "Ridicule/Joke" either made fun of seizures of people with epilepsy of joked about the simulation of a seizure. 41% of all tweeds belonging either to the category "Metaphorical" or "Ridicule/Joke" were regarded as derogatory concerning seizures or people with epilepsy. In 2017 a lower number of pages and accounts was found on Twitter 'X' than on Facebook related to epilepsy,[2] which just failed to reach significance (p=0.056). Accounts of "non-profit foundations" were most common (80%).

Evaluation of YouTube

Probably in 2008, Lo et al.[16] analysed the top 10 videos, identified by the number of "hits" on YouTube. The videos had been posted in 2005, 2006, and 2007. Eight of these videos were amateur videos, while the other two were professionally produced and posted for educational purposes. The authors evaluated the comments on the videos. The amateur videos were more often commented (i.e., 985 comments on average) than the professional ones (i.e., 159 comments on average). Most comments were not seeking or providing information. The comments for three videos provided information only in a considerable amount (i.e., 30-55%). Most videos were more often commented on sympathetically than derogatorily. There were many more derogatory than sympathetic comments on only two videos. Especially a video with the title "Seizure Caused by VIDEO GAMES!" got nearly 57% derogative comments. A video with the title "Real seizure captured in a crowded mall" had a polarizing effect with 36% derogatory and 34% sympathetic comments. In 2012 Kerson[17] reported about 127 videos found with the search terms "epilepsy" and "seizure" as a controlled presentation of themselves from people with epilepsy or supporting organizations. Out of the videos, 62% were self-narrated or narrated by a related person, and 28% were narrated by medical professionals or support groups. The author cited large parts of the texts accompanying the videos and encouraged readers to have a look at the videos themselves. It was emphasized that the posts allowed people to disclose material that society commonly chooses to hide. It is interpreted as a search for community, which was often answered by sympathetic comments. The question is how the message of the personal post could be appreciated in clinical practice. Brna et al.[18] performed a search on a single day in October 2011 in YouTube using the terms "epilepsy" and "seizures" with the search limits "videos" and "short (<4 min)". After excluding videos with a lack of relevance, 167 videos, including 5 duplicates, were analysed by four reviewers. The agreement of the reviewers was evaluated with the kappa-type measure[19] and categorized as poor agreement (k<0.00), slight agreement (k=0.00-0.20), fair agreement (k=0.21-0.40), moderate agreement (k=0.41-0.60), substantial agreement (k=0.61-0.80) and almost perfect agreement (k=0.81-1.00). According to this classification there was substantial agreement concerning the age of the shown individuals, moderate agreement for classifying a shown event as epileptic or non-epileptic, but the agreement for classifying an event as "indeterminate" was just slight. The range for classification of a "seizure" video as "non-epileptic seizure" between the reviews was from 25% to 52%. At least three of the reviewers agreed in 28% of the videos for the classification as "non-epileptic seizure". For the further classification of seizures the agreement was moderate for "generalized seizures", fair for "focal seizures" and slight for "unclassified". In April 2012 a single search was performed in YouTube using the terms "epilepsy" and "seizures".[20] The top 100 results of this search, according to the YouTube algorithm, were further analysed. 44% of the videos presented personal experiences and another 38% were informative or educational. The videos were rated on an accuracy scale, a sympathy scale, and a difficulty scale. 51% of the videos were regarded as accurate, 85% as sympathetic and only 6% as derogatory. On the difficulty scale, only 2% of the videos were rated as using technical language, while all others were regarded as understandable by laypersons. Bhoot et al.[21] evaluated 59 videos found on YouTube on the 23rd of March 2023 using keywords, such as "epilepsy", "seizures", "epilepsy treatment", "epilepsy prevention", "epilepsy cause" and "epilepsy cure". The majority of the videos were concerned with the treatment (i.e., 76.27%) and/or aetiology (i.e., 71.90%) of epilepsy. About half of the videos (i.e., 54.24%) displayed symptoms of epilepsy. The videos were rated with a mean GQS[5] of 3.3 and a mean modified DISCERN score[6] of 3.2.

Evaluations Focussing on a Special Theme in the Field of Epileptology on YouTube

A search focused on the combination of the term epilepsy with either "Cannabidiol" or "CBD oil" was performed by Silek and Bilgin Topcuoglu[22] on 3rd and 4th August 2022. They evaluated 100 videos using the GQS[5] and the modified version of the DISCERN score.[6] The mean GQS was 3.21; the mean modified DISCERN score was 3.71. Posts by doctors scored higher than others on both measures [i.e., GQS 3.51 standard deviation (SD) 1.02 vs. 3.01 SD 1.17; DISCERN 3.82 SD 1.02 vs. 3.07 SD 1.12].

Another search focused on the terms "sudden unexpected death in epilepsy" or "SUDEP."[23] The search was performed on January 9th, 2018, and 113 videos with a view count of at least 100 were found and further evaluated. Most posts were from individual users (51.3%), followed by posts from activist groups (40.7%). Only 8% of the posts were from professional societies. They had mainly an educational focus and were posted on average more than one year later than the posts from the other groups. Overall, there were only 298 comments. Most of them were on the posts of individual users (77.85%), which mainly consisted of tributes to patients who encountered SUDEP and personal experience. There was no evaluation based on one of the established scores.

Vagal nerve stimulation (VNS) for treatment of epilepsy was the focus of a search performed in May 2023 using the terms "VNS for seizures", "VNS surgery", and "VNS epilepsy".[24] We looked for videos in English that are not older than 15 years and that have at least 250 views. Fifty one videos were selected and evaluated with the GQS[5] and the modified DISCERN score.[6] The results of the GQS are stratified into low quality for 1-2 points, moderate quality for 3 points, and high quality for 4-5 points. According to this classification, 74.5% of the videos were of low quality and only 15.7% were of high quality. The total results of the modified DISCERN score are not reported separately. However, it is stated that the correlation with the GQS was high (i.e, r=0.807). 60.8% of the videos shared general information, and 25.5% presented experiences. Only two videos explained the use of magnets to provide additional stimulation. Both videos were rated as being of high quality according to the GQS.

Another survey was conducted concerning paroxysmal episodes in children, with "infantile spasms" and "absence seizures" from the field of epilepsy and "sleep myoclonus" as a phenomenon in the borderland of epilepsy.[25] The searches were performed on two dates in July and August 2011. Twenty videos of infantile spasms, 25 of absences, and 22 of sleep myoclonus were rated by all the authors concerning the correlation between the title of the video and the clinical diagnosis on a scale, with 0 points indicating "definitely not", 1 point for "unlikely", 2 points for "probable", and 3 points for "definite". With mean scores between 1.67 and 1.97, the videos presenting features of epilepsy or sleep myoclonus fall slightly below the classification of probably correctly titled. Especially for infantile spasms, 25% of the videos were rated as definitely showing other conditions. Some absence videos showed absences as part of a more serious epileptic condition, which may lead to unnecessary worries in parents of children with childhood absence epilepsy. Some videos were combined with misleading comments. However, the occurrence and severity of these problems were not quantified.

EVALUATION NOT RESTRICTED TO A SINGLE SOCIAL MEDIA PLATFORM

Evaluation Restricted to a Country or not English Language

In a search with the terms "epilepsy" and "seizures" Serbian, Croatian, and Bosnian on the platforms Facebook, YouTube, and Twitter 'X' at the end of 2021, over 4000 data points were found, from which 1000 were extracted using a randomized algorithm.[26] Accounts from support groups for people with epilepsy were most common (45.4%). The authors distinguished this group from other non-profit foundations with a representation below 5%. The most common topic of the posts and videos was stigmatization (31%). Most posts were seeking and providing information and advice (40%). Only about 5% of posts strengthened psychosocial support according to the classification of the authors. Alsalem[27] performed the same search as Karadžić and Ristić[26] a year before in Arabic language. He just found 795 pages, accounts, and videos meeting the objectives of his study. Most accounts were from medical and healthcare professionals and institutions (43%) and only 4% from non-profit institutions. People looked for information or advice on many accounts (32%), while only 13% of accounts were providing advice or consultations. The most frequent theme was the definition and classification of epilepsy (21%). On the other hand, 4% of accounts described nutrition treatments of epilepsy and another 6% discussed spiritual explanations and treatment. An internet search restricted to the Polish language and focused on the treatment of epilepsy with cannabidiol was performed on 27th November 2021, and data were obtained for the period of one year.[28] Three hundred fourteen texts were analysed. The most common sources were social media (i.e: Facebook, 37 posts; YouTube, 33 posts; Twitter 'X', 6 posts). All posts were evaluated with an online version of the original DISCERN score.[7] In this version, 16 questions have to be answered on a five-point Likert scale. The posts reached an overall score of 26.97, which means a mean score of 1.7 per post. As can be estimated from a figure in the paper, the mean score for the social media posts was slightly lower. This indicates a rather low quality. But when looking at the original data it is interesting to note that if the scoring had been restricted to the five items of the modified DISCERN score[6] the result would have been a little bit higher (i.e. 1.95).

Evaluation not Restricted

When performing a qualitative analysis of posts and tweets about epilepsy Meng et al.[2] extracted the most recent 50 results concerning eight thematic categories of their search without further differentiating between the media platforms Facebook and Twitter 'X'. They found that most posts provided information (48%), and support was looked for in only 8% of posts. In a sweeping analysis performed for the first two weeks of October 2020 on seven media platforms and world wide web 1,100 posts with the hashtags "epilepsy" or "epileptic". A sentiment analysis was performed, which revealed that 22% of the posts expressed a negative sentiment. This amount was higher on the World Wide Web and on Twitter 'X'. The results were published as a conference abstract only.[29]

DISCUSSION

More than 40% of the papers evaluating social media posts concerning epilepsy and people living with epilepsy focused on YouTube videos. However, the mode of evaluating the social media posts varied significantly between different papers. This is summarized in Table 1. Another problem is the interrater variability, which is taken into consideration in only a few papers (see also Table 1). Some papers mainly focused on the group of authors and their aim in their studies. When looking at the quality of the posts, the results were very different. Perhaps the highest amount of misinformation was found on TikTok with 55% of videos claiming to show an epileptic seizure were rated as showing a psychogenic non-epileptic seizure.[11] The highest amount of derogatory posts was found on Twitter 'X' with 41% of all tweeds. They were classified by the authors[15] as belonging either to the category "Metaphorical" or "Ridicule/Joke". When a qualitative evaluation of posts is performed, a standardized method should be applied and interrater reliability should be reported. Only four papers used standardized scores to evaluate the posts. According to these scores only the reliability of videos about the cannabidiol oil in treatment of epilepsy[22] was clearly more than modest. The results of the evaluation of the posts with two standardized scores are summarized in Table 2 and Table 3. The main limitation of this study is that, due to the high diversity of the evaluations performed in the cited papers, no thorough meta-analysis can be performed. There are more questions than answers after reading the referred studies. What should be evaluated when trying to understand the representation of epilepsy and people living with it on social media platforms? The groups of the authors? The aims of the posts? The quality according to a standardized score? The attitudes of the comments on these posts?

Table 1. Kinds of evaluation and reported interrater reliability

Platform	References	Kind of evaluation	Interrater reliability
Facebook	Meng et al.[2]	Sources	Not applicable
Instagram	Baxendale[3]	Categories of aims	Not applicable
Instagram	Popoola-Samuel et al.[4]	Aims and quality of posts	Not reported
Pinterest	Mahroum et al.[8]	Sources and aims	Not applicable
Reddit	To et al.[9]	Categories of aims	Not applicable
Reddit	To et al.[10]	Categories of aims	Not applicable
TikTok	Jiang et al.[11]	Sources, aims and reliability	**No interrater variability**
TikTok	Birkun[12]	Quality	Not applicable
Twitter	Domingo-Espiñeira[13]	Sources, aims	Not applicable
Twitter	Domingo-Espiñeira[14]	Themes and aims	Not applicable
Twitter	McNeil et al.[15]	Categories of aims	**No interrater variability**
Twitter	Meng et al.[2]	Sources	Not applicable
YouTube	Lo et al.[16]	Evaluation of comments!	Not applicable
YouTube	Kerson[17]	Hermeneutic	Not applicable
YouTube	Brna et al.[18]	Showing seizures or not	Epileptic seizure k=0.57 Non-epileptic seizure k=0.43 Indeterminate k=0.16
YouTube	Wong et al.[20]	Categories, accuracy, difficulty and sympathy of posts	Categories k=0.73 Accuracy k=0.54 Difficulty k=0.49 Sympathy scale 0.30
YouTube	Bhoot et al.[21]	Popularity, sources, aims, quality	Not applicable
YouTube	Silek and Bilgin Topcuoglu[22]	Quality	DISCERN Cronbach α=0.882 GQS Cronbach α=0.911
YouTube	Rayi et al.[23]	Type of content, sources, comments	Type of content k=0.68
YouTube	Özçelik et al.[24]	Categories, quality	GQS k=0.781
YouTube	Borusiak et al.[25]	Certainty of diagnosis, quality	Certainty of diagnosis: Infantile spasms k=0.49 Absences k=0.32 Sleep myoclonus k=0.32
Facebook, YouTube, Twitter	Karadžić and Ristić[26]	Topics, sources, aims	Not applicable
Facebook, YouTube, Twitter	Alsalem[27]	Topics, sources, aims	Not applicable
Facebook, YouTube, Twitter and others	Zakrzewski et al.[28]	Quality	Not applicable
Flickr, Instagram, Reddit, Tumblr, Twitter, Vimeo, YouTube, World Wide Web	Gangloff and Hanrahan[29]	Sentiment analysis	Not applicable

Cronbach α=measure of interrelatedness with 1.0 marking maximal correlation of results. DISCERN=standardized quality index of consumer health information.[6,7] k=Kappa-type measure,[19] k<0.00=poor agreement, k=0.00-0.20=slight agreement, k=0.21-0.40=fair agreement (k=0.21-0.40), k=0.41-0.60=moderate agreement, k=0.61-0.80=substantial agreement and k=0.81-1.00=almost perfect agreement.
Twitter 'X', GQS: Global Quality Score[5]

Table 2. Mean scores in GQS[5]

Platform	Score	References
Instagram	2.26	Popoola-Samuel et al.[4]
YouTube	3.3	Bhoot et al.[21]
YouTube	3.21	Silek and Bilgin Topcuoglu[22]

Global Quality Score: Five-point Likert scale score with one point for poor quality and five points for excellent quality.
GQS: Global Quality Score

Table 3. Mean scores in DISCERN score

Platform	Score	References
Instagram	2.11 (2.)	Popoola-Samuel et al.[4]
YouTube	3.2 (2.)	Bhoot et al.[21]
YouTube - focus on CBD	3.71 (2.)	Silek and Bilgin Topcuoglu[22]
YouTube, Twitter, Facebook - polish - focus on CBD	<1.7 (1.)	Zakrzewski et al.[28]

1. Original version.[7]
2. Modified version.[6]
DISCERN=standardized quality index of consumer health information. In the original version (1.), there are 20 items, each scored on a five-point Likert scale, where one represents poor quality and five represents excellent quality. Here, the mean score is given. In the modified version (2.), there are five questions to be answered with "yes" or "no," resulting in one point for each "yes". The range is from 0-5 points, with higher points indicating better quality.
CBD: Cannabidiol, Twitter 'X'

Footnotes

Data Availability Statement

The data used in this study can be checked by repeating the Web of science and PubMed research and excluding papers, which were published after December 18th, 2024.

Conflict of Interest: Johannes Rösche received a speaker honorarium from EISAI.

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Amygdala Kindling Resistance in Rats with Genetic Absence Epilepsy: Role of Sex Differences

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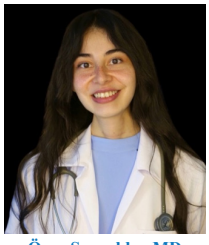

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Abstract

Objective: Genetic Absence Epilepsy Rats from Strasbourg (GAERS) exhibit notable resistance to amygdala kindling-induced seizures compared to Wistar rats. However, the influence of sex difference on kindling resistance in GAERS remains unexplored. This study aims to evaluate whether male and female GAERS differ in their susceptibility to kindling.

Methods: Three-to-4-month-old female (n=6) and male (n=6) GAERS and male Wistar rats as control (n=6) were implanted with a stimulation electrode stereotaxically into the basolateral amygdala and four recording electrodes on the cortex. After one-week recovery, animals were stimulated at the afterdischarge (AD) threshold twice a day for kindling until the maximum number of 15 stimulations or three consecutive stage 5 seizures according to Racine's scale. Stage and cumulative amygdala AD duration were analysed using GraphPad Prism with a one-way ANOVA test.

Results: At the end of the kindling procedure, all Wistar rats exhibited stage 5 seizures, whereas neither male nor female GAERS rats progressed to stage 5 ($p<0.001$). Cumulative amygdala AD duration was significantly higher in male Wistar rats compared to male GAERS ($p=0.001$) and female GAERS ($p=0.01$). However, no significant difference in cumulative amygdala AD duration was observed between male and female GAERS ($p=0.94$).

Conclusion: We have confirmed that this resistance also applies to female GAERS. This finding implies the importance of studying sex differences in epilepsy, as most existing research has focused predominantly on males.

Keywords: Absence epilepsy, kindling resistance, epilepsy rat model

INTRODUCTION

Epilepsy is a chronic neurological disorder characterized by spontaneous and recurrent seizures. It remains a significant global health issue, affecting approximately 50 million people worldwide.[1] Understanding the mechanisms underlying epilepsy development and progression, known as epileptogenesis, is critical for developing more effective treatments.[2] One widely used experimental model to study epileptogenesis and seizure dynamics is the kindling model.[3] In this model, repeated sub-treshold electrical stimulation of a specific brain region, often the amygdala, leads to the gradual development of seizures. Over time, this results in the generation of permanent changes in brain excitability, ultimately causing spontaneous seizures.[4,5] The Racine scale, which ranges from stage 1 (mild facial clonus) to stage 5 (generalized tonic-clonic seizures), is commonly employed to classify seizure severity in kindling studies.[6] The kindling model has been extensively studied in various rodent strains, each offering distinct insights into seizure susceptibility, progression, and resistance.[7] Genetic Absence Epilepsy Rats from Strasbourg (GAERS) is a well-established animal model for absence epilepsy, characterized by spontaneous spike-and-wave discharges (SWDs) seen on the electroencephalogram (EEG), which are also observed in human absence epilepsy.[8] GAERS have traditionally been considered resistant to convulsive seizures,[5,9,10] making them an interesting model to study epileptogenesis.[11] In contrast,

Wistar rats, commonly used as a control group, are susceptible to kindling, which produces convulsive seizures.[7,12,13] The differences in seizure susceptibility between these strains provide a valuable framework to investigate the underlying mechanisms of resistance and progression in kindling.[14,15] Previous studies have reported that GAERS rats exhibit slower kindling progression and lower seizure severity compared to non-epileptic controls.[1,5,15] The specific mechanisms behind this resistance are not fully understood, but it is hypothesized that both genetic and neurobiological factors contribute to their kindling resistance.[16,17] Additionally, sex differences in seizure susceptibility have been a topic of increasing interest, as hormonal influences and neuroanatomical differences between male and female rats may play a significant role in modulating seizure activity.[18,19] Understanding whether sex affects kindling resistance in GAERS rats is crucial, as it can provide insight into potential sex-specific therapeutic strategies for epilepsy.[7,12,20]

In this study, we investigated kindling resistance by comparing seizure progression and the duration of amygdala afterdischarge (AD) among male Wistar rats (control group), male GAERS rats, and female GAERS rats. We hypothesized that Wistar rats would exhibit faster kindling progression and longer AD durations compared to GAERS rats. We also aimed to explore potential sex differences in kindling dynamics within the GAERS population. By analyzing seizure stages, AD durations, and progression patterns, we sought to delineate the factors contributing to kindling resistance and their potential implications for understanding the broader mechanisms of epileptogenesis. Understanding these dynamics has significant implications for epilepsy research. For instance, investigating the differences between these strains could reveal potential targets for therapeutic interventions aimed at increasing seizure resistance. Additionally, understanding the sex-related factors influencing seizure dynamics could lead to personalized treatment strategies, considering sex-specific neurological and hormonal factors. This study provides new insights into the kindling resistance observed in GAERS rats and explores how both strain and sex contribute to differences in seizure dynamics. These findings are important for advancing our understanding of epilepsy and for developing novel and targeted approaches to managing this complex neurological disorder.

METHODS

Animals

Experiments were carried out with non-epileptic control male Wistar rats (n=6) and male (n=6) and female (n=6) GAERS rats aged 3 to 4 months. The animals were kept in a temperature-controlled room (20±3 °C) with a 12-h light-dark cycle. All animals were allowed free access to commercial rat pellets and tap water. All rats were housed in separate cages. The experimental protocol was approved by the Acıbadem Mehmet Ali Aydınlar University Ethical Committee for Experimental Animals (decision no: ACU-HADYEK 2023/39, date: 21.06.2023).

MAIN POINTS

- This study highlights the importance of studying sex differences in epilepsy research.
- Both male and female Genetic Absence Epilepsy Rats from Strasbourg (GAERS) show kindling resistance, with no significant difference between the sexes.
- Cumulative amygdala afterdischarge durations were significantly shorter in both male and female GAERS when compared to Wistar rats, suggesting greater seizure resistance in GAERS.

Stereotaxic Surgery

Animals were anesthetized using inhalation isoflurane (2.5-3%; the flow rate of oxygen was ~0.8 L/min) anesthesia and placed into a stereotaxic instrument (Stoelting Model 51,600, Stoelting Co. Illinois, USA). The scalp was longitudinally incised and the skull was leveled between lambda and bregma. A bipolar twisted stainless-steel electrode (MS303/1 twisted; Plastics One Inc., Roanoke, VA, USA), insulated except at the tip for stimulation, was implanted into the right basolateral amygdala (BLA) at coordinates anteroposterior (AP): -2.6 mm and lateral (L): 4.8 mm from bregma, and dorsoventral: -8.5 mm from the surface of the skull. For unilateral cortical EEG recording stainless steel screws were placed on the dura over the left frontal (AP: +2.0 mm and L: ±1.7 mm from bregma) and left occipital cortex (AP: -6.3 mm and L: ±4.0 mm from bregma). A ground electrode was placed over the cerebellum. Coordinates were obtained from the stereotaxic atlas of Paxinos and Watson,[21] and the bregma was used as the reference point. Electrodes were connected by insulated wires to a microconnector for EEG recordings, fixing them to the skull with dental acrylic following the surgery, the animals were returned to their cages for routine care, each housed individually, and allowed to recover for one week before the EEG recordings. The experimental study design is presented in Figure 1 and was created via BioRender.com.

Kindling

On the day of the experiment, the animals were placed in plexiglass cages and electrical stimulations were delivered from an isolated constant current stimulator (Accupulser A310, Stimulus isolator A365; World Precision Instrument, Sarasota, FL, USA). Following a 30-minute habituation period, basal EEG was recorded for 30 minutes. Then, the rats were stimulated with an initial stimulus of 50 μA (biphasic square wave pulses of 80 Hz, each 1 msec in duration, for a total duration of 2 seconds) and continued with 50 μA increments until an initial AD was obtained. The AD activity was defined as spike discharges lasting 2 seconds or more following the stimulation. The animals were stimulated twice daily with the determined current that produces AD in the EEG. Stimulations were given during a period that lacked SWDs in GAERS. If a SWD was observed in the EEG when the animal was connected to the stimulator, a waiting period was allowed before the stimulation was delivered. Seizure stages observed after each stimulus were classified using Racine's[6] standard 5-stage scale: stage 1, facial clonus; stage 2, rhythmic head movements, head nodding; stage 3, unilateral forelimb clonus; stage 4, bilateral forelimb clonus and rearing; stage 5, falling, rearing and tonic-clonic convulsion. If an animal had not reached stage 5 seizures in kindling development groups, electrical stimulation was terminated following the 15th stimulus. Thus, the maximum number of stimulations was 15 in the groups. Electrical activity in the amygdala and cortex was recorded with a PowerLab System before and after each stimulus. Amygdala AD durations were assessed from the EEG recordings offline.

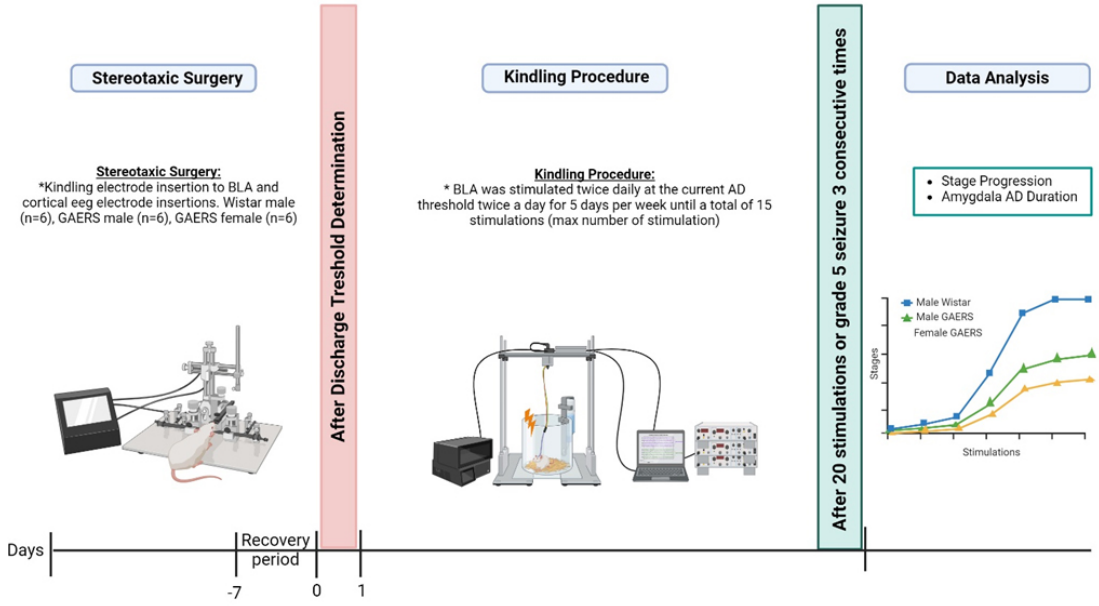

Figure 1. Experimental study design
GAERS: Genetic Absence Epilepsy Rats from Strasbourg, BLA: Basolateral amygdala, AD: Afterdischarge

EEG Analysis

Basal EEG was recorded from all Wistar rats to exclude any animal that could have absence-like activity. Electrical activity of the cortex and of the stimulated region of the amygdala was amplified through a BioAmp ML 136 amplifier, with bandpass filter settings at 1-40 Hz and recorded using Chart v.8.1 (PowerLab 8S ADInstruments, Oxfordshire, UK). A SWD complex in GAERS was identified as such if its duration was at least 1 s with a train of sharp spikes and slow waves (7-11 Hz) and amplitude of at least twice the background amplitude of the EEG.[10,22] The criteria for AD activity were defined as spike discharges lasting 2 seconds or more following stimulation, consistent with the guidelines.[6,16] The AD duration was measured as the total duration of spikes recorded on the EEG from the BLA electrode after the stimulation ended.

Histological Verification

At the end of the experiment, the animals were decapitated to verify the electrode placements. The brains were removed and placed in a formalin/sucrose mixture. Frozen sections were cut at 40 µm on a cryostat and stained with thionine. Only the animals with correct BLA electrode placement were included in this study (Figure 2).

Data Analysis

The results were expressed as "mean±standard error of the mean" and statistically evaluated using repeated measures ANOVA (GraphPad Prism, version 10.3.0, San Diego, CA, USA). One-way ANOVA was followed by Dunnett's post-hoc multiple comparison test. This was used to compare the mean numbers of stimulations to reach the first stage 2, 3, 4, and 5 seizures, among more than two groups. Statistical significance was determined at $p<0.05$.

RESULTS

The mean number of stimulations to display the first stage 5 seizure was 8.2±2.6 in Wistar control rats, as shown in Figure 3.

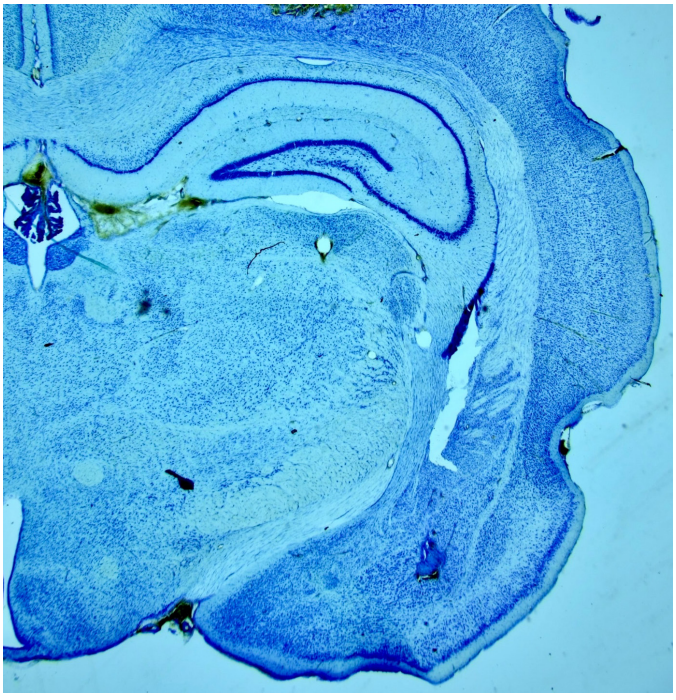

Figure 2. Histological verification of BLA electrode placement with thionine staining. The arrowhead in this coronal section indicates the location of BLA
GAERS: Genetic Absence Epilepsy Rats from Strasbourg, BLA: Basolateral amygdala

In contrast to Wistar rats, both male and female GAERS never showed stage 5 seizures following 15 stimulations (Figure 3). Therefore, all GAERS were stimulated until the maximum number of stimulations (15) was reached.

Kindling stimulation with currents at AD threshold produced AD that was recorded simultaneously from the amygdala and

frontoparietal cortices of both groups. Cumulative AD durations in the amygdala of Wistar rats (317.0±17.3s) were significantly longer than those in both male GAERS (91.22±23.47s) and female GAERS (82.28±14.44s). No significant difference in the cumulative AD duration in the amygdala was observed between male GAERS (91.22±23.47s) and female GAERS (82.28±14.44s), as shown in Figure 4.

DISCUSSION

The results of our study are consistent with previous studies and provide further evidence that while Wistar rats rapidly progress to stage 5 seizures and have longer cumulative AD durations, GAERS never progress to stage 3-5.[5,9] This indicates that GAERS rats have an enhanced resistance to kindling-induced seizure development. The absence of significant differences in stage progression and cumulative AD durations between male and female GAERS supports the hypothesis that genetic factors in GAERS rats provide resistance against kindling, regardless of sex.

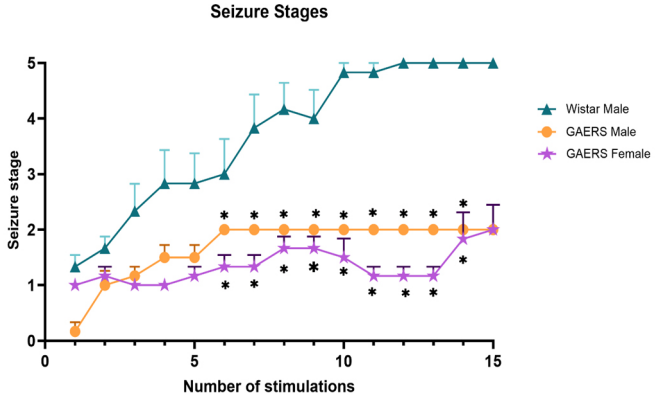

Figure 3. Amygdala kindling progression of male Wistar rats and male and female GAERS rats. Values are represented as mean±standard error of the mean (*p≤0.05)
GAERS: Genetic Absence Epilepsy Rats from Strasbourg, AD: Afterdischarge

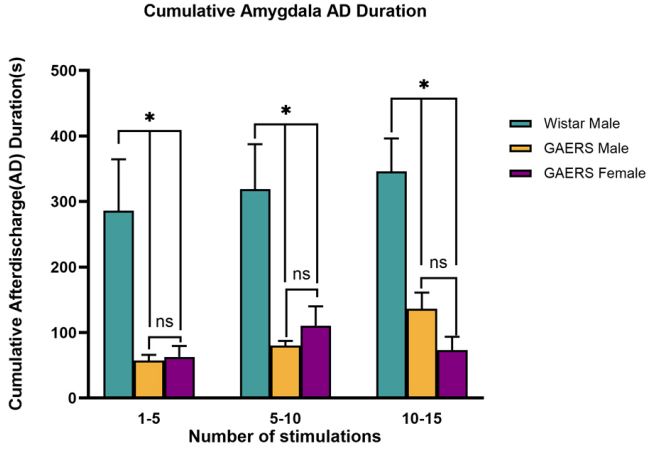

Figure 4. Cumulative amygdala AD duration of male Wistar rats and male and female GAERS rats. Values are represented as mean±standard error of the mean (*p<0.05)
GAERS: Genetic Absence Epilepsy Rats from Strasbourg, AD: Afterdischarge

In recent years, the significance of a male-female balance in preclinical research has gained prominence. Traditionally, preclinical scientific studies have involved only male subjects, which has led to obscured results and potentially dangerous consequences for women. This sex bias in research has overlooked how sex-specific factors may influence disease mechanisms and treatment responses, thus highlighting the critical need for balanced research on both sexes.

Recognizing this issue, the National Institutes of Health (NIH) has implemented policies supporting the inclusion of female subjects in preclinical experiments to ensure more accurate and comprehensive findings.[23,24] By promoting sex-balanced research, NIH aims to improve our understanding of sex-specific biological processes, which is crucial for developing targeted therapies.[23,24]

Study Limitations

A limitation of this study is that only male Wistar rats were used as controls, precluding an assessment of potential sex differences in seizure susceptibility within the Wistar group. Previous studies have demonstrated significant sex differences in drug-resistant epilepsy and in antiseizure drug pharmacokinetics, including variations in drug half-life influenced by hormonal and metabolic factors.[25,26] Therefore, to avoid redundancy, maintain focus on our primary research objectives, and minimize unnecessary animal use, in accordance with ethical principles, female Wistar rats were not included in this study. In addition, the study focused solely on behavioural and electrophysiological data and did not explore the molecular and genetic mechanisms that may underlie the observed kindling resistance in GAERS rats. Inclusion of such data could provide a deeper understanding of why GAERS resists seizure progression. Furthermore, monitoring the estrogen cycles of female GAERS rats would be essential to determine whether hormonal fluctuations affect seizure susceptibility, as estrogen has been implicated in modulating seizure activity in other epilepsy models. Together, these elements would enrich the results of the study and contribute to a more comprehensive view of seizure susceptibility and sex differences in epilepsy models.

CONCLUSION

The observed findings highlight our understanding of how kindling mechanisms may vary by sex. Further studies are needed to explore the underlying mechanisms of kindling resistance in female and male GAERS. Addressing this is crucial for developing targeted therapies and improving our understanding of sex-specific epileptic processes. Ultimately, a comprehensive examination of both sexes will enhance the efficacy of epilepsy treatments and contribute to more personalized medical approaches.

Ethics

Ethics Committee Approval: The experimental protocol was approved by the Acıbadem Mehmet Ali Aydınlar University Ethical Committee for Experimental Animals (decision no: ACU-HADYEK 2023/39, date: 21.06.2023).

Informed Consent: Animal experiment.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Ö.S., E.T.E., N.M., T.T.T., N.Ç.Y., F.Y.O., Concept: N.Ç.Y., F.Y.O., Design: N.Ç.Y., F.Y.O., Data Collection or Processing: Ö.S., E.T.E., N.M., T.T.T., Analysis or Interpretation: Ö.S., E.T.E., N.M., T.T.T., Literature Search: Ö.S., E.T.E., N.M., T.T.T., Writing: Ö.S., N.Ç.Y., F.Y.O.

Conflict of Interest: No conflict of interest was declared by the authors.

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Archives of Epilepsy

Original Article

Examining the Effect of Anti-seizure Medications Monotherapy on Cognitive Functions in Patients with Epilepsy: A 1-month Longitudinal Study

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Abstract

Objective: Cognitive impairment in epilepsy is one of the most important problems affecting daily life. This study aimed to investigate the change in cognitive functions of patients with epilepsy a month after starting anti-seizure medications (ASMs).

Methods: Patients with epilepsy who started treatment with ASMs were included. The general cognitive status, attention, memory, executive functions, and language skills of epilepsy patients were evaluated with detailed neuropsychological tests before and one month after the initiation of ASMs.

Results: The study included 14 patients with epilepsy. The patients showed increased attention, visual memory, and inhibition skills 1 month after using ASMs compared to pre-treatment status.

Conclusion: Appropriate and successful treatment of epilepsy patients can improve cognitive performance in the short term. However, long-term longitudinal studies are needed to support these findings.

Keywords: Antiseizure medications, cognitive impairment, epilepsy, monotherapy

INTRODUCTION

Cognitive impairment is one of the major problems experienced by people with epilepsy.[1] Cognitive impairment is associated with many causes. Factors such as seizure characteristics, age of onset of epilepsy, location of epileptic activity, type of epilepsy, number or type of anti-seizure medications (ASMs), and individual characteristics contribute to the occurrence of cognitive impairment.[2] Patients with epilepsy have impairments in memory, visual-spatial functions, executive functions, attention, information processing speed, and naming skills.[3-5]

Experts emphasise that ASMs may be the cause of cognitive impairment. Additionally, cognitive impairments may be observed when epilepsy is not controlled with ASMs.[2,6]

Many studies have shown a decline in cognitive functions in long-term chronic epilepsy.[7] However, it is also stated that in new-onset epilepsy, existing cognitive capacity/status can be preserved with early and successful treatment.[8-10]

Considering all these, there is a need for longitudinal studies in which many factors are considered for an in-depth examination of cognitive functions in epilepsy. In this study, we aimed to examine the changes in cognitive functions by applying comprehensive neuropsychological tests to newly diagnosed epilepsy patients before, and 30 days after treatment.

METHODS

Participants

This study was carried out at a university hospital, in the department of neurology, epilepsy centre, between 2019 and 2020. Neurological examination and neuropsychological evaluation were performed on patients diagnosed with epilepsy before using ASMs. Neuropsychological evaluations were repeated in patients 30 days after they started using ASMs. The seizure type, classification of epilepsy, type of ASMs, and seizure frequency were noted. Patients with any psychiatric or neurological diseases, and patients undergoing epilepsy surgery were excluded.

Neurological and clinical examinations of the patients were performed by a clinical neurophysiologist, and neuropsychological evaluations were performed by a neuropsychologist.

This study's compliance with ethical standards was approved by the Dokuz Eylül University Ethics Committee (decision no: 2021/22-29, date: 28.07.2021).

Neuropsychological Assessment

In our previous cross-sectional study, the neuropsychological assessment tools used were described in detail.[5] In summary, the cognitive functions of all participants were evaluated. General cognitive status was evaluated with the Mini-Mental State Examination,[11,12] and attention was assessed with digit span, (forward and backward digit span), and the Wechsler Memory Scale (WMS) mental control subtests.[13,14] Episodic verbal memory was measured by the Oktem Verbal Memory Processes test, and visual memory was measured by the WMS visual reproduction subtest.[13,14] For executive functions, verbal fluency tests (phonemic and semantic), Stroop test TBAG form, clock drawing, similarity, and proverb interpretation tests.[16-20] Naming ability was evaluated with the Boston Naming test.[21] For depression and anxiety symptoms, the Beck Depression Scale and the Beck Anxiety Scale were used.[22-25]

Statistical Analysis

The data of this study were analyzed in the Statistical Package for the Social Science version 24 (Armonk, NY: IBM Corp.). Normal distribution of the data was examined with the Kolmogorov-Smirnov test. Data that did not meet normal distribution conditions were examined with the repeated measures Wilcoxon signed-rank test. $P<0.05$ is used for statistical significance.

RESULTS

Fourteen patients were included. Ten of the patients (71.4%) were female, the median age was 28 (minimum-maximum, 20-54). Eight of the patients (57.2%) have focal epilepsy which is the most frequent epilepsy syndrome. Six of the patients (42.8%) use new-generation ASMs which of 4 (28.6%) use levetiracetam (LEV) and 2 (14.3%) use lamotrigine (LTG) whereas, 8 of them (57.2%) use classical ASMs which of 6 (42.9%) use carbamazepine (CBZ) and of 2 (14.3%) use valproic aside (VPA). The demographic data, seizure classifications, seizure types, and dosage of ASMs ratios of the participants are presented in Table 1.

Statistically significant differences were found in WMS-R mental control 5 ($Z=-2.945$, $p=0.003$), WMS-R immediate ($Z=-2.434$, $p=0.015$), WMS-R delayed ($Z=-2.373$, $p=0.018$), Stroop test interference ($Z=-2.355$, $p=0.019$), between pre- and post-treatment in epilepsy patients. The mean, standard deviation, and statistical values of neuropsychological test scores are presented in Table 2.

The mean scores of the neuropsychological tests of epilepsy patients receiving both classical and new-generation ASMs were compared before and after treatment. No statistically significant difference was found in terms of cognitive functions in epilepsy patients receiving classical-generation ASMs before and after

Table 1. Clinical and demographical features

Epilepsy patients (n=14)	Value
Age (mean±SD)	33.14±12.65
Education (years) (mean±SD)	11.36±3.20
Gender n (%)	
Male	4 (28.6%)
Female	10 (71.4%)
Handedness n (%)	
Right	12 (85.7%)
Left	2 (14.3%)
Epilepsy classification n (%)	
Focal	8 (57.2%)
JME	2 (14.3%)
JAE	1 (7.1%)
GTCA	2 (14.3%)
Unknown	1 (7.1%)
Seizure type n (%)	
Generalized	5 (35.7%)
Focal	8 (57.1%)
Unknown	1 (7.1%)
Seizure frequency n (%)	
Seizure free	7 (50.0%)
Occasionally	6 (42.9%)
Frequently	1 (7.1%)
EEG findings n (%)	
Epileptic abnormality	6 (42.9%)
No epileptiform activity	7 (50.0%)
Antiseizure medications	**Distribution n (%)**
LEV	4 (28.6%)
CBZ	6 (42.9%)
VPA	2 (14.3%)
LTG	2 (14.3%)

The table presents the means or proportions of demographic and clinical data. Seizure-free means <1 per year, occasionally <1 per week to >1 per year, and frequently means >1 per week in seizure frequency.
EEG: Electroencephalography, GTCA: Generalized tonic-clonic seizures alone, JME: Juvenile myoclonic epilepsy, JAE: Juvenile absence epilepsy, LEV: Levetiracetam, CBZ: Carbamazepine, VPA: Valproic acid, LTG: Lamotrigine

MAIN POINTS

- The strongest aspect of this study is that it examined the cognitive functions of epilepsy patients longitudinally.
- Significant improvements in attention, executive functions, visual memory and mood were found after antiseizure post-treatment compared to pre-treatment.
- This study shed light on subsequent longitudinal studies.

Table 2. Scores of neuropsychological tests and mood

Neuropsychological tests	Pre-treatment	Post-treatment	Z	p
Global cognition				
MMSE	29.15±1.14	29.21±1.18	0.00	1.00
Attention				
Forward digit span	5.71±1.20	5.57±1.08	-0.513	0.608
Backward digit span	4.00±1.30	4.07±0.99	-0.439	0.660
WMS-R mental control 1	6.86±2.71	6.64±2.73	-0.522	0.601
WMS-R mental control 2	4.21±1.80	3.78±1.96	-0.915	0.360
WMS-R mental control 3	22.07±20.46	14.16±7.34	-0.892	0.373
WMS-R mental control 4	24.86±16.12	22.5±12.53	-1.417	0.156
WMS-R mental control 5	81.17±43.45	61.25±29.08	-2.945	**0.003**
Verbal memory				
OVMPT first recall	5.79±1.92	6.07±1.85	-0.672	0.502
OVMPT highest recall	14.36±1.64	14.14±2.14	-1.134	0.257
OVMPT reaching criteria	4.86±2.95	4.57±3.47	-0.511	0.610
OVMPT total learning	118.07±16.72	119.0±21.73	-0.315	0.753
OVMPT recall	12.93±1.77	12.07±3.31	-1.030	0.303
OVMPT recognition	2.07±1.77	2.85±3.08	-1.030	0.303
Visual memory				
WMS-R immediate	11.073.81	12.16±3.83	-2.434	**0.015**
WMS-R delayed	11.07±4.02	12.08±4.10	-2.373	**0.018**
Executive functions				
Verbal categorical fluency	19.43±6.72	20.92±6.92	-1.260	0.208
Letter fluency	33.36±19.87	36.14±18.10	-1.385	0.166
Stroop test interference	57.71±30.19	46.35±20.28	-2.355	**0.019**
Similarity	9.08±2.23	9.46±2.22	-1.155	0.248
Abstraction	2.86±0.36	2.64±0.92	-1.342	0.180
Clock drawing	9.43±0.93	9.42±0.93	-0.0	1.00
Language				
Naming	14.09±1.81	14.23±1.53	-0.577	0.564
Mood				
Beck Depression Scale	14.64±11.31	13.14±8.87	-0.525	0.599
Beck Anxiety Scale	17.29±12.93	11.85±9.86	-2.267	**0.023**

The mean and standard deviation of all neuropsychological tests are presented. The p value was set to <0.05. The Z-value indicates the Wilcoxon-signed rank test. Bold values indicate p<0.05.
MMSE: The Mini-Mental State Examination, WMS-R: The Wechsler Memory Scale-Revised, OVMPT: Oktem Verbal Memory Processes test, Stroop test (condition: the time required for color naming)

treatment (p>0.05). Statistically significant differences were found in the cognitive functions of epilepsy patients receiving new-generation ASMs before and after treatment (p>0.05). A significant change was found in the WMS-R mental control 5 [t(5)=2.849, p=0.036], Stroop test interference duration [t(5)=7.228, p=0.001] and Similarity tests [t(5)=-5.00, p=0.038] of the epilepsy patients receiving newer-generation ASMs compared to before treatment. Figure 1 shows a flow chart.

DISCUSSION

Our results showed that in epilepsy patients who started new-onset ASMs, sustained attention, visual memory, and inhibition skills increased after 1 month of monotherapy. Many studies have indicated that high doses of polytherapy lead to impaired cognitive functions compared to monotherapy in epilepsy.[4,26-30] The results of our study are consistent with these findings. Mean cognitive function scores measured at baseline were within the normal range according to age and educational neuropsychological test norms in newly treated epilepsy patients. However, a significant increase was found in the previously mentioned cognitive test scores in measurements made 1 month after ASMs treatment. These results are important, showing that appropriate and successful treatment, in epilepsy patients does not worsen cognitive functions over a short period. However, longer-term longitudinal studies are necessary to reveal changes in cognitive functions in patients with epilepsy.

ASMs and cognition-based studies have shown that LTG and LEV have less adverse effects on cognitive functions, while CBZ, valproate, and phenytoin, which are the classical ASMs,

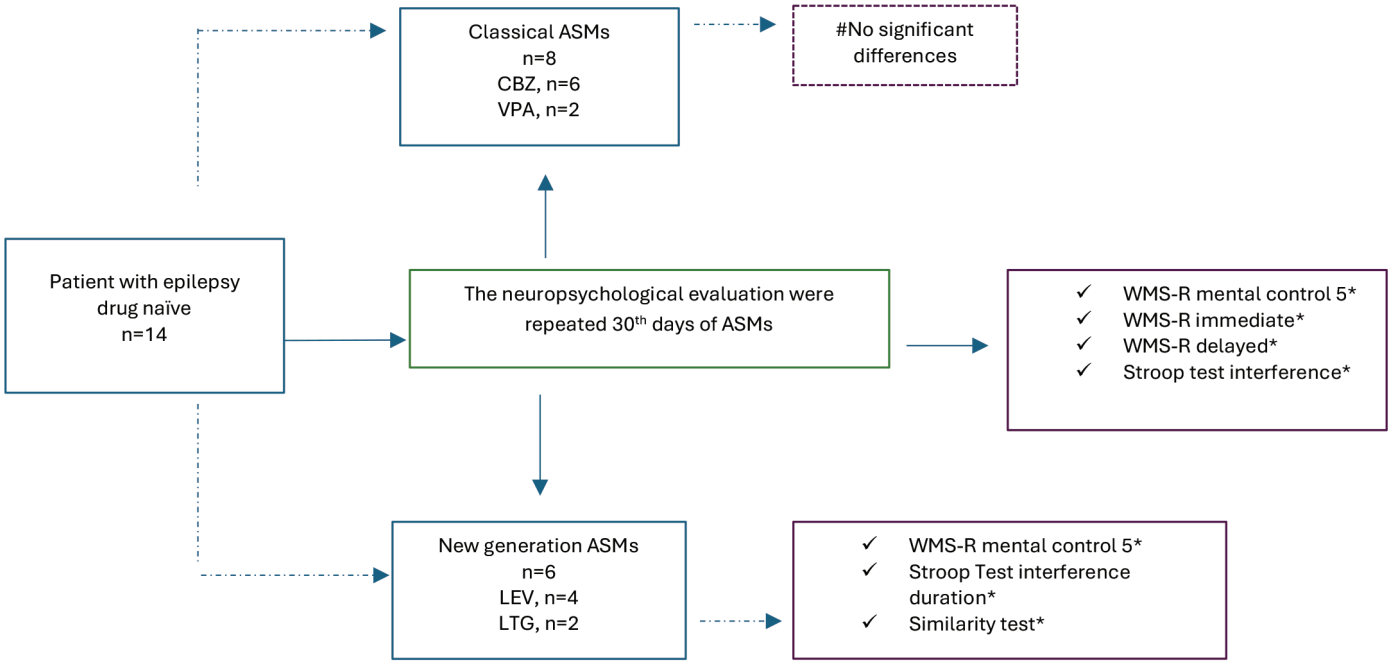

Figure 1. Flow chart of the study and is shown significant differences neuropsychological assessment
*p<0.05.
ASMs: Anti-seizure medications, CBZ: Carbamazepine, LEV: Levetiracetam, LTG: Lamotrigine, VPA: Valproic aside, WMS-R: The Wechsler Memory Scale-Revised

have more adverse effects on cognitive functions.[5,30-36] Consistent with the literature, our study observedthat LTG and LEV, which are considered new-generation ASMs, increased attention and executive functions in a one-month longitudinal examination. However, CBZ and VPA, which are considered classical-ASMs, did not show a significant difference in cognitive functions. This finding is not consistent with the literature. The small number of our epilepsy patients and the short-term use of ASMs may have caused these results. Especially, topiramate was reported to have the highest negative effect on cognitive functions.[36] The effects of ASMs on cognitive functions could not be examined separately due to the small number of participants in this study.

Difficulties in cognitive domains such as verbal memory, visual memory, executive functions, attention, working memory, and language have been generally reported in individuals with epilepsy.[2,26-28] Although the control groups in the studies revealing these findings consisted of healthy individuals or individuals with mild cognitive impairment or epilepsy subtypes, the reported involvement of cognitive difficulties was almost similar. Memory impairments occur more in temporal epilepsy, and executive function impairment occurs in frontal epilepsy.[37,38] A good definition of disease-related factors such as the type of epilepsy, medications used, duration of epilepsy, and methodological factors such as neuropsychological measurement tools and number of participants that may affect cognition, is crucial for understanding the extent to which cognitive functions are affected in epilepsy.

It was stated that the general cognitive capacity of epilepsy patients is lower than controls before the diagnosis of epilepsy.[39-43] A longitudinal study showed that memory functions were lower in drug-resistant focal epilepsy patients compared to healthy controls even after 4.8 years.[43] It is estimated that patients with drug-resistant epilepsy discontinuing current treatment, the possibility of evaluating new treatment options, and uncontrolled seizures contribute to cognitive dysfunction.[44] Therefore, it is suggested that cognitive disorders seen in patients with treatment-resistant epilepsy are different from cognitive disorders in individuals with epilepsy.[2] In another longitudinal study that included 2-10 years of follow-up of temporal epilepsy patients receiving medical and surgical treatment, it was shown that memory functions decreased over time in both groups, while there was no significant change in other cognitive domains.[45]

Although longitudinal studies with long-term follow-up have shown a decline in cognition over time, many factors affect these results. Increasing age, chronic epilepsy, increased doses of medication, polytherapy for epilepsy treatment, uncontrolled seizures, and other features that may change in the long term may contribute to deterioration in cognitive functions. Our study provides preliminary findings on the short-term results of anti-seizure monotherapy in a heterogeneous epilepsy group. For future studies with larger numbers of participants, longer follow-ups are needed.

Study Limitations

An important limitation of this study is the small number of participants. The small number of participants made it difficult to examine in depth the disease-related factors on cognitive functions.

CONCLUSION

Many factors contribute to cognitive impairment in epilepsy. Longitudinal studies of patients with epilepsy help differentiate

factors such as intra-individual and inter-individual variability, as well as treatment effectiveness. A one-month longitudinal study of patients with epilepsy has shown an improvement in cognitive abilities. However, this is a preliminary study. Longer-term studies with more participants may shed light on the relationship between epilepsy and cognitive impairment.

Ethics

Ethics Committee Approval: This study's compliance with ethical standards was approved by the Dokuz Eylül University Ethics Committee (decision no: 2021/22-29, date: 28.07.2021).

Informed Consent: A written informed consent form was obtained from each patient.

Footnotes

Authorship Contributions

Surgical and Medical Practices: D.M.D., İ.Ö., B.B., Concept: H.E.B., D.M.D., İ.Ö., B.B., Design: H.E.B., D.M.D., İ.Ö., B.B., Data Collection or Processing: H.E.B., D.M.D., İ.Ö., B.B., Analysis or Interpretation: H.E.B., D.M.D., İ.Ö., B.B., Literature Search: H.E.B., D.M.D., İ.Ö., B.B., Writing: H.E.B., D.M.D., İ.Ö., B.B.

Conflict of Interest: No conflict of interest was declared by the authors.

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Archives of Epilepsy

Original Article

Examination of the Relationship Between Alexithymia and Satisfaction with Life in Patients with Epilepsy: A Cross-sectional Study

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Abstract

Objective: Patients with epilepsy (PWE) may experience emotional difficulties and distress if they cannot cope consistently with the emotional and physical challenges of having a seizure. This study was conducted to examine the relationship between alexithymia and life satisfaction in PWE.

Methods: This study was conducted with 207 PWE in a hospital in eastern Türkiye. Data were collected using the "Individual information forms", "Toronto Alexithymia Scale", and "Satisfaction with Life Scale". Descriptive statistics, t-tests, ANOVA, correlation, and regression analyses, and post-hoc LSD analyses were employed for data evaluation.

Results: In the present study, the alexithymia total mean score of the PWE was 58.01±9.07, the total mean score of "difficulty identifying feelings" was 19.84±5.82, the total mean score of "difficulty describing feelings" was 14.42±3.30, and the total mean score of "externally oriented thinking" was 23.75±2.88. The total mean satisfaction with life score was 13.82±4.23. A significant negative correlation was found between total alexithymia and life satisfaction scores of PWE, who participated in the study ($F=11.87$; $p<0.05$).

Conclusion: It was found that PWE had high alexithymia levels and lower life satisfaction levels. As the total alexithymia score increased, the total life satisfaction score decreased.

Keywords: Epilepsy, alexithymia, satisfaction with life, nursing

INTRODUCTION

Epilepsy is a condition characterized by sudden, recurrent epileptic seizures that are not triggered by a definable act and that occur as a result of abnormal and excessive electrical discharge of neurons in the cortex.[1] Epilepsy, which affects more than 45 million people worldwide, is among the top five neurological disorders that cause disability and death over time.[2]

The diagnosis of epilepsy is a health issue that leads to both psychosocial and clinical problems. The sudden occurrence of seizures causes individuals to feel out of control, which negatively affects the quality of life of patients by causing high levels of anxiety, stress, and depression.[3]

Patients with epilepsy (PWE) may experience emotional difficulties and distress if they cannot cope consistently with the emotional and physical challenges of having a seizure.[4] Although alexithymia has been proposed as the underlying factor of many psychosomatic diseases, studies have identified functional disorders and lesions in the brains of epileptic patients that are similar to those found in alexithymic patients. It has also been demonstrated that individuals with epilepsy have difficulty expressing their thoughts and feelings, similarly to alexithymic individuals.[5,6] In a study conducted with epileptic patients in Russia, it was reported that the patients had high alexithymic characteristics and that alexithymic features had a maximum effect on psychopathological variables.[7] Alexithymia is a concept of Greek origin derived from the combination of words meaning "a; abstinence, lexis; word, thymos; feeling" and means "absence of words for emotions".[8] In addition, alexithymia is characterized by difficulty expressing all feelings at emotional, behavioral, physiological, and subjective/experiential levels.[9] Individuals' suppression of their emotions or inability to express what they have experienced increases anxiety and stress, negatively affecting the immune system, disrupting treatment compliance, and quality of life.[10] Quality of life in epilepsy is a broad concept that includes personal well-being and implies a high overall level of happiness and well-being in life.[11]

Satisfaction with life is defined as the degree of positive evaluation of the overall quality of one's current life as a whole. In other words, it is individuals' subjective evaluation of how much they love the life they live and how happy they are in the cognitive and emotional

dimensions.[12] The life satisfaction of individuals diagnosed with a chronic disease decreases significantly due to some symptoms and complications caused by the disease.[13]

It is also stated in the literature that there is an inverse relationship between life satisfaction and the presence of chronic diseases.[14] Epilepsy, which is a chronic disease, changes the lives of individuals and their families affects the way individuals with epilepsy express their emotions and their satisfaction with life.[15] Alexithymia, which is defined as the difficulty in recognizing and expressing emotions, is a common personality trait found in both healthy and ill individuals.[16] In the studies reviewed, it was found that the incidence of alexithymia in individuals with epilepsy ranges between 26% and 76%.[15,17-19] The literature review did not find any studies that examined the relationship between alexithymia and life satisfaction in PWE. Therefore, this study was conducted to examine the relationship between alexithymia and life satisfaction in PWE.

METHODS

Study Type

This study was conducted as a descriptive, cross-sectional analysis.

Participants

The population consisted of 450 registered PWE in a hospital in eastern Türkiye. As a result of the calculation of the sample size based on the known population, it was determined that at least 207 patients should be reached with a margin of error of 5% and a 95% confidence interval. The formula utilized was $(1.96)^2$ (0.5) (0.5) / [$(0.05)^2$ (356-1)] + $(1.96)^2$ (0.5) (0.5) (0.5). The inclusion criteria for participation in the study were as follows: individuals aged 18 years and older who had been diagnosed with epilepsy for at least six months; had no hearing or vision problems; voluntarily agreed to participate in the study; and possessed the cognitive competence to answer the questions. Individuals still under investigation or without a clinically definite diagnosis of epilepsy and with other chronic diseases were excluded. Other exclusion criteria were an inability to give informed consent, to read or speak Turkish, and moderate to severe learning disabilities as indicated by patients' medical records or by the responsible clinician.

Data Collection

Individual information forms, the Toronto Alexithymia Scale, and the Satisfaction with Life Scale were used to collect data. The corresponding author collected the data.

MAIN POINTS

- Epilepsy diagnosis is a health problem that causes psychosocial and clinical challenges.
- Patients with epilepsy (PWE) have high alexithymia levels and low satisfaction with life levels.
- Individuals with epilepsy have difficulty expressing their thoughts and feelings, just like alexithymic individuals.
- It is vital to inform nurses about preventing the negative situations alexithymia may cause in PWE.

Individual Information Form

It was prepared by the researcher in line with the relevant literature data and includes 10 questions related to the individual characteristics of the participants and the duration of their disease.

Toronto Alexithymia Scale

TAS-20 was developed by Bagby et al.,[19] 1994. The validity study of the Turkish version of the scale was conducted by Güleç et al.,[20] 2009. The scale consists of a total of 20 items rated in a five-point Likert-type scale. In its Turkish version, the scale consists of three subscales: "Difficulty identifying feelings", "Difficulty describing feelings," and "externally-oriented thinking". Total scores range from 20 to 100, with higher scores reflecting higher levels of alexithymia. TAS-20 scores are considered 61 and above alexithymic, 52-60 are considered borderline alexithymic, and below 51 are considered normal. When the Turkish validity and reliability findings were examined, it was determined that the scale had a three-factor structure and the total Cronbach's alpha value was 0.78. When the cut-off point of the scale is examined, it is seen that if the "pure alexithymic group" is to be studied, it will be necessary to take 59 as the top score.[21] In our study, the Cronbach's alpha value was 0.74.

Satisfaction with Life Scale

The Satisfaction with Life Scale is a five-item self-report scale that measures an individual's global satisfaction with life.[22] Dağlı and Baysal[22] conducted a Turkish adaptation study. The minimum possible score on the scale is 5, while the maximum possible score is 25. While a high score on the scale indicates an increase in individuals' satisfaction with life, a low score on the scale indicates low life satisfaction. Cronbach's alpha internal consistency coefficient was 0.88.[23] In the present study, the Cronbach's alpha internal consistency coefficient was 0.82.

Statistical Analysis

The data obtained in the study were evaluated using the IBM Statistical Package for the Social Sciences (SPSS) statistics for Windows, version 22.0, (SPSS inc., Chicago, IL, USA) statistical program. Parametric methods were used in the data analysis. The relationships between the dimensions determining the scale levels of the patients were examined through correlation and regression analyses. T-test, one-way analysis of variance (ANOVA), and post-hoc (Tukey, LSD) were used to examine the differences in scale levels based on the patients' descriptive characteristics.

Ethical Consideration

Before commencing the study, ethical approval was obtained from the Van Yüzüncü Yıl University Clinical Research Ethics Committee (decision no: 02.02.2022, date: 11.02.2022). During the face-to-face interviews, participants were provided with a form explaining the purpose of the research and the collection of data, after which written consent was obtained. Institutional permission was obtained from the concerned hospital on 22.12.2021. The study was conducted in accordance with the Declaration of Helsinki.

RESULTS

The mean age of the participants was 35.99±11.67. While 55.1% were female, 59.9% were married, 27.5% were high school graduates, 35.7% were not working, 76.8% had a moderate level of income and 53.1% did not have social security. It was found that 61.8% of the patients had had epilepsy between 1-5 years, 77.3% did not have any other epileptic patients in their families, and 69.1% did not have any other disease except epilepsy.

The total mean score for alexithymia was 58.01±9.07; the total mean score for "difficulty identifying feelings" was 19.84±5.82; the total mean score for "difficulty describing feelings" was 14.42±3.30; and the total mean score for "externally oriented thinking" was 23.75±2.88. The total mean satisfaction with life score was 13.82±4.23 (Table 1).

Table 1. Mean alexithymia and satisfaction with life scores of the patients (n=207)

	Mean±SD	Min	Max
Alexithymia total	58.01±9.07	30.00	80.00
Difficulty identifying feelings	19.84±5.82	7.00	35.00
Difficulty describing feelings	14.42±3.30	6.00	24.00
Externally-oriented thinking	23.75±2.88	12.00	31.00
Satisfaction with life total	13.82±4.23	5.00	25.00

SD: Standard deviation, min: Minimum, max: Maximum

When the correlation analyses between total alexithymia scores, sub-scale scores, and total satisfaction with life scores were examined, a very high positive correlation was found between difficulty identifying feelings and the alexithymia total ($r=0.91$, $p<0.05$). Additionally, a high positive correlation was found between difficulty describing feelings and alexithymia total $r=0.83$ ($p<0.05$), a high positive correlation was found between difficulty describing feelings and difficulty identifying feelings $r=0.72$ ($p<0.05$), a high positive correlation was found between difficulty describing feelings and difficulty identifying feelings $r=0.72$ ($p<0.05$), a positive weak correlation was found between externally-oriented thinking and total alexithymia $r=0.34$ ($p<0.05$), a negative very weak correlation was found between satisfaction with life and alexithymia total $r=-0.23$ ($p<0.05$), negative weak correlation was found between satisfaction with life and difficulty identifying feelings $r=-0.25$ ($p<0.05$), and a negative weak correlation was found between satisfaction with life and difficulty describing feelings $r=-0.31$ ($p<0.05$) (Table 2).

Table 3 shows that the regression analysis, conducted to find out the cause and effect relationship between the total alexithymia and life satisfaction scores of PWE who participated in the study, was significant ($F=11.87$; $p<0.05$). It was found that total alexithymia score explained 5% of the change in satisfaction with life level ($R^2=0.05$). The alexithymia total score was associated with a decrease in satisfaction with life total score (ß=-0.10).

Regression analysis was conducted to determine the cause-and-effect relationships between difficulty identifying feelings, difficulty describing feelings, externally oriented thinking, and

Table 2. Correlation analysis between alexithymia and satisfaction with life scores (n=207)

			Difficulty identifying feelings	Difficulty describing feelings	Externally-oriented thinking	Satisfaction with life total
Alexithymia total	r	1.00				
	p	0.00				
Difficulty identifying	r	0.91**	1.00			
	p	0.00	0.00			
Difficulty describing feelings	r	0.83**	0.72**	1		
	p	0.00	0.00	0.00		
Externally-oriented thinking	r	0.34**	0.02	0.02	1	
	p	0.00	0.71	0.68	0.00	
Satisfaction with life total	r	-0.23**	-0.25**	-0.31**	0.13	1
	p	0.00	0.00	0.00	0.05	0.00

*<0.05; **<0.01; r: Correlation analysis

Table 3. The effect of alexithymia on satisfaction with life (n=207)

Dependent variable	Independent variable	ß	t	p	F	Model (p)	R^2
Satisfaction with life total	Fixed	20.16	10.83	0.00	11.87	0.00	0.05
	Alexithymia total	-0.10	-3.44	0.00			
Satisfaction with life total	Fixed	14.71	5.69	0.00	9.20	0.00	0.10
	Difficulty identifying feelings	-0.04	-0.69	0.49			
	Difficulty describing feelings	-0.34	-2.82	0.00			
	Externally-oriented thinking	0.21	0.78	0.36			

f: Linear regression analysis, t: Independent sample t-test

Table 4. Comparisons of patients' alexithymia and satisfaction with life scores in terms of descriptive characteristics (n=207)

Demographic features	n	Alexithymia total	Difficulty identifying feelings	Difficulty describing feelings	Externally-oriented thinking	Satisfaction with life total
Age		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
≤30	80	59.70±7.64	21.00±4.91	15.20±3.46	23.50±3.15	12.60±4.11
31-40	59	57.47±9.74	19.35±5.62	14.11±2.99	24.00±2.84	14.28±3.91
41-50	40	57.47±10.26	20.07±7.21	13.90±3.49	23.50±2.65	14.65±4.42
≥51	28	55.14±9.07	17.21±5.74	13.57±2.84	24.35±2.49	15.17±4.26
F		2.00	3.21	2.66	0.85	4.10
p		0.11	**0.02**	**0.04**	0.46	**0.00**
Post-hoc			1>4, 3>4 (p<0.05)	1>3, 1>4 (p<0.05)		2>1, 3>1, 4>1 (p<0.05)
Gender						
Female	114	58.05±8.70	20.20±5.87	14.33±3.47	23.51±2.85	13.29±4.06
Male	93	57.97±9.54	19.39±5.75	14.52±3.09	24.05±2.92	14.48±4.36
t		0.05	0.98	-0.41	-1.33	-2.03
p		0.95	0.32	0.67	0.18	**0.04**
Marital status						
Single	83	59.26±7.84	20.71±5.18	14.95±3.45	23.60±2.90	12.96±4.14
Married	124	57.18±9.74	19.25±6.16	14.06±3.16	23.86±2.88	14.40±4.21
t		1.62	1.76	1.90	-0.63	-2.42
p		0.10	0.07	0.05	0.52	**0.01**
Educational status						
Literate	48	56.97±8.37	19.25±5.57	13.79±2.92	23.93±2.27	13.97±3.72
Primary education	56	57.53±10.54	19.64±6.54	14.16±3.21	23.73±2.83	14.32±4.06
High school	57	59.43±8.40	20.28±5.18	15.22±3.32	23.93±3.10	12.64±4.23
University and higher	46	57.93±8.69	20.15±6.01	14.39±3.64	23.39±3.29	14.52±4.73
F		0.72	0.33	1.85	0.37	2.19
p		0.53	0.80	0.13	0.77	0.09
Occupation						
Self-employed	28	57.82±8.53	19.46±5.94	14.50±2.75	23.85±2.96	14.21±4.10
Officer	28	57.03±10.03	18.75±5.81	13.96±3.80	24.32±2.46	14.96±4.31
Worker	18	59.83±11.37	20.77±6.32	15.00±3.83	24.05±3.03	15.61±4.01
Farmer	11	56.63±7.60	19.36±4.65	14.00±2.00	23.27±2.79	15.45±5.16
Student	34	59.61±8.03	21.38±5.62	14.82±3.67	23.41±3.40	12.82±4.11
Not employed	74	57.59±9.14	19.50±6.05	14.41±3.30	23.67±2.53	13.04±4.13
Other	14	57.50±8.88	20.00±5.23	13.78±2.69	23.71±4.04	13.78±3.76
F		0.42	0.70	0.37	0.35	1.97
p		0.86	0.64	0.89	0.90	0.07
Economic status						
Good	21	56.38±12.73	18.76±7.14	13.71±4.67	23.90±3.09	16.42±4.24
Moderate	159	57.93±8.44	19.87±5.66	14.42±2.98	23.64±2.86	13.63±4.03
Poor	27	59.77±9.40	20.48±5.76	14.96±3.84	24.33±2.92	12.92±4.74
F		0.85	0.52	0.84	0.68	4.91
p		0.42	0.59	0.43	0.50	**0.00**
Post-hoc						1>2, 1>3 (p<0.05)
Social security						
Yes	110	58.40±9.42	20.23±5.80	14.43±3.41	23.72±2.67	14.64±4.40
No	97	57.58±8.67	19.39±5.84	14.40±3.18	23.79±3.12	12.89±3.85
t		0.64	1.04	0.07	-0.16	3.02
p		0.52	0.29	0.94	0.86	**0.00**

Table 4. Continued

Demographic features	n	Alexithymia total	Difficulty identifying feelings	Difficulty describing feelings	Externally-oriented thinking	Satisfaction with life total
Disease duration						
1-5 years	128	57.90±9.31	19.73±5.69	14.32±3.43	23.84±3.09	13.53±4.21
6-10 years	46	56.54±8.56	19.13±6.20	14.15±2.78	23.26±2.76	13.43±3.79
≥11 years	33	60.51±8.53	21.24±5.71	15.15±3.43	24.12±2.13	15.51±4.59
F		1.88	1.32	1.01	0.99	3.19
p		0.15	0.26	0.36	0.37	**0.04**
Post-hoc						3>1, 3>2 (p<0.05)
Presence of another patient with epilepsy in the family						
Yes	47	57.29±9.80	19.63±5.88	14.02±3.59	23.63±2.80	14.38±4.19
No	160	58.23±8.86	19.90±5.82	14.53±3.21	23.79±2.92	13.66±4.24
t		-0.61	-0.27	-0.94	-0.32	1.02
p		0.53	0.78	0.34	0.74	0.30
Presence of a disease other than epilepsy						
Yes	64	58.39±9.79	20.15±5.97	14.60±3.51	23.62±2.89	13.85±3.46
No	143	57.85±8.75	19.69±5.76	14.33±3.23	23.81±2.89	13.81±4.54
t		0.39	0.52	0.55	-0.44	0.07
p		0.69	0.60	0.58	0.65	0.93

F: ANOVA test, t: Independent groups t-test, Post-hoc: Tukey, LSD, SD: Standard deviation

life satisfaction total scores of PWE, who participated in the study, was significant (F=9.20; p<0.05). It was found that 10.7% of the total change in satisfaction with life was explained by difficulty identifying feelings, difficulty describing feelings, and externally oriented thinking (R^2=0.10).

The analysis was conducted to find out whether the alexithymia and satisfaction with life scores of PWE who participated in the study differed according to descriptive characteristics. Significant correlation was found between the age of the patients and their difficulty identifying feelings and difficulty describing feelings, which are subscales of alexithymia (p<0.05). Total satisfaction with life scores of patients differed significantly in terms of age, marital status, economic status, social security and disease duration (p<0.05) (Table 4).

DISCUSSION

When the results obtained from the study were examined, it was found that the PWE were borderline alexithymic. The total mean score for alexithymia was 58.01±9.07. TAS-20 scores with values of 52-60 are considered borderline alexithymic.[21] Similar to the results of our study, Choi et al.[4] found that 26.7% of the PWE in their study had an alexithymia score between 52 and 60 and were borderline alexithymic. Similarly, Wolf et al.[17] found the mean alexithymia score of 91 PWE to be 53.07, while Kaplan et al.[15] found the mean alexithymia score of 82 PWE to be 56.15. When evaluated in terms of cut-off score, the groups in both studies were borderline alexithymic. In their study, Tombini et al.[8] found the alexithymia score of PWE to be 47.6; while Myers et al.[18] found the alexithymia score of 35 epileptic patients to be 50.09 and found that only 28.6% of the epileptic patients were alexithymic. These results differ from those of our study.

The literature review revealed international studies in which the alexithymia levels of individuals differed across disease groups, such as peptic ulcer, irritable colon syndrome, hypertension, Turner syndrome, asthma, chronic obstructive pulmonary disease, rheumatoid arthritis and chronic bronchitis.[16,23-26]

In our study, the mean scores for difficulties in identifying and describing feelings were high. The most important feature of alexithymic individuals is that they have difficulty identifying and describing their feelings. They cannot identify specific and clearly felt emotions in their inner world, and cannot describe them. They describe their feelings with simple and superficial expressions, without going deep, revealing them in the form of bodily reactions. They also have difficulty expressing thoughts clearly.[27] It has been shown that PWE are individuals who are passive, pessimistic, avoidant, exhausted, lazy, contented, utilitarian, purposeful, unskillful, overcontrolled, materialistic, unsharing, and shy, with little imagination and difficulty identifying and describing their feelings, which are among alexithymic characteristics.[28] A study conducted by Chung and Allen[29] involving 71 PWE showed results similar to ours, with high scores indicating difficulty in identifying feelings. Similarly, in a systematic review examining 43 studies, Monti and Meletti[30] stated that PWE had difficulty identifying their feelings in general and more difficulty identifying and describing their feelings in times of fear and sadness. It seems inevitable that PWE who cannot express their feelings and cannot express what they want to tell, even in an emergency, feel lonely in their families and society. For this reason, considering that emotions such as sadness, fear, and excitement can trigger epileptic seizures, it is important to manage emotional stress in PWE. Therefore, it is important to provide the necessary support to this patient group.

The mean scores of difficulty identifying feelings and difficulty describing feelings, which are subscales of alexithymia, were found to be significantly elevated in our study. Patients who were ≤30 years of age had higher mean scores in total alexithymia, difficulty identifying feelings, and difficulty describing feelings than patients who were ≥50 years of age. This result is consistent with the findings in Choi et al.'s[4] study on PWE. The results obtained in that study are similar to those of the present study. Likewise, Yaşar and Gündoğmuş[31] found a statistically significant positive correlation between the participants' TAS-20 total, difficulty identifying feelings, and difficulty describing feelings subscale scores and the variable of age. The results of the present study align with those of other studies, suggesting that age may be a determining factor in alexithymia, with younger individuals potentially being more affected. The higher levels of alexithymia observed in patients aged 30 or younger may be attributed to their limited experience in identifying, describing, and regulating emotions. Furthermore, they may not have yet developed effective coping strategies for dealing with negative situations associated with living with the chronic disease epilepsy.

In individuals with a chronic disease, it is inevitable to experience a decline in life satisfaction until they adapt to the condition and the ensuing treatment process.[32] Karyani et al.[33] found that individuals with a chronic disease had lower satisfaction with life. From this point of view, epilepsy, which is a chronic disease, can be considered one of the neurological diseases that affects the life satisfaction of patients due to patient-related factors, such as demographic, sociocultural, and behavioral aspects, as well as factors related to the disease and treatment, and those related to the health team and health system.

In the present study, PWE had low satisfaction with life levels. Likewise, Gandy et al.[34] found that 672 PWE had low mean satisfaction with life scores. The reason these patients have low satisfaction with life may be because epileptic seizures cause subjective cognitive difficulties. Similarly, in a study conducted by Sung et al.[35] on 270 PWE, it was reported that patients had low satisfaction with life scores and that this situation is associated with the uncertainty brought by epilepsy, epileptic seizures, the necessity of using medication and having low self-efficacy. In line with the results of our study, a 70-patient study by Aidan and Rimmerman[36]; a 507-patient study by Villanueva et al.[37]; and a 524-patient study by Konda et al.[38] all found low mean satisfaction with life scores, despite involving different populations.[37] Unlike the results of our study, a study conducted in the United States found that PWE had high mean satisfaction with life scores.[39] It is thought that this is due to cultural differences, having good financial means, a good family life, a strong social life with positive intercultural relationships, and spending their free time with hobbies that make them happy. The results support the findings of studies in the literature.

Individuals who are satisfied with their lives have fewer negative feelings (for example, anger, sadness, and anxiety), more positive feelings (for example, happiness, enjoyment and having meaningful close relationships with others), and fewer psychological and physical health problems.[40] Studies have shown that satisfaction with life is positively correlated with happiness and quality of life, and that it is negatively correlated with depression, anxiety, post-traumatic stress disorder, and lack of emotional awareness associated with alexithymia.[31] Yang et al.[41] found that individuals with a poor level of personal health and a high level of anxiety had low satisfaction with life. Both situations affect the satisfaction individuals get from life.

Regression analysis was conducted to determine the causal relationship between alexithymia total and satisfaction with life total scores of PWE who participated in the study, therefore, it was found that alexithymia total score decreased satisfaction with life total score. Similar to the results of our study found that the self-efficacy and alexithymia levels of PWE were significantly correlated in terms of developing post-traumatic stress disorder and psychiatric comorbid disease in the post- epileptic period. It has been reported that alexithymia affects quality of life, and therefore, affects life satisfaction.[17] In a study conducted on individuals with post-traumatic stress disorder, it was found that high alexithymia was associated with low satisfaction with life.[42] The study of autistic individuals revealed that alexithymia increased the depression and anxiety levels of patients, caused them to experience difficulty identifying and describing feelings, and, as a result, decreased their satisfaction with life.[43] A study conducted with 124 chronic hepatitis C patients stated that psychological distress, the presence of mood disorders during treatment, and chronic disease increased alexithymia levels and therefore caused patients' life satisfaction to decrease.[44] The results of our study are in line with those of studies conducted abroad. Based on these results, it can be concluded that alexithymia affects satisfaction with life and is an important variable that should be evaluated.

Study Limitations

The study was conducted with PWE in a hospital in Türkiye. Since the study was conducted in a single center, the data cannot be generalized to all PWE.

CONCLUSION

In the present study, PWE had high alexithymia levels and low satisfaction with life levels. As the total alexithymia score of PWE increased, their total satisfaction with life score decreased. In line with these results, it can be concluded that it is vital to inform caregivers and nurses about preventing the negative situations alexithymia may cause in PWE. It is recommended to conduct similar studies on alexithymia and satisfaction with life with a larger sample size, which are thought to be effective concepts in the treatment and care processes of PWE.

Ethics

Ethics Committee Approval: This study was approved by the Van Yüzüncü Yıl University Clinical Research Ethics Committee (decision no: 02.02.2022, date: 11.02.2022).

Informed Consent: Consent form was filled out by all participants.

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Footnotes

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Archives of Epilepsy

Original Article

Epileptic Seizures and Nutritional Status in Children with Cerebral Palsy: Unraveling the Interconnections

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Abstract

Objective: This cross-sectional study explores the complex relationship between nutritional status and the prevalence of epileptic seizures in children with cerebral palsy (CP).

Methods: Conducted between September and October 2024 at a private physiotherapy and rehabilitation center in Türkiye, the study included 58 participants aged 3-15 years diagnosed with CP. The research focused on evaluating socio-demographic data, health information, and detailed 24-hour food consumption patterns alongside anthropometric measurements and the Gross Motor Function Classification System.

Results: Our findings reveal a significantly higher risk of epileptic seizures in children born via cesarean section compared to vaginal delivery (p=0.014). No significant direct correlation was identified between the specific components of food consumed and the occurrence of epileptic seizures. However, children with epilepsy demonstrated dietary preferences that were higher in energy, carbohydrates, and saturated fats, potentially affecting their overall nutritional status and exacerbating existing health conditions. Furthermore, malnutrition, particularly marked by lower Mid-Upper Arm Circumference Z-scores in children experiencing seizures, suggests a potential worsening of their seizure condition and general health (p=0.022). Additionally, higher incidences of chewing difficulties and swallowing disorders were observed in children with seizures compared to those without.

Conclusion: This study underscores the necessity for specialized nutritional strategies to address malnutrition, improve health, and manage seizures in children with CP, emphasizing the role of balanced dietary intake over diets high in energy and fats.

Keywords: Epileptic seizures, nutrition, malnutrition, cerebral palsy

INTRODUCTION

Cerebral palsy (CP) encompasses a group of disorders that impair individuals' ability to move, maintain balance, and, posture.[1] This condition results from non-progressive brain damage or malformation occurring during fetal development, at birth, or in the early years of life and it is characterized as a lifelong neurological disorder.[2,3] According to the Centers for Disease Control and Prevention, the incidence of CP is reported to be 3.6 per thousand live births.[4] Individuals with CP often experience a range of associated conditions, including epilepsy, intellectual disability, and difficulties with feeding and swallowing.[5]

The relationship between epileptic seizures and nutrition in children with CP is complex and multifaceted. Epilepsy, which is a common comorbidity in CP, may significantly affect the nutritional status of the child.[6] Seizures may lead to malnutrition and other nutritional deficiencies by preventing nutrient intake and absorption.[2] In addition, some antiepileptic drugs used to manage epilepsy in children with CP may have negative effects on appetite, digestion, and nutrient absorption.[7]

On the other hand, malnutrition may also contribute to the development and severity of epileptic seizures in children with CP.[8] Malnutrition, which is common in this population, may increase the frequency and severity of seizures by leading to electrolyte imbalances, vitamin deficiencies and other metabolic disorders that may decrease the seizure threshold.[6] Meeting the nutritional needs of children with CP is critical for improving their general health and well-being.[1,8] In this study, we aimed to investigate the relationship between epilepsy and nutrition in children with CP.

METHODS

This is a cross-sectional study conducted in a private physiotherapy and rehabilitation centre in Türkiye. The study was conducted between September and October 2024. Ethical approval was obtained from the İnönü University Clinical Research Ethics Committee (decision no: 2024/6331, date: 11.09.2024) in accordance with the Declaration of Helsinki. Participants and their mothers were informed about the study, and their written consent was obtained. The inclusion criteria were being diagnosed with CP between the ages of 3-15 years and voluntarily agreeing to participate in the study.

Within the scope of the research, 65 children diagnosed with CP were reached, and 7 of these participants declared that they did not agree to participate in the research left. As a result, 58 participants completed the study. Socio-demographic information, health information, 24-hour food consumption record, Gross Motor Function Classification System (GMFCS), and anthropometric measurements of the participants were obtained through face-to-face interviews. The presence of epileptic seizures was determined from the diagnoses in the medical reports.

GMFCS is an assessment system that classifies gross motor functions of children with CP at five levels. In this scale classification developed by Palisano et al.,[9] grade 1 refers to independent movement, grade 2 refers to partially assisted movement, grade 3 refers to the need for assisted walking, grade 4 refers to wheelchair use, and grade 5 refers to severe motor function limitations.

The 24-hour food consumption record was taken by recording the foods consumed by the children in the last 24 hours in accordance with the observations of the mothers of children with CP.

Anthropometric measurements, including height and Mid-Upper Arm Circumference (MUAC), of the children were taken with a non-flexible tape measure. Body weights were measured using a scale. Body mass index (BMI) Z-score, height-for-age (HFA) Z-score, and MUAC Z-score were calculated according to the World Health Organization Child Growth Standards.[10]

Statistical Analysis

Data were analysed using IBM Statistical Package for the Social Sciences 22.0 software (IBM Corporation, New York, USA), and food consumption records were evaluated using BeBIS 8.2 package program (BeBIS software, İstanbul, Türkiye). Descriptive data were expressed as arithmetic mean, standard deviation, number, and percentage. The normal distribution of the data was evaluated using histograms, Q-Q graphs, and skewness and kurtosis values within the range of ±1.00. The Pearson chi-square test was used to analyze categorical variables. T-tests and t-tests were used to determine the differences between independent groups. The statistical significance level was accepted as $p<0.05$.

MAIN POINTS

- This study investigates the relationship between nutritional status and epileptic seizures in children with cerebral palsy (CP).
- Children with epilepsy have been found to consume diets with higher energy, carbohydrate and fat content, which may adversely affect their nutritional health.
- Malnutrition, particularly low Mid-Upper Arm Circumference Z-scores, is linked to worsening seizure conditions.
- The study results highlight the need for specific nutritional strategies to address malnutrition and improve seizure management in children with CP, and emphasize the importance of balanced diets rather than high-energy and fat-laden intake.

RESULTS

This study was conducted on 58 children with CP. The presence of epileptic seizures and general information about the participants are presented in Table 1. The mean age of children with epileptic seizures was 7.83±3.54 years, while the mean age of children without epileptic seizures was 8.46±3.63 years. A significant correlation was found between the type of birth of the participants and the presence of seizures ($p=0.014$). However, no significant relationship was found between gender, number of siblings, maternal and paternal education level, family income level, GMFCS, and the presence of seizures ($p>0.05$).

Information on the relationship between food consumption and the presence of epileptic seizure is shown in Table 2. Accordingly, no significant relationship was found between the presence of epileptic seizure and food components ($p>0.05$).

Information on the relationship between malnutrition scores and the presence of epileptic seizures is given in Table 3. MUAC Z-score was found to be lower in participants who reported epileptic seizures. No significant relationship was found between HFA Z-score and BMI Z-score values ($p>0.05$).

Information on epileptic seizures and nutritional problems is presented in Figure 1. Accordingly, 47.8% of the participants with epileptic seizures had chewing difficulties and 34.8% had swallowing disorders. In children with CP who did not have seizures, 31.4% had chewing difficulties and 17.1% had swallowing disorders.

DISCUSSION

CP is a complication that can develop before, during, and after birth. The birth process in these patients brings many risks. In this study, no significant relationship was found between the birth weight of the participants and the presence of epileptic seizures.

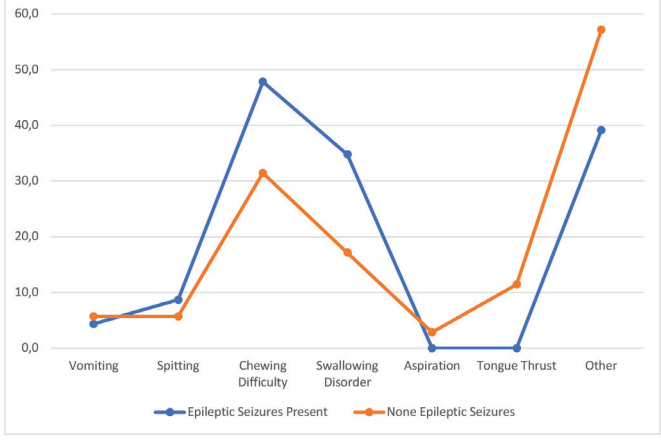

Figure 1. Nutritional problems according to the presence of epileptic seizures

Table 1. Distribution of general information according to the presence of epileptic seizures

		Epileptic seizures present (n=23)		None epileptic seizures (n=35)			
		Mean	**SD**	**Mean**	**SD**	**Test**	**p**
Age		7.83	3.54	8.46	3.63	-0.654[t]	0.516
Birth weight		2472.17	879.69	2394.00	1110.15	352[U]	0.422
		n	**%**	**n**	**%**		
Gender	**Woman**	11	18.97	17	29.31	0.003[χ²]	0.956
	Male	12	20.69	18	31.03		
Type of birth	**Vaginal delivery**	5	8.62	19	32.76	6.061[χ²]	0.014
	Cesarean section	18	31.03	16	27.59		
Number of sibling	**None**	2	3.45	4	6.90	2.282[χ²]	0.809
	1	7	12.07	7	12.07		
	2	12	20.69	20	34.48		
	3	2	3.45	2	3.45		
	4	0	0.00	1	1.72		
	5	0	0.00	1	1.72		
Father's education status	**Primary education**	8	13.79	14	24.14	4.351[χ²]	0.226
	High school	6	10.34	15	25.86		
	University	9	15.52	6	10.34		
Mother's education status	**Primary education**	8	13.79	20	34.48	5.653[χ²]	0.130
	High school	9	15.52	13	22.41		
	University	6	10.34	2	3.45		
Family income status	**Income exceeds expenses**	0	0.00	2	3.45	2.666[χ²]	0.264
	Income and expenditure equal	14	24.14	15	25.86		
	Income less than expenditure	9	15.52	18	31.03		
GMFCS	**Grade 1**	9	15.52	15	25.86	2.012[χ²]	0.733
	Grade 2	0	0.00	2	3.45		
	Grade 3	4	6.90	7	12.07		
	Grade 4	5	8.62	5	8.62		
	Grade 5	5	8.62	6	10.34		

[t]: Independent t-test statistic, [U]: Mann-Whitney U test statistic, [χ²]: Chi-square test statistic, $p<0.05$.
GMFCS: Gross Motor Function Classification System, SD: Standard deviation

Table 2. The relationship between the participants' food consumption and the presence of epileptic seizures

		Epileptic seizures present		None epileptic seizures		Test	p
Nutrient components		**Mean**	**SD**	**Mean**	**SD**		
Food consumption	**Energy**	1304.54	430.85	1220.13	364.12	0.803[t]	0.425
	Carbonhydrat	138.13	47.25	131.10	62.85	0.458[t]	0.649
	Protein	48.20	19.27	46.60	14.48	0.360[t]	0.720
	Lipid	61.46	19.71	54.44	15.68	1.506[t]	0.138
	Saturated fat	24.92	7.93	21.93	6.71	1.542[t]	0.129
	Fiber	15.27	9.55	12.27	5.85	326[U]	0.224
	Antioxidant	2.01	2.20	1.54	1.36	0.915[t]	0.367
	Glisemic index	146.70	58.01	133.11	103.90	0.570[t]	0.571
	Water	1871.41	795.49	1646.94	562.79	1.259[t]	0.213

[t]: Independent t-test statistic, [U]: Mann-Whitney U test statistic, $p<0.05$.
SD: Standard deviation

Table 3. The relationship between the presence of epileptic seizures and malnutrition scores

	Z-score	Epileptic seizures				Test	p
		Available		None			
		n	%	n	%		
MUAC Z-score	**<(-2 SD)**	4	6.90	5	8.62	13.145$^{\chi^2}$	**0.022**
	(-2 SD)-(-1 SD)	1	1.72	5	8.62		
	(-1 SD)-median	3	5.17	12	20.69		
	Median-(1 SD)	12	20.69	7	12.07		
	(1 SD)-(2 SD)	1	1.72	6	10.34		
	>(2 SD)	2	3.45	0	0.00		
HFA Z-score	**<(-2 SD)**	9	15.52	13	22.41	3.597$^{\chi^2}$	0.463
	(-2 SD)-(-1 SD)	8	13.79	10	17.24		
	(-1 SD)-median	1	1.72	7	12.07		
	Median-(1 SD)	3	5.17	4	6.90		
	(1 SD)-(2 SD)	2	3.45	1	1.72		
	>(2 SD)	0	0.00	0	0.00		
BMI Z-score	**<(-2 SD)**	8	13.79	15	25.86		
	(-2 SD)-(-1 SD)	4	6.90	7	12.07	3.458$^{\chi^2}$	0.630
	(-1 SD)-median	5	8.62	4	6.90		
	Median-(1 SD)	4	6.90	6	10.34		
	(1 SD)-(2 SD)	0	0.00	2	3.45		
	>(2 SD)	2	3.45	1	1.72		

$^{\chi^2}$: Chi-square test statistic, $p<0.05$.
MUAC: Mid-Upper Arm Circumference, HFA: Height-for-age, BMI: Body mass index, SD: Standard deviation

However, the mode of delivery was found to be associated with epileptic seizure, and the risk of it was significantly higher in children born by caesarean section. Ehrenstein et al.[11] analysed 277,435 births and reported that prolonged gestation was a risk factor for early epilepsy, and caesarean section may be associated with the risk of epilepsy. In addition, Li et al.[12] reported that the risk of epilepsy in preterm delivery was 2.16 times as high as in full-term delivery. The literature supports the findings of this study and suggests that complications related to labour may increase the risk of epilepsy.

When the effect of epileptic seizures on children's dietary preferences was analysed, no significant relationship was found between the food components consumed by the participants and epileptic seizures. However, it was observed that children with epilepsy preferred a diet with higher energy, carbohydrate, saturated fat, and a high glycaemic index. These dietary habits may lead to inadequate intake of some nutrients. Furthermore, although children with epileptic seizures are younger on average, their higher energy, carbohydrate, and saturated fat intake suggests that these children have unhealthy eating habits.

In a study, it was reported that unbalanced macro and micronutrient intake increased lack of seizure control in patients with epilepsy, and that high calorie intake and low vegetable consumption increased the likelihood of seizure.[13] Hameed and Aghdam[14] emphasised that sugar craving may be associated with epileptic seizures, and this condition is also associated with agitation. Szałwińska et al.[15] reported that irregular eating habits and lack of physical activity observed in adults with epilepsy, increased the risk of cardiovascular disease.

These findings indicate that the dietary habits of children with epilepsy should be improved. In particular, adoption of balanced and varied dietary patterns instead of diets containing high energy and saturated fat may improve the general health status of children and may help control seizures.

The relationship between epilepsy and malnutrition stands out as an important problem, especially in developing countries. Rogathe et al.[16] reported that epilepsy was not associated with malnutrition in a study conducted in Africa. On the other hand, Crepin et al.[17] reported that epilepsy was associated with malnutrition due to socio-cultural factors and anti-epileptic drugs. In another study, low-protein diets, micronutrient deficiencies, and socio-cultural attitudes were reported to contribute to malnutrition in individuals with epilepsy.[18] In this study, children with CP who had epileptic seizures experienced significant malnutrition compared to those who did not. It is thought that the different results in the literature are related to socio-economic reasons, age, gender and the drugs used. Soltani et al.[19] emphasised that patients with epilepsy were at risk of inadequate nutrient intake and needed special diets to protect their health and better control epileptic attacks.

In this study, nutritional problems among individuals diagnosed with CP were analysed in detail by comparing individuals with and without epileptic seizures. While, vomiting, spitting and aspiration complaints were similar in both groups, chewing difficulty and swallowing disorder were found at higher rates in individuals with epileptic seizures. These findings suggest that the risk of malnutrition is higher in children with CP who are also diagnosed with epilepsy compared to those without epilepsy. In addition, mothers whose children are malnourished prefer meals containing

higher levels of carbohydrates and fats to meet the energy needs of their children.[20] This explains the high energy, carbohydrate, and saturated fat intake in children with epileptic seizures.

Study Limitations

While this study reveals the relationship between nutritional status and epileptic seizures in children with CP, it also has some limitations. The cross-sectional nature of the study limits the establishment of causal relationships, and the generalizability of the findings is restricted by the small sample size and single-centre design. In addition, parent-reported food consumption data carry the risk of recall bias.

CONCLUSION

The presence of epileptic seizures in children with CP increases the risk of malnutrition by negatively affecting their eating habits and nutritional status. Special nutrition programmes are needed to regulate the eating habits of these children and to protect their health. Special nutrition programmes and nutrition interventions for children with epilepsy can make significant contributions to improving the quality of life.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the İnönü University Clinical Research Ethics Committee (decision no: 2024/6331, date: 11.09.2024) in accordance with the Declaration of Helsinki.

Informed Consent: Participants and their mothers were informed about the study, and their written consent was obtained.

Footnotes

Authorship Contributions

Surgical and Medical Practices: H.A., Concept: H.T., Design: H.T., Data Collection or Processing: H.A., Analysis or Interpretation: H.T., Literature Search: H.T., H.A., Writing: H.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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Archives of Epilepsy

Original Article

Obstructive Sleep Apnea and Epilepsy: Study from a Tertiary Care Centre in Southern India

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Abstract

Objective: Obstructive sleep apnea (OSA) is a sleep-related disorder resulting in hypoxemia and epilepsy itself causes central and obstructive apnea. Studies looking at this relation are limited. Hence, we aimed to examine the incidence of OSA in patients with epilepsy. To estimate the prevalence of OSA in patients with epilepsy. To study seizure characteristics among patients with comorbid OSA.

Methods: Patients above 18 years, and diagnosed with seizures/epilepsy attending our neurology epilepsy clinic for the past 1 year were included in our study. Patients with metabolic causes, psychogenic seizures, and symptomatic or provoked seizures were excluded. Retrospective analysis was done. Patients were screened for OSA using the Berlin questionnaire. Those with high scores underwent complete clinical evaluation, evaluation using the Epworth Sleepiness Scale, and diagnostic polysomnography with a portable ResMed USA device. Univariate binary logistic regression analysis was used to obtain the results.

Results: Out of 195 epileptic patients screened, 63 patients scored high on the Berlin questionnaire. Of them, 4 had severe OSA, 6 had moderate OSA, and 11 had mild OSA based on polysomnography. Prevalence of OSA is 33.3%. Age and body mass index were strongly associated with OSA syndrome, (p values 0.001 and 0.0003). There is no association between seizure type and the occurrence of OSA (p value=0.5).

Conclusion: Even though we found no direct relationship, we observed that treating underlying OSA reduced the frequency of seizures, resulting in the patient's overall well-being.

Keywords: Epilepsy, seizure, OSA, Berlin questionnaire

INTRODUCTION

The relationship between epilepsy and sleep has long been known, but our understanding of its practical application is incomplete. Sleep fragmentation due to obstructive sleep apnea (OSA) causes metabolic dysregulation with sympathetic overactivity, leading to alterations in glucose metabolism, orexin, and ghrelin levels.[1] On the other hand, epilepsy itself can exacerbate OSA. William Gowers in the 19th century first highlighted the effects of sleep on seizures. In his study, he observed that seizures occurred only at night in 21% of patients, only during the day in 42%, and in the remaining 37% they occurred either during the day or at night.[2] This led to the concept of 'pure sleep epilepsy', which is used for epilepsy seen exclusively during sleep. A variety of syndromic and non-syndromic epilepsies can manifest as pure sleep epilepsy but are usually associated with focal epilepsies.[3] Pure sleep epilepsies often respond well to antiepileptic drugs. polysomnographic abnormalities include increased wakefulness after sleep onset time, increased rapid eye movement (REM) latency, and increased slow-wave sleep, with reduced REM sleep compared to controls.[4]

Sleep deprivation increases the rate of kindling, and REM sleep deprivation accelerates the kindling of the amygdala. Hence, sleep fragmentation may increase seizure frequency by interfering with seizure inhibitory mechanisms, potentially aggravating the kindling process, and accelerating the progression of the epileptic focus, as derived from studies by Shouse on animals.

Patients with neurologic disorders seem to have a greater prevalence of sleep disturbance than normal subjects. A study done by Miller et al.[5] showed that the majority of patients with epilepsy had complaints regarding sleep. A polysomnographic investigation by Malow et al.[6] showed that nearly one-third of patients with medically refractory epilepsy had a respiratory disturbance index of more than 56. Therapeutic intervention for epilepsy may also increase the risk of sleep apnea. Some of the anticonvulsant medications have weight gain as a side effect and may alter respiratory regulation. Valproate, vigabatrin, and gabapentin are well known to accelerate obesity, which increases the likelihood of sleep apnea. Benzodiazepines and barbiturates may cause carbon dioxide and oxygen desaturation and increase upper

airway musculature relaxation.[7] The changes in the regulation of breathing may be more sensitive to these inhibitory medications and exacerbate underlying sleep-related breathing disturbance during certain stages of sleep. Vagus nerve stimulation has also been reported to increase airway disturbance potentially during sleep in some patients.[8]

There is a need to address the possibility that the seizure focus may cause apnea. Snoring and apnea that occur as a part of seizures may be ictal or postictal phenomena. Repetitive nightly seizures can be mistaken for sleep apnea.[9] Seizures cause nocturnal choking, as seen in insular epilepsy[10]. This is one reason that adequate electroencephalographic monitoring should be included in the overnight polysomnogram. Studies looking at this bidirectional influence are limited. Hence, we aimed to examine the incidence of OSA in patients presenting with epilepsy in a tertiary care hospital.

Aim: To study the correlation between OSA and epilepsy.

Objectives: 1. To estimate the prevalence of OSA in patients with epilepsy.

2. To study seizure characteristics among patients with comorbid OSA.

Inclusion Criteria

Patients above 18 years and diagnosed with epilepsy/seizure based on 2017 International League Against Epilepsy criteria, electroencephalogram (EEG) and brain imaging [magnetic resonance imaging (MRI) was considered].

Exclusion Criteria

Patients with hypothyroidism, obesity, hepatic dysfunction, renal dysfunction, purely psychogenic seizures, uncertain diagnosis (for instance patients with a differential diagnosis of seizure vs. syncope), symptomatic or provoked seizures (seizure occurring as a symptom or manifestation of a known cerebral insult) were excluded.

METHODS

This is a retrospective single-center study done over 1 year. In this study, patients with epilepsy were screened for OSA syndrome (OSAS) by direct interview using the Berlin questionnaire. Those with high scores on the questionnaire underwent diagnostic polysomnography (PSG). Each patient underwent a complete clinical evaluation, including an appropriate medical history and clinical examination, an EEG, an MRI brain, the Epworth Sleepiness Scale, and a portable home-based PSG (ResMed USA device). The PSG was scored according to American Academy of Sleep Medicine (AASM) guidelines. Informed consent was obtained. The study was started after getting clearance from the Project and Budget Approval Committee and the Nizam's Institute of Medical Sciences Institutional Ethics Committee (decision no: ECINIMS/2236/2018, date: 02.11.2018). We included patients above the age of 18 years. Information regarding the patient's demographic profile, including age, sex, body mass index (BMI), associated comorbidities, epilepsy characteristics, and seizure frequency, was noted. PSG was done with a portable home-based device (ResMed USA). It was classified according to AASM guidelines as mild, moderate, and severe OSA. Apnea, hypopnea interval, and oxygen desaturation index were noted. The overnight PSG is the standard diagnostic test for OSA. It involves simultaneous recordings of multiple physiologic signals during sleep, including the EEG, electrooculogram, electromyogram, oronasal airflow, and oxyhemoglobin saturation. Collectively, these recordings allow identification and classification of sleep-related apneas and hypopneas. Since we used a portable device, nasal cannula, sensor placed around the chest for chest expansion, and a pulse oximeter. An apnea is defined as the complete halt of airflow for at least 10 seconds. Apneas are again classified as obstructive, central, or mixed based on whether effort to breathe is present during the event. AASM guidelines define hypopneas as a reduction of 30% or more in nasal flow with >3% desaturation of arterial oxygen, measured by pulse oximetry, or EEG arousal. Identification and avoidance of factors that might trigger or exacerbate seizures is important in patients with epilepsy. The most frequent factors are sleep disturbance, alcohol ingestion, drugs, stress, and photosensitivity.

MAIN POINTS

- In our study, we found no direct association between epilepsy and the occurrence of obstructive sleep apnea (OSA) (p value 0.5).
- However, treating underlying OSA reduced the frequency of seizures, resulting in the patient's overall well-being.

Statistical Analysis

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, and frequency and proportion for categorical variables. Data were also represented using bar diagrams. All the outcome scores were categorized into poor and good outcomes based on standard cut-off values. Univariate binary logistic regression analysis was performed to test the association between the explanatory variables and outcome variables. The unadjusted odds ratio along with the 95% confidence interval (CI) is presented. Variables with statistical significance in univariate analysis were used to conduct multivariate regression analysis. The adjusted odds ratios along with their 95% CI are presented. The p value <0.05 was considered statistically significant. IBM Statistical Package for the Social Sciences (SPSS) version 22 was used for statistical analysis. IBM Corp., released in 2013. IBM SPSS statistics for Windows, version 22.0. Armonk, NY: IBM Corp.

RESULTS

A total of 195 epileptic patients were screened, out of which 63 patients scored high on the Berlin questionnaire (Table 1) and were included in the analysis. Demographic details are listed in Table 2. There were 41 males and 22 females, with a female-male ratio of 1.86. The mean age was 40.63 years with a standard deviation of 17.58. The eldest patient was aged 73 years, while the youngest patient was aged 20 years. Among the participants, most were in the age group of 20 to 40 years, i.e., 36 members, whereas 4 members were below 20 years of age and the rest of the participants were above 40 years. The BMI of the participants ranged between 18.9 and 40.8 kg/m^2, and the mean BMI of the participants was 29.5 kg/m^2 with a standard deviation of 3.25. Among 63 epileptic patients, 33 patients had generalised epilepsy and 30 patients had

focal epilepsy (Figure 1). Out of which, 11 had a frontal focus, and 19 had a temporal focus. Almost all patients had snoring (Figure 2). After analyzing all 63 patients who underwent PSG, 4 had severe OSAS, 6 had moderate OSAS, and 11 had mild OSAS (Figure 3). A total of 21 patients had OSAS, which accounts for 33.3% of the study group. The types of epilepsy among patients with OSA are depicted in Table 3. No association was seen between epilepsy and OSAS, (p value 0.5) (Table 3). When we study the association between various demographic characteristics of epileptic patients some characteristics were significantly associated with the occurrence of OSA. Age was significantly associated with OSAS with a p value of 0.001 (Table 4).

Table 1. Subjects response to Berlin questionnaire

Item	Number of patients
Do you snore?	
Yes	63
No	0
Your snoring is:	
Slightly louder than breathing	58
As loud as talking	5
Louder than talking	0
Very loud-can be heard in adjacent rooms	0
How often do you snore?	
Nearly every day	1
3-4 times a week	9
1-2 times a week	29
1-2 times a month	22
Never or nearly never	8
Has your snoring ever bothered other people?	
Yes	0
No	63
Has anyone noticed that you quit breathing during your sleep?	
Nearly every day	0
3-4 times a week	0
1-2 times a week	0
1-2 times a month	0
Never or nearly never	63

Table 2. Descriptive analysis for baseline characteristics in the study population (n=63)

Baseline characteristics	Number of patients
Gender	
Male	41
Female	22
Age range	
<20 years	4
20-40 years	36
>40 years	23
Median age	35
Mean	40.63±17.58
Body mass index	
Mean	29.5±3.25
Median	29.3
Range	18.9 to 40.8
Co-morbid medical conditions	
Hypertension	18
Diabetes	9
Types of epilepsy	
Generalized	33
Focal	30
Seizure frequency	
Per month	22
Per year	41
Disease duration	3.19±2.49

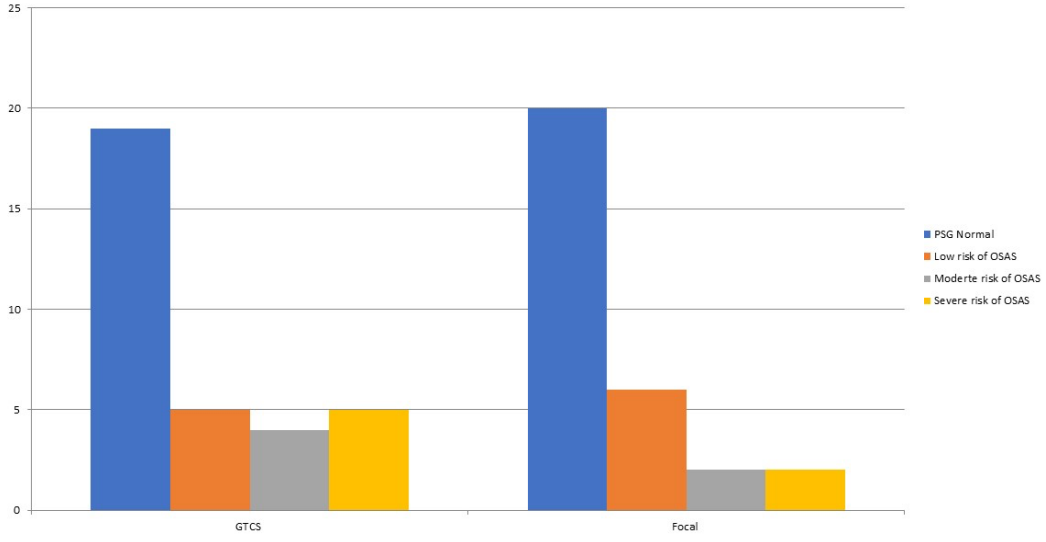

Figure 1. Distribution of OSAS among patients with epilepsy
OSAS: Obstructive sleep apnea syndrome, PSG: Polysomnography, GTCS: Generalised tonic-clonic seizures

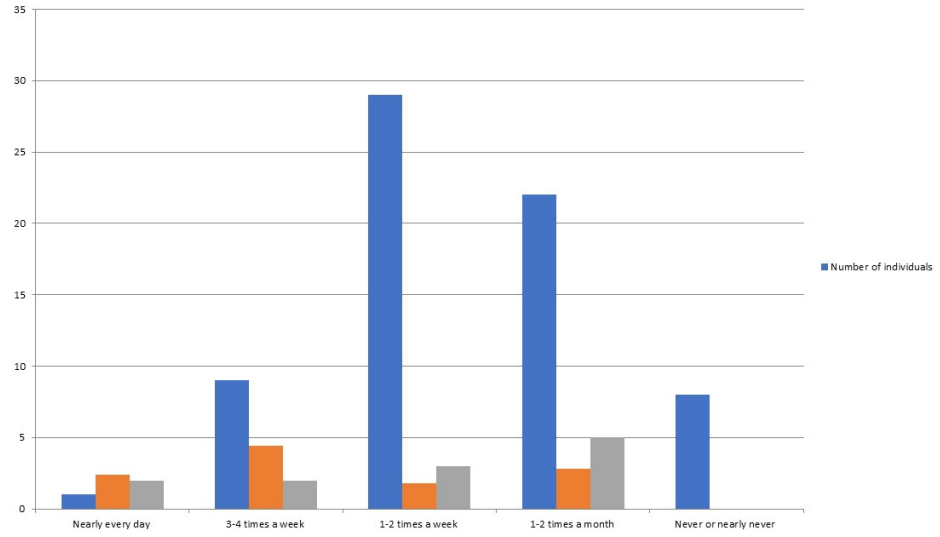

Figure 2. Frequency of snoring among the study population

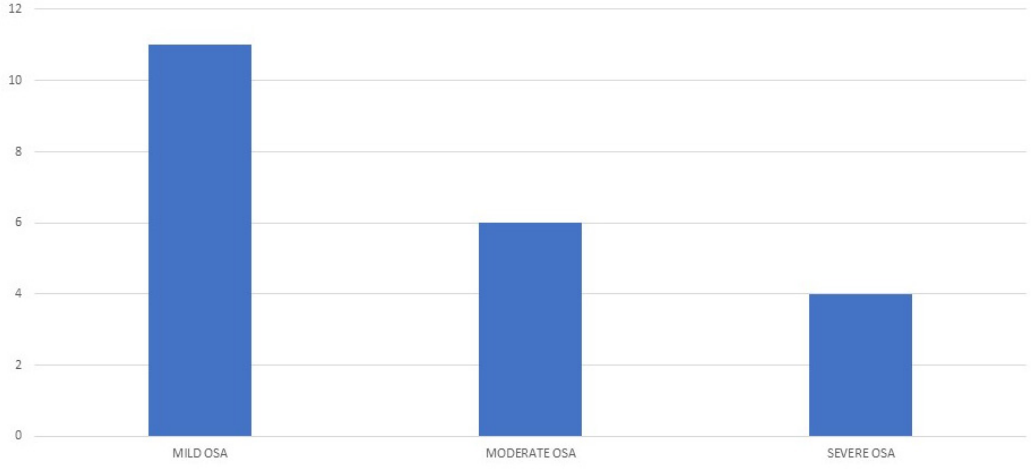

Figure 3. Polysomnography findings in the study group
OSA: Obstructive sleep apnea

BMI was also significantly associated with OSAS with a p value of 0.0003 (Table 5). Multiple regression analysis showed that age and BMI are strongly associated with OSAS. The presence of co-morbidities, such as hypertension (HTN) and diabetes mellitus (DM), was also significantly associated with OSAS.

DISCUSSION

The prevalence of epilepsy in developing countries is 14 per 1000 subjects.[11] Seizures are typically encountered during sleep in certain syndromes, for example, nocturnal frontal lobe epilepsy. However, in recent years, considerable attention has been given to studying the relationship between sleep and epilepsy.[2,12] Among these, OSAS is a common condition occurring in about 2% of adult women and 4% of adult men in the general population.[3]

OSAS causes significant sleep deprivation and fragmentation, leading to impaired sleep continuity; hence, increased daytime sleepiness and impaired cognitive functions.[13] Such alterations could have a considerable negative influence on seizure activity in patients with epilepsy. The frequency of OSAS among patients with epilepsy and the relationship between the severity of epilepsy and the severity of OSAS are still not clear. Hence, we aim to study the frequency of OSAS among patients with epilepsy.

The mean age was 40.63 years with a standard deviation of 17.58. Our patients with epilepsy had a higher age at presentation compared to the general population. Female preponderance was noted. The participants' BMI ranged between 18.9 and 40.8 kg/m^2, and the mean BMI was 29.5 kg/m^2 with a standard deviation of 3.25. Among 63 epileptic patients, 33 patients had generalised epilepsy, and the remaining 30 patients had focal epilepsy. Among focal epilepsy patients, the majority had a temporal focus, followed by a frontal focus. Almost all patients experienced snoring. Among the 63 patients who underwent PSG, 4 had severe OSAS, 6 had moderate OSAS, and 11 had mild OSAS. The majority of mild OSA patients had focal epilepsy (54.5%) and the majority of the patients with moderate and severe OSA had generalized epilepsy (66.6% and 71.4%, respectively). We included only patients >18 years old, which may have led to the limited number of patients

Table 3. Association between epilepsy subtypes and OSA risk

Characteristics	Patients with normal PSG	Low risk of OSAS	Moderate risk of OSAS	High risk of OSAS	p value
Type of epilepsy					
GTCS	19	5	4	5	0.5
Focal	20	6	2	2	

The chi-square value has 3 degrees of freedom.
The chi-square value is 1.93.
P value 0.5.
OSAS: Obstructive sleep apnea syndrome, PSG: Polysomnography, GTCS: Generalised tonic-clonic seizures

Table 4. Association between age and OSA risk

Characteristics	Patients with normal PSG	Low risk of OSAS	Moderate risk of OSAS	High risk of OSAS	p value
Age					
<20 years	4	0	0	0	0.001
20-40 years	27	2	6	1	
>40 years	8	9	3	6	

The chi-square value has 6 degrees of freedom.
Chi-square value is 21.75.
The p value is 0.001.
OSA: Obstructive sleep apnea, OSAS: OSA syndrome, PSG: Polysomnography

Table 5. Association between BMI and OSA risk

Characteristics	Patients with normal PSG	Low risk of OSAS	Moderate risk of OSAS	High risk of OSAS	p value
BMI					
<25	2	1	0	0	0.0003
25-30	28	1	5	0	
>30	9	7	1	7	

The chi-square has a value of 24.41.
P value 0.0003.
OSA: Obstructive sleep apnea, OSAS: OSA syndrome, BMI: Body mass index, PSG: Polysomnography

below the age of 20 (6%). Most of the patients were 20-40 years old, with a median age of 35 years.

Our epilepsy patients with OSA had higher age and increased BMI, which are common risk factors for OSA in the general population. These people also experienced associated comorbidities like DM and HTN. This has been reported in other studies by Malow et al.[4] In our study, the frequency of OSAS among patients with epilepsy was assessed using a simple methodology, the Berlin questionnaire, which is a valid tool used to screen OSAS in a source-limited setting like ours. The prevalence of OSAS was 33.3% in our study. A study conducted by Al-Abri et al.[14] in Oman showed the frequency of OSAS in a similar population to 9%. However, Indian studies similar to our study are not yet available to date. Indian studies done on the general population showed a prevalence of 6.2% according to Singh et al.[15] Our study showed a significant increase in the prevalence of OSAS in epilepsy patients; further studies are needed to either confirm or refute our results. Until now, there are no well-conducted randomized studies. Our study is the first of its kind from India. Other factors contributing to increased prevalence were increased age, and BMI. The chi-square test showed a significant association between age and the presence of OSAS with a p value of 0.001. A study by Deng et al.[16] showed a similar association, wherein multiple linear regression showed that increasing age was associated with OSA exacerbation. BMI was also significantly associated with the occurrence of OSAS with a p value of 0.0003. Deng et al.[16] showed a similar association where they stated that BMI was independently associated with an increased risk of OSAS.

Our study did not show any association between the type of epilepsy and the occurrence of OSAS, similar to the findings reported by Al-Abri et al.[14] In our study, the frequency of OSAS was greater in patients with epilepsy than in the general population. Thirty-three percent of patients had a BMI in the obese or overweight range. Similarly, other studies reported obesity and overweight in 30% to 50% of patients with epilepsy. One culprit could be the type of antiepileptic drug (AED) the patient is taking, especially sodium valproate. However, we did not study the effect of antiepileptic drugs on body weight and OSA. Snoring was present in all participants. Almost all patients reported daytime sleepiness with no significant association with either the type or severity of epilepsy, nor with the number of AEDs.

Other comorbidities like HTN and DM were also significantly associated with OSAS in our study. Manni et al.[17] found that the major risk factors for OSAS in epilepsy patients were the same as those typically found in the general population. He also found evidence that OSAS coexists in epilepsy in 10% of unselected adult epilepsy patients, 20% of children with epilepsy, and up to

30% of drug-resistant epilepsy patients. The major limitation in this study was the small sample size. A larger sample size may give a better understanding of the real association between epilepsy and OSAS. During our study period, we observed that treating underlying OSAS in epileptic patients reduced the frequency of seizures and associated co-morbidities of the patients. For example, a 72-year-old male, known epileptic for 3 years on levetiracetam 1 gm/day, lacosamide 400 mg/day, and clobazam 20 mg/day, presented with multiple episodes of generalised tonic-clonic seizures. On average, he had two episodes per month. He was compliant with AEDs; he was also taking regular medication for HTN. He satisfied the inclusion criteria for our study and gave consent. He complained of snoring and daytime sleepiness. He had a BMI of 33.1; overnight PSG showed the presence of OSA with an apnea hypopnea index of 21. He was advised to undergo weight reduction and to seek a pulmonologist consultation. He had used nighttime CPAP for 6 months. After this, his frequency of seizures reduced to approximately one every two months. We observed a similar situation in three more patients. This study highlights the importance of screening for OSAS and other associated co-morbidities in all patients with epilepsy, as an effective treatment of these will benefit epileptic patients in reducing seizure frequency.

Study Limitations

1. Small sample size.

2. Limited study period.

3. Our study is done at a tertiary center, correspondingly there is every chance of selection bias.

4. We did not study the effects of AEDs on the occurrence of OSAS in epileptic patients.

5. In particular, our study is limited by the fact that in diagnosing OSAS, we used a portable device that doesn't allow EEG recording. Thus, nocturnal seizures occurring during the monitored night and the consequences of these on breathing patterns might have been undiagnosed.

CONCLUSION

The prevalence of OSAS is 33.3% in our study. Age and BMI were the demographic characteristics that were strongly associated with the presence of OSAS. HTN and DM were also significantly associated with the presence of OSAS. There is no direct association between epilepsy and the occurrence of OSAS (p value 0.5). Even though we found no direct relationship in our study, we observed that treating underlying OSAS and other comorbidities in epileptic patients reduced the frequency of seizures and improved overall well-being.

Ethics

Ethics Committee Approval: The study was started after getting clearance from the Project and Budget Approval Committee and the Nizam's Institute of Medical Sciences Institutional Ethics Committee (decision no: ECINIMS/2236/2018, date: 02.11.2018).

Informed Consent: Informed consent was obtained.

Footnotes

Author Contributions: Surgical and Medical Practices: S.P.T., S.N., C.S.R., Concept: S.N., C.S.R., Design: S.P.T., S.N., C.S.R., Data Collection or Processing: S.P.T., S.N., C.S.R., Analysis or Interpretation: S.P.T., S.N., Literature Search: S.P.T., C.S.R., Writing: S.P.T.

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Archives of Epilepsy

Case Report

Dyke-Davidoff-Masson Syndrome Following Head Trauma: Clinical and Radiologic Findings

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Abstract

Dyke-Davidoff-Masson syndrome (DDM) is an unusual condition characterized by facial asymmetry, hemiparesis, mental retardation, learning disabilities, sensorineural hearing loss, psychiatric disorders, and epilepsy. Some of the typical radiologic findings related to the condition are cerebral hemiatrophy, unilateral thickening of the skull, hyperaeration of frontal sinuses. In this article, we present a case of DDMS acquired after head trauma at the age of 28. Our aim is to point out some of the clinical and radiological diagnostic criteria of acquired DDMS.

Keywords: Epilepsy, hemiatrophy, hemiparesis, mental retardation, Dyke-Davidoff-Masson syndrome, acquired

INTRODUCTION

Dyke-Davidoff-Masson syndrome (DDMS) is a very rare condition that is congenital or acquired.[1,2] Mental retardation, hemiparesis, learning disabilities, and focal or generalized epileptic seizures, sensorineural hearing loss, and psychiatric disorders are the most remarkable clinical findings. Radiologic findings are hemicerebral atrophy or hypoplasia along with ipsilateral skull hypertrophy, facial asymmetry, hyperaeration of the mastoid cells, and frontal sinuses.[3] These classical criteria are only observed if the condition occurs before 3 years of age. Male patients were reported to be slightly the majority of cases.[4]

CASE PRESENTATION

Our patient is a 28-year-old female with post-traumatic left hemiparesis and an intellectual disability. She consulted us at our hospital emergency department with partial motor seizures on the left side, while having no loss of consciousness. The neurosurgery clinic was consulted due to the findings in her radiological examinations. In her neurological examination, the patient was evaluated as being in a post-seizure period, and no other pathology was detected except for left hemiparesis with 4/5 muscle strength and mental retardation. Following the observation period, she was discharged after being given anti-seizure treatment. There is no notable finding in the patient's anamnesis and birth history. Her parents reported that she had normal development until the age of 10. It was later revealed that she had had a head trauma after falling at the age of 10, and was treated in the intensive care unit of the hospital, where she had been admitted for 3 weeks, and then discharged with anti-seizure medication. No documentation could be obtained from this period. During outpatient check-ups, focal motor seizures were observed in the left arm twice a month without loss of consciousness. A 1.5 T magnetic resonance imaging (MRI) unit (Signa HDxt; General Electric) was used with a head coil. Based on MRI, transverse images showed right cerebral hemiatrophy with ipsilateral enlarged lateral ventricle, gliosis, and thickened diploic space (Figure 1). Informed consent was obtained from the patient's parents.

DISCUSSION

DDMS was initially described in 1933 by Dyke et al.[1] Two types of DDMS are mentioned, congenital and acquired.[1,2] Intrauterine vascular occlusion may occur in cases of the congenital type of DDMS and the symptoms begin at birth or immediately afterwards. The central nervous system damage due to trauma, ischemic and hemorrhagic conditions, and infection may be playing a role in the acquired type of DDMS.[5] The case presented is the acquired type of DDMS that developed after trauma at the age of 10.

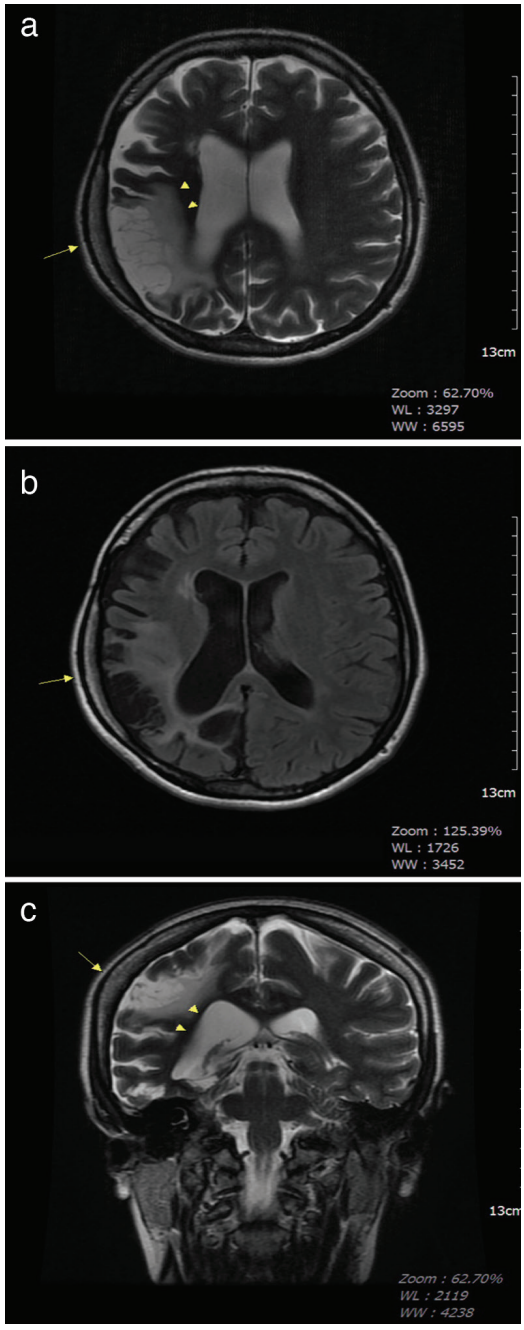

Figure 1. a) T2-W FSE and b) FLAIR supraventricular transverse images show that right cerebral hemiatrophy with enlarged sulcal space, right lateral ventricle, gliosis (arrow head), and also ipsilateral thickening of the calvarium (long arrow). c) Coronal T2W image shows right cerebral hemiatrophy with enlarged sulcal space and right lateral ventricle (arrow head), and also thickening of the calvarium (long arrow)

MAIN POINTS

- Dyke-Davidoff-Masson syndrome is a rare entity characterized by hemi cerebral atrophy/hypoplasia secondary to brain insult in fetal or early childhood period.
- Classical radiological findings and hyperpneumatization of the frontal sinuses are not always seen if an insult to the brain occurs older ages.
- We believe that calvarial thickening and hyperpneumatization of the sinuses replace brain parenchyma.

The clinical features include seizures, facial deformity, contralateral hemiparesis, and intellectual disability. The radiological findings typically demonstrate fascial deformity, enlargement of frontal sinuses, and mastoid cells on craniography. Brain computed tomography and MRI showed cerebral hemiatrophy, ipsilateral dilated lateral ventricles, thickening of the skull vault, elevation of the petrous back, and ipsilateral falcine displacement.[3] The clinical features of the case included seizures, contralateral hemiparesis, and intellectual disability. Radiological examinations revealed right cerebral hemiatrophy with ipsilateral, enlarged lateral ventricle, gliosis, and thickened diploic space. There were no facial deformities, enlargement of the frontal sinuses, and the mastoid cells in the classic triad. However, with its clinical and radiological findings, the case we present can be defined as acquired type DDMS.

The differential diagnosis includes hemimegalencephaly, Sturge-Weber syndrome, and Rasmussen encephalitis (RE). Sturge-Weber syndrome can also be associated with DDMS. RE tends not to have hyperosteosis. The clinical features of the case included seizures, contralateral hemiparesis and mental retardation. Radiological examinations revealed right cerebral hemiatrophy with ipsilateral enlarged lateral ventricle, gliosis, and thickened diploic space. There were no facial deformities, enlargement of frontal sinuses and mastoid cells in the classic triad. However, the case we present can be defined as acquired type DDMS with clinical and radiological differential diagnosis findings such as seizures, contralateral hemiparesis, intellectual disability, right cerebral hemiatrophy with ipsilateral enlarged lateral ventricle, and thickened diploic space.

The treatment consists of controlling seizures, physiotherapy, and speech therapy. Prognosis is better in cases when hemiparesis onset occurs after 2 years of age. Furthermore, the frequency of prolonged or recurrent seizures decreases. Hemispherectomy is a treatment option to alleviate treatment-resistant seizures in selected cases.[6]

CONCLUSION

DDMS can be taken into account in the differential diagnosis of seizure syndrome cases with clinical and radiological findings typical of the syndrome. The case we present includes many of the typical findings that would suggest the presence of DDMS. Also, it is important to remember that DDMS can occur after trauma.

Ethics

Informed Consent: Informed consent was obtained from the patient's parents.

Note: We presented in Turkish Neurosurgical Society 30. Scientific Congress, e-poster (EPS-158), 8-12 April 2016 Belek, Antalya, Türkiye.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.E.A., Concept: E.E.E., Design: M.E.A., Data Collection or Processing: M.E.A., Analysis or Interpretation: M.E.A., Literature Search: E.E.E., Writing: M.E.A.

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Non-convulsive Status Epilepticus in a Child During Treatment of Central Nervous System Infection

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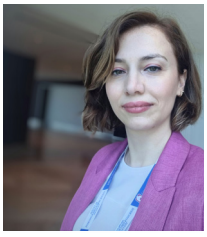

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Dear Editor,

I read with interest the manuscript by Gezegen et al.[1] reporting a rare presentation of non-convulsive status epilepticus (NCSE). While the report offers valuable insights, I would like to discuss a different presentation about this disorder.

I present a toddler with normal renal function who had NCSE during treatment of a central nervous system (CNS) infection with ceftriaxone.

A 22-month-old girl had a history of two simple febrile seizures, and presented with a refractory fever, nausea, and vomiting. She was hospitalized, and 100 mg/kg/d IV ceftriaxone was administered. She was referred to the pediatric neurology clinic on the third day of therapy, owing to persistent fever and inability to speak. She was alert and had no focal motor deficits. She was making noise but not speaking. She had mild unsteadiness.

Twenty white blood cells, glucose 49 mg/dL, and protein 35 mg/dL were observed after lumbar puncture. She was diagnosed with meningitis that was partially treated. The therapy was augmented with vancomycin. Despite her heightened awareness and decreased fever, she was still speechless and had an unsteady gait. Her mother's recordings showed she was twitching her mouth and eyes while sleeping. IV midazolam was administered for possible NCSE, which improved her speech. Contrast-enhanced cerebral magnetic resonance imaging was normal. The next-day sleep electroencephalogram (EEG) was normal.

After 8 days, her mother reported a recurrence of speech impairment and unsteady gait. The cerebrospinal fluid (CSF) culture was negative. The ceftriaxone treatment was discontinued. The EEG of the patient revealed rhythmic delta/theta activity with typical spatiotemporal evolution, which is considered NCSE based on Salzburg EEG criteria for the diagnosis of NCSE. IV levetiracetam was administered. She regained the ability to speak the same day, and her gait improved. Her EEG has become normal for her age. During the two-year follow-up, she experienced no seizures and had typical development. Genetic testing for epilepsy was unremarkable.

In our case it was observed that the patient's clinical condition occurred after administering ceftriaxone and disappeared entirely when the medication was discontinued, suggesting that ceftriaxone was the cause of this condition. There are numerous articles in the literature that relate cephalosporins to NCSE.[2,3] The incidence of CNS adverse effects is higher in individuals with renal failure, primarily attributed to elevated medication levels in the systemic circulation. When the blood-brain barrier is compromised, as observed in our patient with meningitis, the CSF concentration of cephalosporins may increase, and CNS toxicity may ensue.[4] Speech was the most impacted in our case. Speech impairment is a recognized consequence of disorders affecting the electrical activity of the brain, such as Landau-Kleffner syndrome and electrical status epilepticus in sleep in children.[5] NCSE should be considered in the presence of neurological symptoms during cephalosporin treatment, irrespective of renal failure.

Ethics

Informed Consent: Written and verbal informed consent was obtained from the parents for the publication of this report.

Acknowledgments

I would like to express our gratitude to the patient and her family for cooperating in this report.

Footnotes

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Archives of Epilepsy

Erratum

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Koçhan Kızılkılıç E, Benbir Şenel G, Koç G, et al. Validity and reliability study of the Turkish version of the subjective handicap of epilepsy. *Arch Epilepsy.* 2024;30(3):84-88.

The mistake has been made inadvertently by the author.

The institution information of Fatma Karantay Mutluay (institution number 5), one of the authors on the first page of the article, has been corrected by the author as follows.

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Corrected institution information of Fatma Karantay Mutluay (institution number 5).

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