Khartoum Medical Journal (2018) Vol. 11, No. 02, pp. 1487 - 1498

# Original articles

## Precipitating factors of seizures in epileptic patients admitted to Omdurman Teaching Hospital Emergency Room 2015

* Muaz A M Esayed [1], Abdelrafei M A [1], Mohamed Saeed [2].

*[1]Omdurman Teaching Hospital, [2]National center for Neurological Sciences Khartoum*

## Abstract:

**Introduction:** In epileptic patients, the seizures may be precipitated by certain factors that may be intrinsic or extrinsic. Non-compliance, infections and sleep deprivation are common factors. There are few studies looking at precipitating factors of seizures in epilepsy from the under- developed countries.

**Objectives:** to determine the precipitating factors of seizures in epileptic patients in the ER.

**Methods:** This was a descriptive, cross-sectional, hospital-based study that enrolled 100 patients in Omdurman Teaching Hospital.

**Results:** in this study, 41% were non-compliant. The commonest age group was 21-30 years. Patients presenting with status epilepticus were 13%. Two thirds of the sample were on mono-therapy, 50% of which were compliant. Infections were reported in 14%; undetermined factors in 12%, sleep deprivation 8%; stress 6%; catamenial 5%; exertion 5%; photosensitivity 3%; music 2% and metabolic 1%.

**Conclusion:** high burden of break-through seizures (29%) was reported in the age group 21-30 years. Non-compliance was more common in patients with mono-therapy and in patients with non-idiopathic generalized epilepsy. Stress, sleep deprivation-related seizures were reported in 6% and 8%, respectively. In 12% of the patients, the precipitating factor was cryptogenic. Reflex and physical exercise were reported in 5% and 3%, respectively. Alcohol was the least factor (1%) in precipitating seizures . Status epilepticus was observed mainly in patients on mono-therapy.

***Corresponding author:** Omdurman Teaching Hospital, E-mail: muaz_muaz@hotmail.com*

## Introduction and review:

Epilepsy is the second commonest serious neurological disorder, affecting an estimated number of 50 million people worldwide [(1)]. The diagnosis is mainly clinical augmented by the electroencephalograph (EEG) findings. Then patients are classified according to the ILAE criteria which categorizes these patients into specific subtypes. Seventy percent of cases will show terminal remission after completing the required treatment period while the rest run an intractable course. The use of antiepileptic drugs (AEDs), emergence of relatively new drugs and drug changes improved the outcome even for the intractable cases. Seizures may be part of epilepsy or a symptom of other underlying disease i.e. symptomatic seizures. In epileptic patients, the seizures may be precipitated by intrinsic or extrinsic factors [(2)]. The main factor is non-compliance or non-adherence to medications [(3)]. Other precipitants are listed below:

**Stress:**

Stress may be related to seizures precipitation in 14%-32% of cases [(4, 5)]. Stress is a domain that is hard to quantify or prove a strong association between it and seizures precipitation. However, it has been demonstrated in many studies to show a modest relation [(6-7)]. Reducing the stress markers in adults, like low collective efficacy, lifetime mood

and anxiety disorder lowering measures would be associated with reduced risks of seizure relapse [8]. Hence, increased epileptogenesis and low seizure threshold are expected secondary to the effects of stress [9]. In some patients, major life events may precede the onset of epilepsy itself [10]. Emotional stress has been reported in one multi-center study of 1677 cases to be a common precipitating factor of seizures in epileptics [11].

## Sleep:

This normal physiological phenomenon is more complex than many other brain related activities. Moreover, it has multiple alternating cycles with different stages of sleep during one night. The EEG waves vary similarly during sleep and slowdown in frequency. This may render the brain liable to abnormal electrical discharges. Moreover, trans-magnetic stimulation showed increased cortical excitability early in the morning leading to liability to seizures around this time [14]. The chance will be bigger when patients are deprived of sleep. In contrast to day time seizures, these nocturnal epileptic seizures are less socially embarrassing as may occur in some syndromes like nocturnal frontal lobe epilepsy. In 2016 a new definition for this syndrome was suggested as sleep-related hyper-motor epilepsy (SHE) [15]. Sleep disorders must be critically addressed in these patients to improve the outcome [16]. Sleep deprivation and tiredness were also reported to be also a common precipitating factor in epilepsy [11-17].

## Infections:

Any system may be involved with sepsis but especially if it involves the central nervous system or upper respiratory tract. Endemic infections like malaria [18] and tuberculosis may be responsible for precipitating seizures in epileptic patients. The former may increase the risk of seizures by 10-folds in comparison to 3-fold in febrile seizures. The use of antipyretic measures will positively influence the risk of precipitating seizures in adults and children [19]. Meningitis in endemic areas is an important risk factor for epilepsy development [20]. Helminthes infections and other parasites are responsible for such complications including neuro-cysticercosis [20, 21]. In 1990, Sander et al found that the risk of remote symptomatic seizures following infection is 2% [1].

### Catamenial epilepsy:

In epileptic women, seizures may be precipitated by the menstrual cycle i.e. occurring immediately before or during menses. This is related to the variable hormonal changes and the elevation of estrogens during the follicular phase. Estrogen has three subtypes (17-β estradiol E2, Estriol and Estrone) which are implicated in the pathogenesis of catamenial epilepsy [22]. The estrogens, being lipophilic are able to cross the blood brain barrier. The negative effect is mediated by their neuro-excitation mechanism on different neurons [23]. However, the exact mechanism is still obscure. There may be 3 patterns of catamenial epilepsy occurring as peri-menstrual, during and mid-luteal[24] . Diagnosis of the condition depends on documentation of ovulation and the description of seizures semiology. The ovulation may be determined by measuring the basal body temperature early morning or urine check using LH kits [25]. Focal treatment use may be beneficial in a small subgroup of these patients while long-term treatment is mostly indicated [26]. This is in view of the unsatisfactory responses in strategies directed to modulate the hormonal levels [27]. Medroxyprogestrone acetate (MPA) (Depo Provera), synthetic analogues and natural progesterone in comparison to oral contraceptive pills have shown some reduction of seizure frequency in catamenial epilepsy patients [28].

## Alcohol:

This is a worldwide problem causing generalized tonic clonic epileptic seizures especially with alcohol withdrawal. This may happen around 24 hours after withdrawal and presents as withdrawal symptoms or delirium tremens [29]. Many reports have documented this relation [30]. The acute and chronic intoxication of alcohol to the human brain is strongly related to seizure precipitation [31]. The toxic effect of methanol will be reflected as neurobiological effects on brain function and

structure [32]. Patients who consume large amounts of alcohol have up to 20-fold risk of worsening seizures [29]. Researchers must bear in mind that other confounding factors in alcoholics may add to the risk of seizure precipitation in these patients. The standard practice is to raise the awareness of epileptic patients against alcohol consumption especially in intractable patients [33]. Moreover, the seizures may be induced by the life style changes made by alcohol intake effects. Some drugs are useful in the acute stage e.g. benzodiazepines, clomethazole and carbamazepine [34].

## Metabolic disturbances:

The rapid changes in the electrolytes or metabolic disturbance are well related to the development of generalized tonic clonic seizures. In the elderly, this may be as high as 77% [35]. They may be associated with higher mortality and ICU admission[36]. Incriminated states include: hypoglycaemia which is the most common[37] and is easily treated as in diabetic patients. Other important conditions are: hypo or hypernatraemia [38-40], hypocalcaemia[41], hypomagnesaemia[42], hyperkalaemia[43-44] and hypercalcaemia[40]. The most important category of patients which the neurologist may face is patients with chronic kidney disease. Their disturbed electrolyte status due to the kidney disease or dialysis make around ten percent of them at risk of precipitated seizures [45]. Thyroid disturbances are important endocrinopathy [46] that may present with seizures in the extreme function disturbances of this gland or other glands' dysfunction. Adult patients with hepatic encephalopathy [47,48]or children with Rye syndrome are also at risk [49].

## Drug- induced epilepsy:

Many substances like drugs, toxins and prohibited compounds can precipitate epileptic seizures through their excitatory effect on the neurons. Screening for this, revealed a minimal percentage in some studies (<1%) This involved a large surveillance of 33000 patients in Boston. Status epilepticus in drug-induced epilepsy patients may occur in 15- 20% [49]. There are various mechanisms to explain the relation between the drugs and seizure precipitation which may be related to intrinsic liability to epilepsy, idiosyncratic effect, anti-epileptic drug interaction, or impairment of excretory mechanisms in the liver or kidney, toxic serum levels or direct brain toxicity [52].

## Reflex epilepsy:

The reflex epilepsy may affect 5% of hospitalized epilepsy cases. In children under 3 years, this may be precipitated by tactile or acoustic stimuli and may be part of reflex myoclonic epilepsy in infancy (RMEI)[53] . This is an interesting type of epilepsy where patients have a peculiar character to react adversely with simple external environmental stimuli like light flashes. Moreover, startle, eating, hot water bathing or reading may trigger the seizures. In other occasions the event may be precipitated by a piece of music. There are various cortical areas in the brain to deal with music; this involves the transverse temporal gyrus (Heschl's gyrus) and beyond[54]. Avoidance of triggers may help in reducing the risk of seizures. Some reflex epilepsy cases are related to skilled actions (Praxis-induced seizures (PIS). These may involve thinking, making decisions and calculations.

## Photosensitivity:

Photosensitivity was studied in the general population and its frequency was estimated at 1.1/100 000. It is higher between 7-19 year of age 5.7/100 000. This supports the strong association with reflex epilepsy as 3% of epileptics are photosensitive and they suffer reflex epilepsy. This disorder commonly affects patients at the age of 12 years and females are slightly more affected than males. Photo paroxysmal response (PPR) has been proved genetically as a risk factor for idiopathic generalized epilepsy. Some genetic loci were identified including 6p21, 7q32, 13q13, 13q31 and 16p13 [55]. The spectrum of semiology may be in the form of myoclonic, absence and tonic clonic seizures. Generalized or focal seizures may appear. Keeping a good distance away from screens and angulated view may help reducing the risk. The use of AEDs like levitiracetam, valproate and benzodiazepines is likely to induce a good

remission. Mainly levitiracetam was shown to produce a significant effect on PPR within 6 hours of administration[56].

## Primary reading epilepsy PRE:

It is a rare type of reflex epilepsy that is precipitated by reading and affects the age group between 12-25 years and one quarter have family history. Male to female ratio is 1.8:1. The semiology shows: jaw jerking, lips, throat and face followed later by generalized tonic clonic seizures. In some patients, the features are only jaw jerking. The condition may show focal pattern or be part of juvenile myoclonic epilepsy. The cessation of reading may stop the seizure as well as using AEDs with excellent outcome. Other forms of praxis-induced epilepsy may occur secondary to motor actions, decision making or calculation [57].

## Startle Epilepsy:

In this category, some areas in the brain like the supplementary motor area, medial frontal lobe or parietal lobe are sharing the mechanism of epileptogenesis. This was studied in similar patients using the technique of MRI [58]. The supplementary motor area was proved by stereotactic EEG to be the main area responsible[59]. In other studies, it was difficult to prove a common mechanism for the theory of startle epilepsy [60]. Some patients have associated mental sub-normality or infantile hemiplegia and epilepsy surgery proved beneficial in such patients [59- 61]. Loud noise, touch, light or sudden movement may all be responsible. The condition must be differentiated from paroxysmal kinesogenic chorea (PKC) and hypereklepsia.

## Objectives

## General objective:-

To evaluate the most common precipitating factors of seizures in epileptic patients admitted to Omdurman Teaching Hospital.

## Specific objectives:

To study the type of epilepsy commonly affected by these precipitating factors

## Methodology:

This was a descriptive, cross-sectional, hospital-based study conducted in Omdurman Teaching Hospital (2nd central hospital in Sudan). One hundred diagnosed epileptic patients presenting to the emergency room in the period between 06/01/2015 to 31/3/2015 were included. All adult patients on treatment for epilepsy as per ILAE definition (1989) were included. Break-through seizure was defined as relapse of seizure in an epileptic patient who is either compliant or non-compliant to AEDs which occurred after at least 6 months of remission. Precipitating factor was defined as: the situation or conditions that took place before the seizure onset. Non-compliant patient was defined as: a patient who did not take his/her drug or drugs on daily basis; or patient who did not or was unable to renew his/her prescription.

Data was analyzed using SPSS for windows version 16.0 .Ethical approval for the study was obtained from the Ethical Committee. An informed consent from patients that had participated in the study has been obtained after explaining the steps of the research. Information had been collected using a questionnaire containing personal, contact details, important history points in regard to the diagnosis, compliance, current situation and current precipitating factor(s). The physical examination had been conducted by the investigator or by the on-call neurology registrar.

## Results:

The males in this study sample were 58% while 42% were females. The commonest age group was 21-30 years. Idiopathic epilepsy constituted 54% of the sample; symptomatic was 21% while cryptogenic epilepsy was 25%. Most of the patients (63%) had their disease being there for 1-10 years. Patient presenting with status epilepticus were 13%; generalized seizures were 61% and focal seizures were 21%. In the patients with status epilepticus, 23% were on poly-therapy. Around two thirds of the sample were on mono-therapy while 27% were on poly-therapy. In this study, 41% were

non-compliant to medications. IGE patients were more compliant (60%) than others. While (85.2%) of patients on poly-therapy had good compliance, on the other hand, (50.7%) of patients on mono-therapy have good compliance.

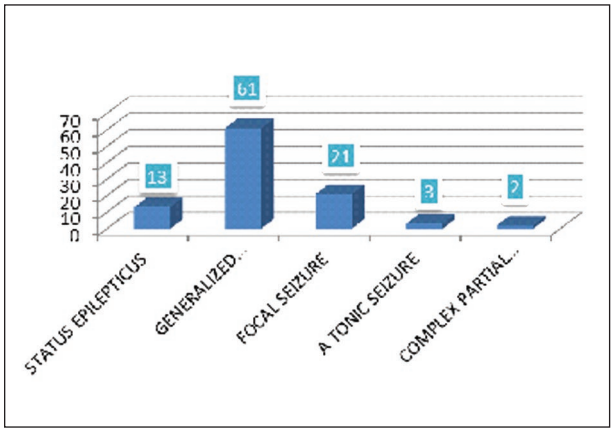


**Figure: Distribution of the study population according to the type of seizure at presentation**

**Table. Distribution of the study population according to the precipitating factors**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| not adherent to medication | 41 | 41.0 | 41.0 | 41.0 |
| sleep deprivation | 8 | 8.0 | 8.0 | 49.0 |
| emotional stress | 6 | 6.0 | 6.0 | 55.0 |
| alcohol abuse | 1 | 1.0 | 1.0 | 56.0 |
| febrile illness | 14 | 14.0 | 14.0 | 70.0 |
| electrolytes disturbance | 1 | 1.0 | 1.0 | 71.0 |
| flickering/flash light | 3 | 3.0 | 3.0 | 74.0 |
| music | 2 | 2.0 | 2.0 | 76.0 |
| undetermined | 12 | 12.0 | 12.0 | 88.0 |
| exertion | 5 | 5.0 | 5.0 | 93.0 |
| missed dose | 1 | 1.0 | 1.0 | 94.0 |
| menstrual cycle | 5 | 5.0 | 5.0 | 99.0 |
| withdrawal of AEDs | 1 | 1.0 | 1.0 | 100.0 |
| Total | 100 | 100.0 | 100.0 | |

## Discussion:

The most common precipitating factors here were non-compliance in 41%; infections in 14%; cryptogenic in 12% followed by sleep deprivation, catamenial, and photosensitivity.

The weaknesses of this study were reflected in the relatively small number of patients. Moreover, it included ER patients who are likely having acute seizure and who managed to reach the ER. However, other outpatient department (OPD) epileptic patients were not included and they may have had their seizures one or few days before coming for follow-up. Also, the assessment of precipitating factors did not adopt an objective questionnaire and adopted the self-reporting. Some factors like alcohol consumption and physical exertion or stress were difficult to quantify in an assured way. In patients with post-ictal state it would be difficult to reveal the precipitating factors and their relatives will volunteer the information. Lastly it represents one center experience in the capital of Sudan but there are no neurology units outside the capital.

The strength of this study is that it provides data from an under-developed country where contact details of patients are not available in the follow-up system. Moreover, the statistical data are few, if any, in this detail and there were no local studies in this issue. However, it added to the patients' awareness to avoid such factors.

most of the patients in our study were in the age group between 18-40 years and the mean age was 42.7 years. The age group that had the biggest burden of break-through seizures was 21-30 years 29.0% and the mean age here was 25.1 years. So, the population aged 18-40 years who constitutes the most effective social strata is affected by break-through seizures. The age group mostly affected here (21-30 years) is older than the one described in the study of Mulago National Referral and Teaching Hospital in Kampala, Uganda [62]. This may be related to two factors. One is that they had a larger sample (268 patients) and they recruited patients from 2 centers. That study showed that age 18-20 years had the most break-through seizures 40.4%. Our results conform to it in that the prevalence of break-through seizures decreased with an increase in the age of participants. An exception to this is a small surge in the age group between 61-70 which may represent the normal risk of epilepsy in this age group.

The finding of better control with increasing age can be explained by the fact that the longer the duration of treatment by AEDs, the better seizure control. Another point is that the older the patient, there is a more understanding from the patient to the risk of non-compliance, complications and the positive effect of health care advice. Moreover, patients having a longer duration of the disease are keen on avoiding the precipitating factors of seizures. Furthermore, some patients may have experienced break-through seizures during their disease and they became more compliant. Another factor is that, medical compliance is shared by younger family members and they may add to elderly patients' compliance because they are more involved in the care of such patients in this part of the world. In an extended spectrum, the bulk of patients in this study were more liable to break-through seizures in the age range of 18-40 was 72%.

Most of the patients who developed break-through seizures in our study were males 58% This is lower than the percentage reported in a study carried out at a tertiary care hospital in Bangladesh, which showed that males had a higher percentage [63] of breakthrough seizures 71.5%. Difference between this and our study may be related to the larger sample size (1168 epileptic patients) and inclusion of paediatric patients. Our study concurs with Mulago National Referral and Teaching Hospital in Kampala, Uganda, which showed that males had a higher percentage of break-through seizures 56.7%. The relatively low percentage in females may be due to a better drug compliance in them and enhanced health seeking behavior [64]. Moreover, females may be enrolled in other health programs like antenatal care, cancer therapy and vaccination which augment other disciplines.

Despite the fact that alcohol was not a major precipitating factor in this study 1%, but abuse of alcohol by males in our part of the world is not different from the rest of it. Survey of drinking cultures in Africa, from the nineteenth century had shown differences between men and women[65] . In another study the prospective incidence of epileptic seizures in newly referred patients in a French Caribbean island (Martinique) 30% of provoked seizures in epileptics was related to alcohol [66]. Women are more abstainers than males. Another reason for the low percentage here is that Sudanese people do not feel comfortable by admitting to alcohol drinking in the presence of other relatives. One more point to add is that all patients were Muslims and even people who drink may not disclose this.

In our study, idiopathic type of epilepsy was mostly affected by these precipitants, which concur with the study carried-out at a tertiary care hospital in Bangladesh [63] . It is well known that idiopathic epilepsy is the commonest type of epilepsy worldwide and we expect that it is the type which is likely affected by these precipitating factors.

Prevalence of break-through seizures in our study is more associated with patients on mono-therapy 73.0% and lower in patients on poly-therapy 27.0%. The fact that the patients on mono-therapy may develop break-through seizures are related to poor doctor communication; non-structured health education; and less medical follow-up. For example, by having one drug they may not feel that the disease is not serious enough. One example that deserves mentioning is one non-compliant patient (Index number 63) who used to take 12 tablets a day whenever he experiences a break-through seizure. However, in patients taking 2 drugs or more, they are likely to receive more medical follow-up, more prescription and more physician/pharmacist exposure, health education by having more questions to ask and possibly meeting other similar patients. On the other hand, patients on monotherapy either had taken suboptimal dose or actually needed more than one drug to control their disease.

The RANSOM study stated that non adherence to AEDs has a variable range between 20-80%. The concept of compliance, or better, of adherence, may depend on self-reporting, though a simple measure, but can still be considered as an effective one[67- 68]. In our study 59% had good compliance and 41% had poor compliance. This is very near to the percentage mentioned in the Mulgo hospital study [62]. It is almost identical to the study of All India Institute of Medical Sciences (AIIMS) which reported 40.9%[69]. However, in a retrospective, open-cohort design that involved 33658 patients, only 26% were non-adherent to AEDs resulting in major clinical consequences including break-through seizures [70;71].

In patients with IGE, the non-compliance was reported in 38.8%. Regarding patients on monotherapy, 50.7% have good compliance and 49.3% have poor compliance to medication, while 85.2% of patients who were on poly-therapy had good compliance and 14.8% had poor compliance. So, there is significant relationship between the number of drugs taken and compliance to medication (p=0.002). Also, the variable range of patients that are non-compliant to AEDs in this study is compatible with the literature range in the overall sample, in patients with idiopathic generalized epilepsy and in patients with mono-therapy. However, for the patients on poly-therapy it showed a lower percentage.

## The precipitating factors for seizures in our study (Figure &Table):

**Drug non-compliance** 41.0%. This may be attributed to anti-epileptic drug unavailability in the market; the patients may be having poor financial resources to maintain a continuous availability of anti-epileptic drugs, or lack of health insurance. Moreover, in Sudan some patients have the habit of taking only the brand they are accustomed to i.e. when it is not available in the market, they stop using it. In a UK study addressing non-compliance with anticonvulsant therapy as a cause of seizures, found that 31% of seizures may be attributable to medication noncompliance[72]. This reflects the socio-demographic differences between nations including the health system integrity; local habits; and endemic diseases profile. Some studies from India and Nigeria have shown that 30–50% of the patients with epilepsy are reported to be non-compliant to the extent of interfering with optimal treatment and seizure control [73- 74] .

## Infections:

infections constituted 14.0% of the precipitating factors in our study. In our part of the world, tropical infections add substantially to the risk of break-through seizures. Examples for that are malaria, diarrheal illnesses, pneumonia and meningitis. Our result is similar to the percentage of 14% demonstrated by a study of 400 patients in Virginia USA to study distribution of seizure precipitants among epilepsy syndromes [75]. However, our patients did not have much of that category among them i.e. epilepsy syndromes. Our result is also almost comparable to a study of a tertiary care hospital in Bangladesh by Chowdhury et al, who found that fever has precipitated seizure in 16.4% of the subjects, and in the Kampala study infections such as malaria, bacterial pneumonia and urological sepsis were 16.6% . This is almost similar to our

percentage being located in the same tropical area. The testing for such infections is of routine importance in febrile epileptic patients presenting with seizures in our hospital. However, the study was not performed during summer or the rainy season and this may have affected the percentage of infections here (January-March).

**Stress** is an individual-related condition that is difficult to quantify. In this sample 6% related their seizures to emotional stress and these were mainly generalized tonic-clonic seizures. This is far lower from the literature figures of 14-32%. The explanation of this may be related to the social circumstances in the ER; short contact period during questionnaire interrogation; or the wish of the patient not to disclose this in front of his accompanying relatives [2- 3]. Another explanation for this is that we did not use an assessment scale for stress in this study. The stress may also cause sleep deprivation leading to overuse of sedatives or alcohol with more risk of seizure precipitation. .

Concerning physical exertion and exercise it was 4.0% in our sample, we expected our study population to suffer this risk factor more as most of them were workers and house wives. However, it did not have a high percentage. This is compatible with the literature evidence that physical exercise and sports may be useful in seizure control [63;76].

In this study, menstruation in females as a precipitating factor was 11.9% among female participants in our study. This is consistent with literature in that, there is a huge variation in the prevalence of catamenial epilepsy. This may range from around 10% up to more than 70% depending on the study population and sample size [77-79]. Another un-published local study was carried out in the Sudan at a charity clinic, from February-2008 to June-2008 by Safa et al. In this study, 630 female patients with epilepsy were included. Hundred forty 22% reported increased frequency of fits either before onset of bleeding (10 patients) or at onset of bleeding 20.6% (130 patients), some of them reported that they had fits only at time of the period. This is related to the hormonal changes [66, 65, 67]. The wide range of literature variation would reflect the importance of this factor among different communities as a precipitating factor of epilepsy.

**Sleep** and **sleep deprivation** in our study was 8.0%. It is interesting to explore the relation between sleep is seizure precipitation. Once called “morpheic epilepsy”, it is now recognized that the seizures in certain epilepsy syndromes are most likely to occur during specific stages of sleep or during transitions from sleep to wakefulness [56]. The percentage in this study is lower than the one reported in India in 405 patients. Among them, sleep deprivation precipitated seizures in 19.7% of epileptic patients [69]. In the study that involved 1168 patients in Bangladesh, the sleep-related seizures were 15.5% which is double that of our figure [63]. In Mulgo Hospital Uganda[62], the percentage was also higher than ours 11.4%. There is no clear explanation for the low percentage of sleep effects on precipitating seizures in our patients. However, the sample size here is smaller than all the above mentioned studies. This may be the main factor behind that. Nevertheless, it does not neglect sleep deprivation as an important risk factor for seizure precipitation.

In 12% of our cases, the precipitating factor remained **cryptogenic**. Factors that showed very low percentages in our sample were **reflex epilepsy** which constituted a small percentage here as seizures were precipitated by flickering and flash lights in 1% while seizures were reported with music in 2%. Some musicogenic epilepsy reports demonstrated high percentage but similar one in concern to specific tone-induced seizures which was 4% [80]. This was not further analyzed with regards to the type of music or tone. However, it should be considered that both light flickering and music usually co-exist in the social gatherings. No cases of primary reading or startle epilepsy were reported in our series. This may be related to the sample size and exclusion of epileptic children from the study.

## Conclusion:

The age group with high burden of break-through seizures precipitated by different factors was between 21-30 years of age. Seizures were mainly

precipitated in 41% of the patients because of non-compliance. Non-compliance was more common in patients with mono-therapy and patients with non-idiopathic generalized epilepsy. Stress, sleep deprivation-related seizures were reported in 6% and 8%, respectively. Catamenial epilepsy was reported in 11.9%. Along with infections 14% these two factors are compatible with literature. In 12% of the patients, the precipitating factor was cryptogenic. Reflex epilepsy and metabolic changes were lower than literature figures 3% each. Physical exercise was associated with 4% risk of seizure precipitation. Alcohol was the least factor precipitating seizures. Status epilepticus was the presentation in 13% of the patients and it was observed mainly in patients on monotherapy.

Projection of the encountered results to the health authorities will hopefully affect priorities in development and quality plans, improving the wellbeing of epileptic patients in Sudan and similar resource poor countries.

## References:


1. Sander JW, Hart YM, Johnson AL, Shorvon SD. National General Practice Study of Epilepsy: newly diagnosed epileptic seizures in a general population. *Lancet* 1990; 24 (336): 1267-71.
2. Strine TW, Kobau R, Chapman DP, Thurman DJ, Price P, Balluz LS. Psychological distress, comorbidities, and health behaviors among U.S. adults with seizures: results from the 2002 National Health Interview Survey. *Epilepsia* 2005; 46:1133-9.
3. Leppik IE. Compliance during treatment of epilepsy. *Epilepsia* 1988; 29 Suppl 2:S79-S84.
4. Bhalla D, Chea K, Chamroeun H etal Comprehensive evaluation of the psychosocial parameters of epilepsy: a representative population-based study in Prey Veng (Cambodia). *Epilepsia* 2013; 54:1342-51.
5. Gilliam F, Kuzniecky R, Faught E, Black L, Carpenter G, Schrodt R. Patient-validated content of epilepsy-specific quality-of-life measurement. *Epilepsia* 1997; 38:233-6.
6. Aird RB. The importance of seizure-inducing factors in the control of refractory forms of epilepsy. *Epilepsia* 1983; 24: 567-83.
7. Frucht MM, Quigg M, Schwaner C, Fountain NB. Distribution of seizure precipitants among epilepsy syndromes. *Epilepsia* 2000; 41:1534-9.
8. Baldin E, Hauser WA, Pack A, Hesdorffer DC. Stress is associated with an increased risk of recurrent seizures in adults. *Epilepsia* 2017; 58:1037-46.
9. Joels M. Stress, the hippocampus, and epilepsy. *Epilepsia* 2009; 50:586-97.
10. Koutsogiannopoulos S, Adelson F, Lee V, Andermann F. Stressors at the onset of adult epilepsy: implications for practice. *Epileptic Disord* 2009; 11:42-7.
11. Nakken KO, Solaas MH, Kjeldsen MJ, Friis ML, Pellock JM, Corey LA. Which seizure-precipitating factors do patients with epilepsy most frequently report? *Epilepsy Behav* 2005 ; 6:85-9.
12. Bennett dr. sleeps deprivation and major motor convulsions. *Neurology* 1963; 13: 953-8.
13. Carreno M, Fernandez S. Sleep-Related Epilepsy. *Curr Treat Options Neurol* 2016; 18:23.
14. Badawy RA, Macdonell RA, Jackson GD, Berkovic SF. Why do seizures in generalized epilepsy often occur in the morning? *Neurology* 2009 21;73: 218-22.
15. Tinuper P, Bisulli F, Cross JH, et al. Definition and diagnostic criteria of sleep-related hypermotor epilepsy. *Neurology* 2016; 10:1834-42.
16. Bazil CW. Sleep, Sleep Apnea, and Epilepsy. *Curr Treat Options Neurol* 2004:339-45.
17. Lawn N, Lieblich S, Lee J, Dunne J. Are seizures in the setting of sleep deprivation provoked?

*Epilepsy Behav* 2014; 33: 122-5.

18. Carrizosa MJ, Kakooza-Mwesige A, Tan CT. Epilepsy in the tropics: Emerging etiologies. *Seizure* 2017; 44: 108-12.
19. Singh A, Trevick S. The Epidemiology of Global Epilepsy. *Neurol Clin* 2016 ; 34:837-47.
20. Lucas MJ, Brouwer MC, van de Beek D. Neurological sequelae of bacterial meningitis. *J Infect* 2016; 73: 18-27.
21. Vezzani A, Fujinami RS, White HS et al. Infections, inflammation and epilepsy. *Acta Neuropathol* 2016; 131: 211-34.
22. Frye CA. Effects and mechanisms of progestogens and androgens in ictal activity. *Epilepsia* 2010; 51 Suppl 3:135-40.
23. Backstrom T. Epileptic seizures in women related to plasma estrogen and progesterone during the menstrual cycle. *Acta Neurol Scand* 1976 ; 54:321-47.
24. Herzog AG, Klein P, Ransil BJ. Three patterns of catamenial epilepsy. *Epilepsia* 1997; 38: 1082-8.
25. Speroff L, Glass RH, Kase NG. Clinical gynecologic endocrinology and infertility. Philadelphia, PA: Lippincot Williams & Willkin; 1999.
26. Herzog AG, Blum AS, Farina EL et al. Valproate and lamotrigine level variation with menstrual cycle phase and oral contraceptive use. *Neurology* 2009; 72:911-4.
27. Foldvary-Schaefer N, Harden C, Herzog A, Falcone T. Hormones and seizures. *Cleve Clin J Med* 2004; 71 Suppl 2:S11-S18.
28. Mattson RH, Cramer JA, Caldwell BV, Siconolfi BC. Treatment of seizures with medroxyprogesterone acetate: preliminary report. *Neurology* 1984; 34:1255-8.
29. Baulac M, Laplane D. [Alcohol and epilepsy]. *Rev Prat* 1990; 40:307-11.
30. Johnson R. Alcohol and fits. *Br J Addict* 1985; 80:227-32.
31. Leach JP, Mohanraj R, Borland W. Alcohol and drugs in epilepsy: pathophysiology, presentation, possibilities, and prevention. *Epilepsia* 2012; 53 Suppl 4:48-57.
32. Fadda F, Rossetti ZL. Chronic ethanol consumption: from neuroadaptation to neurodegeneration. *Prog Neurobiol* 1998; 56: 385-431.
33. Chan AW. Alcoholism and epilepsy. *Epilepsia* 1985; 26:323-33.
34. Long D, Long B, Koyfman A. The emergency medicine management of severe alcohol withdrawal. *Am J Emerg Med* 2017; 35: 1005-11.
35. Loiseau J, Loiseau P, Duche B, Guyot M, Dartigues JF, Aublet B. A survey of epileptic disorders in southwest France: seizures in elderly patients. *Ann Neurol* 1990; 27: 232-7.
36. Bleck TP, Smith MC, Pierre-Louis SJ, Jares JJ, Murray J, Hansen CA. Neurologic complications of critical medical illnesses. *Crit Care Med* 1993; 21:98-103.
37. Malouf R, Brust JC. Hypoglycemia: causes, neurological manifestations, and outcome. *Ann Neurol* 1985; 17: 421-30.
38. Adrogue HJ, Madias NE. Hyponatremia. *N Engl J Med* 2000 25; 342:1581-9.
39. Adrogue HJ, Madias NE. Hypernatremia. *N Engl J Med* 2000 18; 342:1493-9.
40. Riggs JE. Neurologic manifestations of electrolyte disturbances. *Neurol Clin* 2002;20: 227-39, vii.
41. Messing RO, Simon RP. Seizures as a manifestation of systemic disease. *Neurol Clin* 1986; 4:563-84.
42. Te Riele MG, Verrips A. Severe hypomagnesaemia causing reversible cerebellopathy. *Cerebellum* 2014; 13: 659-62.

43. Tiamkao S, Pranboon S, Thepsuthammarat K, Sawanyawisuth K. Status epilepticus in the elderly patients: A national data study in Thailand. *J Neurol Sci* 2017 15; 372:501-5.

44. Lacerda G, Krummel T, Hirsch E. Neurologic presentations of renal diseases. *Neurol Clin* 2010; 28: 45-59.

45. Glenn CM, Astley SJ, Watkins SL. Dialysis-associated seizures in children and adolescents. *Pediatr Nephrol* 1992; 6: 182-6.

46. Schmid KW, Wolf C, Feldt B, Fischer-Colbrie R. [Increased secretogranin II protein and mRNA expression in C cells of the thyroid in Hashimoto's thyroiditis]. *Verh Dtsch Ges Pathol* 1996;80: 247-9.

47. Rudler M, Marois C, Weiss N, Thabut D, Navarro V. Status epilepticus in patients with cirrhosis: How to avoid misdiagnosis in patients with hepatic encephalopathy. *Seizure* 2017; 45: 192-7.

48. Saner F, Gu Y, Minouchehr S et al. Neurological complications after cadaveric and living donor liver transplantation. *J Neurol* 2006; 253: 612-7.

49. Hirayama Y, Saito Y, Maegaki Y. "Symptomatic" infection-associated acute encephalopathy in children with underlying neurological disorders. *Brain Dev* 2017; 39: 243-7.

50. Tetracycline and drug-attributed rises in blood urea nitrogen. A report from the Boston Collaborative drug surveillance program. *JAMA* 1972 17; 220:377-9.

51. Adverse reactions to the tricyclic-antidepressant drugs. Report from Boston Collaborative Drug Surveillance Program. *Lancet* 1972 4; 1:529-31.

52. Ruffmann C, Bogliun G, Beghi E. Epileptogenic drugs: a systematic review. *Expert Rev Neurother* 2006; 6:575-89.

53. Verrotti A, Matricardi S, Pavone P, Marino R, Curatolo P. Reflex myoclonic epilepsy in infancy: a critical review. *Epileptic Disord* 2013; 15:114-22.

54. Maguire MJ. Music and epilepsy: a critical review. *Epilepsia* 2012; 53:947-61.

55. de Kovel CG, Pinto D, Tauer U et al. Whole-genome linkage scan for epilepsy-related photosensitivity: a mega-analysis. *Epilepsy Res* 2010; 89:286-94.

56. French JA, Krauss GL, Kasteleijn D, DiVentura BD, Bagiella E. Effects of marketed antiepileptic drugs and placebo in the human photosensitivity screening protocol. *Neurotherapeutics* 2014; 11:412-8.

57. Inoue M, Ates N, Vossen JM, Coenen AM. Effects of the neuroleptanalgesic fentanyl-fluanisone (Hypnorm) on spike-wave discharges in epileptic rats. *Pharmacol Biochem Behav* 1994; 48:547-51.

58. Fernandez S, Donaire A, Maestro I, et al. Functional neuroimaging in startle epilepsy: involvement of a mesial frontoparietal network. *Epilepsia* 2011; 52:1725-32.

59. Job AS, De PL, Principe A, et al. The pivotal role of the supplementary motor area in startle epilepsy as demonstrated by SEEG epileptogenicity maps. *Epilepsia* 2014; 55:85-88.

60. Tibussek D, Wohlrab G, Boltshauser E, Schmitt B. Proven startle-provoked epileptic seizures in childhood: semiologic and electrophysiologic variability. *Epilepsia* 2006; 47: 1050-8.

61. Oguni H, Hayashi K, Usui N, Osawa M, Shimizu H. Startle epilepsy with infantile hemiplegia: report of two cases improved by surgery. *Epilepsia* 1998; 39:93-8.

62. Kaddumukasa M, Kaddumukasa M, Matovu S, Katabira E. The frequency and precipitating factors for breakthrough seizures among patients with epilepsy in Uganda. *BMC Neurol* 2013 21;13: 182.

63. Chowdhury RN, Hasan MH, Rahman KM, Dev

SR, Amin MA, Miah T. Precipitating factor of seizure in epilepsy: experience in a tertiary care hospital. *Mymensingh Med J* 2014; 23: 56-61.

64. Rutten LJ, Arora NK, Bakos AD, Aziz N, Rowland J. Information needs and sources of information among cancer patients: a systematic review of research (1980-2003). *Patient Educ Couns* 2005; 57: 250-61.

65. Justin W. Drinking crisis? Change and continuity in cultures of drinking in sub-Saharan Africa. *African Journal of Drug & Alcohol Studies* 2006 1;5.

66. Jallon P, Smadja D, Cabre P, Le MG, Bazin M. EPIMART: prospective incidence study of epileptic seizures in newly referred patients in a French Caribbean island (Martinique). *Epilepsia* 1999; 40:1103-9.

67. Haynes RB, Taylor DW, Sackett DL, Gibson ES, Bernholz CD, Mukherjee J. Can simple clinical measurements detect patient noncompliance? *Hypertension* 1980; 2:757-64.

68. Walsh JC, Mandalia S, Gazzard BG. Responses to a 1 month self-report on adherence to antiretroviral therapy are consistent with electronic data and virological treatment outcome. *AIDS* 2002 25; 16:269-77.

69. Balamurugan E, Aggarwal M, Lamba A, Dang N, Tripathi M. Perceived trigger factors of seizures in persons with epilepsy. *Seizure* 2013; 22:743-7.

70. Faught E, Duh MS, Weiner JR, Guerin A, Cunnington MC. Nonadherence to antiepileptic drugs and increased mortality: findings from the RANSOM Study. *Neurology* 2008 11;71:1572-8.

71. Faught RE, Weiner JR, Guerin A, Cunnington MC, Duh MS. Impact of nonadherence to antiepileptic drugs on health care utilization and costs: findings from the RANSOM study. *Epilepsia* 2009; 50:501-9.

72. Stanaway L, Lambie DG, Johnson RH. Non-compliance with anticonvulsant therapy as a cause of seizures. *N Z Med J* 1985 13;98: 150-2.

73) Das K, Banerjee M, Mondal GP, Devi LG, Singh OP, Mukherjee BB. Evaluation of socio-economic factors causing discontinuation of epilepsy treatment resulting in seizure recurrence: a study in an urban epilepsy clinic in India. *Seizure* 2007; 16:601-7.

74. Elechi CA. Default and non-compliance among adult epileptics in Zaria, Nigeria. The need to restructure continued care. *Trop Geogr Med* 1991; 43:242-5.

75. Frucht MM, Quigg M, Schwaner C, Fountain NB. Distribution of seizure precipitants among epilepsy syndromes. *Epilepsia* 2000; 41:1534-9.

76. Capovilla G, Kaufman KR, Perucca E, Moshe SL, Arida RM. Epilepsy, seizures, physical exercise, and sports: A report from the ILAE Task Force on Sports and Epilepsy. *Epilepsia* 2016; 57:6-12.

77. Foldvary-Schaefer N, Falcone T. Catamenial epilepsy: pathophysiology, diagnosis, and management. *Neurology* 2003 1; 61(6 Suppl 2):S2-15.

78. Duncan S, Read CL, Brodie MJ. How common is catamenial epilepsy? *Epilepsia* 1993 ;34: 827-31.

79. Reddy DS. Pharmacology of catamenial epilepsy. *Methods Find Exp Clin Pharmacol* 2004; 26: 547-61.

80. Wieser HG, Hungerbuhler H, Siegel AM, Buck A. Musicogenic epilepsy: review of the literature and case report with ictal single photon emission computed tomography. *Epilepsia* 1997; 38:200-7.