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***Original research article***

# Epidemiology and Impact of Malnutrition on Epileptic School-Age People in the Batibo Sub-Division, Cameroon

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**ABSTRACT**

This work aimed to assess the prevalence of epilepsy and the impact of malnutrition in order to improve physical and school performance among school-age people with epilepsy in a rural health district of the North-West Region of Cameroon. Two hundred and fifty-three (253) participants who lived with epilepsy were screened for malnutrition; 223 had active malnutrition in epilepsy. The first results revealed that 75.9% of epileptics (respondents) think that a balanced diet is a diet that is eaten in a time of ill-health, 14.6% think that it is a diet consisting of a suitable proportion of food from all food groups, 7.1% think that it is a diet that provides the body with the right number of nutrients, and 2.4% think that it is a diet that is loaded with a single nutrient. In general, the majority of epileptics did not have the right idea about a balanced diet. Secondly, our results revealed that 58.9% of epileptics eat twice per day, 17.4% eat at any time per day because they are hungry, 12.7% eat thrice per day, and 10.7% eat once per day. The third result revealed that 9.1% of epileptics eat breakfast, and 90.9% don't. Then, 5.9% of epileptics take snacks between breakfast and lunch, while 94.1% don't. Findings revealed that 5.9% of epileptics take lunch, while 94.1% don't. Moreover, 50.2% of epileptics take snacks, and 49.8% of the respondents don't take them. Also, 49.8% of the respondents eat during supper, and 50.2% don't. The fourth result shows that the majority of the respondents consume starches, fruits, and vegetables in their various forms 5-6 times a week, 2-4 times a week, and once per week. Most of the respondents don't consume milk and its products, and 80-85% of the respondents don't eat animal protein. Out of this 80- 85%, most stated that they might be lucky to eat fish about once or thrice a week. Also, most of the respondents (80-85%) don't consume high amounts of low-glycemic fats and their products, but don't consume cakes, candy, cookies, doughnuts, and fruit-flavored drinks, while most of the epileptics consume palm oil and groundnut oil. The fifth result reveals that 68.4% of the respondents have problems with appetite, like always feeling hungry or never feeling hungry; 92.9% of the respondents do skip breakfast more than 3 times a week; and 7.1% don't. The age-standardized prevalence of active malnutrition in people with epilepsy was 3.5% (95% CI: 3.2-3.9). Overall, the prevalence of active malnutrition in epilepsy varied widely among the households, ranging between 1.2% and 7.7%. The mean age among the participants with epilepsy was between 10 and 29 years. Epilepsy was reported in 59% of people, and the median age at first seizure was 11 years (interquartile range: 8-15). The 1-year incidence of epilepsy was estimated to be 171/100,000 (95% CI: 114.0-254.6). About 81% of people with epilepsy were either untreated or receiving inappropriate treatment. Family history of epilepsy was the main factor associated with epilepsy after multivariate analysis (OR: 6.8; 95% CI: 3.2-14.1). Many parameters like nutrition have an important effect on epileptic seizure's frequence on human being.

**Keywords:** Epidemiology. Epilepsy. Malnutrition. School-age people. Batibo-Subdivision. Cameroon.

**RÉSUMÉ**

L'objectif de cette étude était d'évaluer la prévalence de l'épilepsie et l'impact de la malnutrition afin d'améliorer les performances physiques et scolaires des enfants épileptiques scolarisés dans un district sanitaire rural de la région du Nord-Ouest du Cameroun. Sur 253 participants épileptiques dépistés pour la malnutrition,

223 présentaient une malnutrition active. Les premiers résultats révèlent que 75,9 % des épileptiques interrogés pensent qu'un régime alimentaire équilibré est un régime suivi en cas de maladie, 14,6 % pensent qu'il s'agit d'un régime composé d'aliments en proportions adéquates de tous les groupes alimentaires, 7,1 % pensent qu'il s'agit d'un régime fournissant à l'organisme le nombre approprié de nutriments et 2,4 % pensent qu'il s'agit d'un régime riche en un seul nutriment. De manière générale, il apparaît que la majorité des épileptiques n'ont pas une conception correcte de ce qu'est un régime alimentaire équilibré. Les deuxièmes résultats indiquent que 58,9 % des personnes épileptiques mangent deux fois par jour, 17,4 % mangent à n'importe quel moment de la journée car elles ont faim, 12,7 % mangent trois fois par jour et 10,7 % une seule fois par jour. Les troisième résultats montrent que 9,1 % des personnes épileptiques prennent un petit-déjeuner, tandis que 90,9 % ne mangent pas à ce moment-là. On observe donc que la majorité ne prend pas de petit-déjeuner. Ensuite, 5,9 % des personnes épileptiques prennent une collation entre le petit-déjeuner et le déjeuner, tandis que 94,1 % n'en prennent pas. Ainsi, la majorité des personnes épileptiques ne prennent pas de collation. Les résultats révèlent que 5,9 % des personnes épileptiques mangent au déjeuner, tandis que 94,1 % ne mangent pas à ce moment-là. On constate donc que la plupart des répondants ne mangent pas au déjeuner. Les résultats ci-dessous indiquent que 50,2 % des personnes épileptiques prennent une collation, tandis que 49,8 % des répondants n'en prennent pas. D'après ces résultats, on peut conclure que la majorité des répondants prennent une collation. Les résultats révèlent que 49,8 % des répondants (épileptiques) mangent au dîner, et 50,2 % ne mangent pas au dîner. Par conséquent, on constate que la majorité des répondants ne mangent pas au dîner. Les quatrième résultats montrent que la majorité des répondants (épileptiques) consomment des féculents, des fruits et des légumes, sous leurs diverses formes, 5 à 6 fois par semaine, 2 à 4 fois par semaine et une fois par semaine. La majorité des répondants ne consomme pas de lait ni de produits laitiers. Par ailleurs, 80 à 85 % des répondants ne consomment pas de protéines animales. Parmi les personnes interrogées, 80 à 85 % ont déclaré avoir de la chance de manger du poisson une à trois fois par semaine. La plupart des répondants (80 à 85 %) ne consomment pas de grandes quantités de graisses à faible indice glycémique ni de produits dérivés. De plus, la majorité des répondants ne consomme pas de gâteaux, de bonbons, de biscuits, de beignets ni de boissons aromatisées aux fruits. En revanche, la plupart des épileptiques consomment de l'huile de palme et de l'huile d'arachide. Enfin, les résultats indiquent que 68,4 % des répondants ont des problèmes d'appétit (faim constante ou absence de faim), tandis que 31,6 % n'en ont pas. Par ailleurs, 92,9 % des répondants sautent le petit-déjeuner plus de trois fois par semaine, contre 7,1 % qui ne le font pas. La prévalence de la malnutrition active chez les personnes épileptiques, standardisée selon l'âge, était de 3,5 % (IC à 95 % : 3,2-3,9). La prévalence de la malnutrition active chez les personnes épileptiques variait considérablement d'un ménage à l'autre, allant de 1,2 % à 7,7 %. L'âge moyen des participants épileptiques se situait entre 10 et 29 ans. Les crises étaient focales chez 59 % des personnes, et l'âge médian de la première crise était de 11 ans (intervalle interquartile : 8-15). L'incidence annuelle de l'épilepsie était estimée à 171/100 000 (IC à 95 % : 114,0-254,6). Environ 81 % des personnes épileptiques n'étaient pas traitées ou recevaient un traitement inadapté. Les antécédents familiaux d'épilepsie constituaient le principal facteur associé à l'épilepsie après analyse multivariée (OR : 6,8 ; IC à 95 % : 3,2-14,1). De nombreux paramètres comme la nutrition ont des effets importants sur la fréquence des crises d'épilepsie chez l'être humain.

**Mots-clés :** Épidémiologie des épileptiques, malnutrition des enfants en âge scolaire, Arrondissement de Batibo, Cameroun.

## 1. INTRODUCTION

Epilepsy is defined as the repeated occurrence of sudden, excessive, and/or synchronous discharges in cerebral cortical neurons resulting in disruption of consciousness, disturbance of sensation, movements, impairment of mental function, or some combination of these signs (Carl 2015). The terms "epilepsy," "seizure," and "convulsion" are not synonymous. A seizure is always a symptom of abnormal function in the central nervous system (CNS) rather than a disease. A seizure discharge may be initiated in an entirely normal cerebral cortex by a variety of acute insults, such as withdrawal from alcohol, low blood sodium, or certain toxins (Carl 2015). Seizures are to be distinguished from epilepsy, which is a chronic condition in which seizures occur repeatedly due to an underlying brain abnormality that persists between seizures. A convulsion is a forceful, involuntary contraction of skeletal muscles and is a physical manifestation of a seizure, but the term is inappropriate as a synonym for epilepsy when epilepsy may consist only of a temporary alteration of consciousness or sensation (James et al. 2001). Epilepsy occurs in approximately 0.7% of the population at any one time. More than two-thirds of seizure problems begin in childhood, with a second peak of onset in the elderly. Usually, epilepsy does not significantly

alter life expectancy, but quality of life may be seriously compromised when seizures are not satisfactorily managed (James et al. 2001). A person needs to have one more epileptic seizure episode at different occurrences before he or she is confirmed to be epileptic. People believe that the disease is mostly of witchcraft origin or a family curse from the gods of the land, which is why most of the affected persons in the community turn to visit native doctors or traditional healers for their treatment instead of seeking medical help from the hospitals. Everyone can develop epilepsy at any age and at any time, irrespective of their origin, educational level, or sociopolitical status. Some types of epilepsy, which are categorized by the type of seizure the person experiences or the part of the brain that is affected, run in families. In these cases, it's likely that there is a genetic influence (Anwar et al. 2020).

Adequate nutrition is the fundamental right of every human being. Poor nutrition is cited as the major factor in more than half of all child deaths, a significantly higher proportion than those claimed by other non-communicable diseases. Malnutrition is not just a stark manifestation of poverty. It is also a non-income form of poverty, and helps perpetuate it (Alison 2013). Nutritional status is defined as the condition of the body resulting from the intake, absorption, and utilization of food. It is determined by a complex interaction between internal/constitutional factors and external environmental factors: internal or constitutional factors such as age, sex, and cultural, social, and economic circumstances (Milan 2015). This research work focused more on the prevalence of epilepsy caused by malnutrition and the impact of this malnutrition on improving the physical and school performance of school-aged people with epilepsy in a rural health district in the North-West Region of Cameroon. As one of the most predisposing factors to epilepsy, most people have always been found to be ignorant about the importance of essential micronutrients such as vitamins and minerals in their diet. This has led to abnormal brain functioning, such as brain tumors, poor physical work performance, and epilepsy.

## 2. MATERIALS AND METHODS

### 2.1. Area of study and justification of sampling

The Batibo Health District is found in the North-West Region (one of the two Anglophone regions) of Cameroon, at about 400 km from the capital city, Yaoundé, and 45 km from the regional capital city, Bamenda (Figure 9). It spans two administrative sub-divisions (Batibo and Widikum) with a total surface area of about 58 $km^2$ covered by grasslands and dense forest. It is divided into 16 health areas and has an estimated population of about 82,000 inhabitants, most of whom practice subsistence agriculture. As well as its high production of crops such as maize, yams, Colocasia, and beans, Batibo is also known for a high production of palm oil, which is sold in the entire region and beyond. Most of the inhabitants speak either Pidgin English (lingua franca) or the Batibo language and its dialects. Traditional health practice is common, and many people consult traditional healers for epilepsy because it is widely believed to be caused by witchcraft (Njamnshi et al. 2009). The Batibo Health District is one of many health districts in the North-West Region that are mostly affected by HIV infection. Indeed, the HIV prevalence here is approximately 6.5%, which is about 70% higher than the national prevalence (Njamnshi et al. 2009). The above study shows that 253 participants living with epilepsy were screened for malnutrition in epilepsy in Batibo. The Batibo Health District was chosen as the main site for this study for the following reasons:

1. Epilepsy is regarded as a serious problem, and in some communities, there are reports of clustering of cases and families with all siblings affected, which suggests that strong Environmental and genetic factors may be involved.

2. Pig-breeding is widely practiced, and pork consumption is popular in this area; hence, exposure to taeniasis and cysticercosis can contribute to increasing the risk of epilepsy in this community. Pig farming is a major source of income for farmers, and it is driven by a high demand for pork, which is a constant feature in most traditional ceremonies such as weddings and funerals; the quantity of Pork served during these and other social events usually reflects the wealth and social standing of the host in the community. Most pig farmers sell their pigs in Batibo and Widikum council markets, which are among the biggest rural markets in the Northwest Region.

3. The Batibo Health District is among the endemic foci for onchocerciasis in the Northwest Region. It contains a fast-flowing river (River Momo), which may favor the breeding of the Simulium fly, the vector of *Onchocerca volvulus*. Considering consistent reports associating onchocerciasis with epilepsy, we sought to obtain evidence of any such association between them in this community.

4. The Batibo Health District has a reputation for strong community participation in health. Community relay agents have vast experience in volunteering in disease surveillance and health sensitization activities requiring

engagement with the community. These community relay agents constituted a readily available pool of volunteers for recruitment to carry out the census and epilepsy screening.

5. We have previously worked as an intern in this health district for about 3 months, during which time we worked in the epilepsy clinic within the district hospital to improve access to care for people with epilepsy. During this period, we contributed to establishing important liaisons with the community and the health authorities of the health district through door-to-door counseling about the nutritional status of those affected by epilepsy, which was essential for the realization of this project.

### 2.2. Materials

The following instruments were used in this study: a) Weighing machine with a capacity of 100 kg and having the least count of 0.1 kg (1 piece); b) Height measuring scale (stadiometer): 1 piece; c) MUAC Tape: for measuring mid-upper arm circumference (1 piece); d) Questionnaire: A well-designed and pretested set of questions to collect household information. e) WHO standard growth reference charts; f) A packet of gloves and accessories.

#### 2.2.1. Research Design

A community-based cross-sectional survey was conducted at the Batibo municipality council area to assess the prevalence of seizures among school-age people with epilepsy in the Northwest region of Cameroon. The following approach was used: 1. Anthropometric measurements of people with epilepsy in the region; 2. General household survey by the application of a questionnaire to the parents or guardians and teachers of the school-age people under 10 years and school-age people above 10 years of the study. The nutritional status of these school-age people was assessed using the direct and indirect methods.

#### 2.2.2. Methods

#### 2.2.3. Anthropometric measurements

Nutritional anthropometry is concerned with the measurement of the variations of the physical dimensions and the gross composition of the human body at different age levels and degrees of nutrition (Milan 2015). The commonly used anthropometric measurements, or indicators of nutritional status, for school-age people are:

**Age:** The school-age people's age was gotten from them directly, i.e., for those who are slightly mature in age (10 years and above), from their parents and teachers to avoid estimated and wrong ages.

**Height:** Principle:

This was measured in school-age people in a standing position (usually children who are 5 years old or more). The head was placed in the Frankfurt position (a position where the line passing from the external ear hole to the lower ear lid is parallel to the floor) during measurement, and the shoulders, buttocks, and heels were touching the vertical stand. A stadiometer was used for measuring. Measurements have been recorded to the nearest millimeter (Joshi et al. 2012).

Procedure:

* The heel, the calf, the buttocks, the shoulder, and the occipital prominence (prominent area on the back of the head) were placed flat against the stand.

* The participant was looking straight ahead.

* The hands of the participant were placed by their side.

* The measurer's left hand was placed on the participant's chin.

* The participant's shoulders were leveled in order to get an accurate reading.

* The measurement was recorded on the questionnaire.

* The headpiece was placed firmly on the participant's head (Joshi et al. 2012).

Height for age: The results were analyzed by plotting against age using the standard reference curve by WHO; participants whose height-for-age is below minus two (-2) standard deviations from the median of the reference population were considered stunted or short for their age. Stunting is the outcome of failure to receive adequate nutrition over an extended period and is also affected by recurrent or chronic illness.

Weight

Principle:

A weighing machine was used, and the measurement was read to the nearest 0.1 kg. The scale was readjusted to zero before each weighing. Also, the scale was checked to see if it was measuring correctly by weighing an object of known weight (UNICEF 2012).

Procedure

- The pointer of the scale was adjusted to zero level.
- The participant's heavy clothes and shoes were taken off.
- The participant's head was kept looking straight ahead.
- The scale was read at eye level to the nearest 0.1 kg.
- The value read was recorded on the questionnaire.

Weight-for-height is an index used for assessing wasting (acute malnutrition). Wasting is defined as a low weight for the height of the participant compared to the standard participant of the same height. Wasted participants are vulnerable to infection and stand a greater chance of dying. The body index of the participant was calculated, and a table was plotted for BMI against age using the standard reference chart by Chekol (2022).

BMI-for-age: the index was expressed in standard deviation units from the mean of WHO participant growth standards adopted in 2006. Participants whose BMI-for-age was below minus one (-1) standard deviation were considered mildly wasted; similarly, below minus -2 and -3 standard deviations were considered moderately and severely wasted, respectively. Participants whose BMI-for-age was greater than +1 standard deviation and less than or equal to +2 standard deviations were considered overweight, and greater than +2 standard deviations was considered obese.

Weight-for-age: participants whose weight-for-age was below minus two (-2) standard deviations from the median of the reference population were considered underweight. The measure reflects the effects of both acute and chronic undernutrition.

Measuring the mid-upper arm circumference (MUAC) of the participant.

Principle: A special tape was used to measure the MUAC of a participant. The tape had three colors. The red indicated severe acute malnutrition, the yellow indicated moderate acute malnutrition, and the green indicated nutritional status (UNICEF 1986).

- The mother, guardian, teacher, or participant was asked to remove any clothing that may cover the participant's arm. In some cases, the participants were asked to stand erect and sideways to the measurer.
- The midpoint of the left upper arm was estimated.
- The participant's arm was straightened, and the tape was wrapped around the arm at the midpoint, making sure the numbers were right side up and the tape was flat against the skin.
- Inspecting the tension of the tape on the participant's arm, making sure the tape has the proper tension and is not too tight or loose. Repeating any step as necessary. When the tape is in the correct position on the arm with correct tension on the arm with the correct position on the arm with correct tension. The measurement was read to the nearest 0.1 cm. Immediately, the measurement was recorded on the questionnaire.

The results were represented in Table 1 below.

### 2.3. Clinical examinations

Clinical methods of assessing nutritional status involve checking for signs of deficiencies in places on the body or asking the patient whether they have any symptoms that might suggest nutrient deficiency. Clinical signs of nutrient deficiency include pallor (on the palm of the hand or the conjunctiva of the eyes), Bitot's spots on the eyes, pitting oedema, goiter, and severe visible wasting (UNICEF 2015).

#### 2.3.1 Principle

To determine the presence of oedema, the researcher applied normal thumb pressure on both feet for three seconds (count the numbers 101, 102, and 103 to estimate three seconds without using a watch). When a shallow print persisted on both feet, the participant was considered to have nutritional edema (pitting edema). We tested for oedema with finger pressure because we could not draw any conclusion by just looking.

**Table 1. Standard classification of MUAC of children**.

| MUAC (in cm)/ colors | Malnutrition |
|---|---|
| <11cm/red | Severe malnutrition (SAM) |
| 11-12.5cm/red | Moderate acute malnutrition (MAM) |
| 12.5-13.5cm/yellow | Acute malnutrition |
| 13.5cm/green | Well nourished |

### 2.3.2 Procedure

The participant's shoes and socks were removed, and pressure was applied to both legs using the thumbs for three seconds, and the results were recorded on the questionnaire.

### 2.3.3 Grade of oedema

Depending on the presence of oedema on the different levels of the body, it was graded as follows:

An increase in grades indicated an increase in the severity of edema.

0 = no oedema; + = below the ankle (pitting pedal oedema); ++ = pitting oedema below the knee; +++ = generalized oedema, Bitot's spots.

These are a sign of vitamin A deficiency; these spots are a creamy color and appear on the white of the eye.

Goiter: Goiter is a swelling on the neck and is the only visible sign of iodine deficiency.

### 2.3.4 Dietary methods of assessment

They include looking at past or current intake of nutrients from food by individuals or groups to determine their nutritional status. The mother, guardian, teacher of younger participants, or the participants themselves were asked what they had eaten over the past 24 hours, and the data collected was recorded on the questionnaire, and the reminder of the last 24 hours was done every 24 hours and three times a week. Dietary diversity is a measure of the number of food groups consumed over a reference period. Usually, over 24 hours, there are six food groups that our body needs every day. These can be represented in the food guide pyramid (Samuel et al. 2021).

The nutritional status of an individual or community is affected by socioeconomic and ecological factors. Therefore, these parameters are likely to serve a useful purpose too.

### 2.3.5 Sampling Techniques

Cluster sampling technique followed by random sampling was used to select children in the division and region as a whole. The basic criterion of the household sample was that the household containing at least one school-age person aged 5-40 years was included in the sample.

### 2.3.6 Study Variable

Study variables were divided into dependent and independent variables. The dependent variable included malnutrition, indicated by stunting and wasting, while independent variables were considered as follows:

- School-age participant characteristics: age, sex, feeding status, and morbidity status
- School-age participant care practices: feeding, hygiene
- Maternal characteristics: age, number of children born
- Environmental health condition: water supply, sanitation, and housing condition.

### 2.3.7 Sample Size

The sample size was determined by using the Taro Yamane Formula:

$n = N / (1 + Ne^2)$; where n = corrected sample size; N = population size;

e = margin of error (MoE);

The number of school-age people aged 5- 40 years with epilepsy seizures in the Momo Division, residents of the Northwest region of Cameroon, was 300.

Margin of error = 15% = 38;

n = 300 / (1 + 300(0.052)) = 300 / 1.75 = 171.43 - 171. Therefore, per the Taro Yamane formula, a sample size of 253 was used.

### 2.3.8 Pre-Testing

The prepared set of questionnaires and anthropometric instruments were pretested among a few parents/caretakers of 5-9-year-old children and 10-year-old children, respectively, who are under the sample plan. Pre-testing was conducted to maintain accuracy and clarity of the questionnaire, to check the consistency in interpretation of questions by respondents, and to identify ambiguous items. After pre-testing, all the ambiguous, misleading, and wrongly interpreted questions were omitted, and the questionnaire was revised with the findings of pre-testing.

### 2.3.9 Validity and Reliability

To ascertain the degree to which the data collection instruments will measure what they purport to measure, the instruments were validated at the Momo division in the north-west region of Cameroon. The expected test in the questionnaire was drawn from the available literature in nutrition education for young school-age people. The questionnaire was also pretested prior to data collection to ascertain content and face validity.

Reliability refers to quality control measures of data collected. The questionnaire was checked daily for completeness, consistency, and clarity as mentioned earlier. In addition, the research supervisor paid a visit to the research area periodically to monitor the process of data collection.

### 2.3.10 Data Collection Techniques

Data were collected using a structured questionnaire and anthropometric measurements.

Interviews were conducted with parents/caretakers of the school children between the ages of 5 and 9 years because they could not answer most of the questions by themselves, and school-age people above 9 years old were administered the questionnaire directly.

### 2.4. Statistical analysis

First, the data were checked for completeness and consistency. Then, they were coded and entered into the computer using Microsoft Excel version 2010 statistical software. Likewise, qualitative data were transcribed and coded by assigning labels to various categories. Verified test parameters were used to establish the relationships between the variables and the nutrition status of school-age people. The data were then analyzed using SPSS.

Logistic and Ethical Considerations:

- Ethical clearance was obtained from the University of Bamenda, College of Technology (COLTECH), and from the regional delegation of public health in Bamenda (000175/Uba/FSCI/023).

-Verbal consent from parents/caretakers and subjects of the study was obtained, and the objective of the study was explained to them. Privacy and confidentiality of collected information were maintained.

## 3. RESULTS

### 3.1 Demographic data

Demographic data comprise sex, education, religion, race, and parental or individual participant education level (Table 2). Results in Table 2 show that out of the 253 participants who took part in the research, 161 were male and 95 were female. According to our findings, it was noticed that males were more exposed to risky activities that expose them to head injuries, which often lead to brain infections, which are one of the predisposing factors to epilepsy. From the results obtained, as seen in the table above, it was also seen that out of the 253 participants who took part in the research, 214 of them were Christians, while 8 of them were Muslims and

were neither Christians nor Muslims. 232 of them were from Batibo, while 11 of them were strangers living in Teben village in the Batibo subdivision.

**Table 2: Demographic Information of Respondents**

| **Sex** | | Frequency | Percent | P values |
|---|---|---|---|---|
| Sex | Male | 161 | 63.6 | 0.4 |
| | Female | 92 | 36.4 | |
| | Total | 253 | 100.0 | |
| **Religion** | | | | |
| | | Frequency | Percent | P values |
| Religion | Christian | 214 | 84.6 | 0.3 |
| | Muslim | 8 | 3.2 | |
| | Others | 31 | 12.3 | |
| | Total | 253 | 100.0 | |
| **Ethnic group** | | | | |
| | | Frequency | Percent | P values |
| Ethnic group | Fulani | 8 | 3.2 | 0.9 |
| | Grass field | 232 | 91.7 | |
| | Others | 3 | 1.2 | |
| | Total | 253 | 100.0 | |
| **Parent occupation** | | | | |
| | | Frequency | Percent | P values |
| Parent occupation | Farming | 233 | 92.1 | 0.1 |
| | Others | 20 | 7.9 | |
| | Total | 253 | 100.0 | |

Table 3 below shows anthropometric data of the studied population (Table 3). From Table 3, it can be seen that 33.2% of the respondents weighed between 31 and 50 kg, 27.3% of the respondents weighed between 16 and 30 kg, 15.8% weighed less than 15 kg, 14.2% of the respondents weighed between 51 and 80 kg, and 9.5% of the respondents weighed 81 kg and above.

In school ages of 5-6 yrs, the majority of participants weigh less than 15 kg (15.8%), as stated above. For school ages 6-8 yrs, the majority weigh between 16- 30 kg (27.3%), as stated above; hence, some of them were falling within the normal range (6.1% of the 27.3%), others were falling below the normal range (19.9% of the 27.3%), and others were falling above the normal range (1.3% of the 27.3%). In the age ranges of 8-10 yrs and 10-14 yrs, the majority of students weigh between 31 and 50 kg (33.2% and 14.2%, respectively). As stated above, this showed that school-age people of ages between 10 and 14 years were falling most in the normal range, and 9.5% of ages above 14 years were overweight. With these results, it was noticed that epileptic cases with a normal weight range had fewer epileptic attacks in a month compared to epileptic cases with abnormal weights. It was also noticed that epileptic cases with normal weight had good dietary habits compared to those with abnormal weight. Epileptic cases with normal weight turned out to have little or no restriction in their diets and ate a variety of foods; hence, this helped them have normal weights, grow normally, have fewer epileptic attacks in a month, and perform better in school and other aspects of life involving physical work, and they were found to be happier than those with abnormal weights who were restricted from eating a variety of foods.

Table 3 still shows the height of the respondents. Results reveal that 34.8% of the respondents are within 1.1 m-1.5 m, and 34.8% of the respondents are within 1.6 m-1.9 m; 15.8% of the respondents are 2 m and above, while 14.6% of the respondents are less than 1 m. It can be said that the majority of the respondents are 1.1 1.1m-1.5m and 1.6 m-1.9 m.

Only 2.2% of the 34.8% of these respondents in this age group had normal height as expected, showed normal growth patterns, and had fewer epilepsy episodes compared to the others who did not grow normally.

Table 3, in addition, gives information on Body Mass Index (BMI) ($kg/m^2$). Results reveal that 41.9% of the respondents have a Body Mass Index of 15.1 ($kg/m^2$), and 39.2% of the respondents have a Body Mass Index of less than 15 ($kg/m^2$), 11.5% of the respondents have a Body Mass Index of 18.1 ($kg/m^2$), and 2.8% of the respondents have a Body Mass Index of 25.1 ($kg/m^2$).

**Table 1: Anthropometric Data (weight (kg), height (M), BMI (kg/M2), MUAC (cm)**

| **Weight (kg)** | | | | |
|---|---|---|---|---|
| | | Frequency | Percent | P value |
| Weight | less than 15kg | 40 | 15.8 | 0.2 |
| | 16- 30 kg | 69 | 27.3 | |
| | 31-50 | 84 | 33.2 | |
| | 51-80 | 36 | 14.2 | |
| | 81 and above | 24 | 9.5 | |
| | Total | 253 | 100.0 | |
| **Height (meter)** | | | | |
| | | Frequency | Percent | P value |
| Height | Less than 1 m | 37 | 14.6 | 0.03 |
| | 1.1 m-1.5 m | 88 | 34.8 | |
| | 1.6 m- 1.9 m | 88 | 34.8 | |
| | 2 m and above | 40 | 15.8 | |
| | Total | 253 | 100.0 | |
| **BMI (kg/m$^2$)** | | | | |
| | | Frequency | Percent | P value |
| BMI | less than 15(kg/M2) | 99 | 39.2 | 0.7 |
| | 15.1(kg/M2)- 18(kg/M2) | 106 | 041.9 | |
| | 18.1(kg/M2)-25(kg/M2) | 29 | 11.5 | |
| | 25.1(kg/M2)-30(kg/M2) | 7 | 2.8 | |
| | 30(kg/M2) and above | 12 | 4.7 | |
| | Total | 253 | 100.0 | |
| **MUAC (cm)** | | | | |
| | | Frequency | Percent | P values |
| MUAC | less than 10(cm) | 17 | 6.7 | 0.7 |
| | 10- 15 (cm) | 68 | 26.9 | |
| | 16-20(cm | 84 | 33.2 | |
| | 21-30(cm | 65 | 25.7 | |
| | 30(cm and above) | 18 | 7.1 | |
| | 34.00 | 1 | 4 | |
| | Total | 253 | 100.0 | |

### 3.2 Clinical Data

Table 4 shows results obtained as far as clinical data is concerned. The table indicates the number of epileptic attacks of the respondents in a month. Results reveal that 47.8% of the respondents have epileptic attacks 51-80 times a month, and 23.7% of the respondents have epileptic attacks 31-51 times a month, 12.6% of the respondents have epileptic attacks 80 times or more per month, 8.7% of the respondents have epileptic attacks within 11-30 times a month, and 7.1% of the respondents have epileptic attacks within 1-10 times a month. The next parameter evaluated was the tongue color, as shown in Table 5 below.

**Table 2: Number of epileptic attacks per month**

| | | Frequency | Percent | p values |
|---|---|---|---|---|
| **Number of epileptic attacks per month** | 1-10 | 18 | 7.1 | 0.5 |
| | 11-30 | 22 | 8.7 | |
| | 31-51 | 60 | 23.7 | |
| | 51-80 | 121 | 47.8 | |
| | 80 and above | 32 | 12.6 | |
| | Total | 253 | 100.0 | |

**Table 5: Tongue color of respondents**

| Tongue color | | | Frequency | Percent | P values |
|---|---|---|---|---|---|
| Tongue color | - | cream white less than **40%** damage | 112 | 44.3 | 0.5 |
| | - | cream white 40**- 60%** damage | 87 | 34.4 | |
| | - | cream white more than **60%** damage | 54 | 21.3 | |
| | - | Total | 253 | 100.0 | |

Results reveal that 44.3% of the respondents have a cream-white-colored tongue, which is less than 40% damaged during epileptic attacks; 34.4% of the respondents have a cream-white-colored tongue, which is 40-60% damaged during epileptic attacks; and 21.3% of the respondents have a cream-white-colored tongue, which is more than 60% damaged during epileptic attacks. It can therefore be said that most of the respondents have a cream-white tongue, which is less than 40% damaged. Therefore, we stipulate that eating a single staple diet for a very long time may have a great influence on our tongue's general health and color.

Table 6 below shows the bodily damage that occurs during seizures in epileptic patients.

**Table 6: Bodily damage during seizures**

| | | Frequency | Percent | P values |
|---|---|---|---|---|
| Valid | Tongue | 64 | 25.3 | 1.7 |
| | Legs | 83 | 32.8 | |
| | Hands | 45 | 17.8 | |
| | Face | 39 | 15.4 | |
| | Others | 22 | 8.7 | |
| | Total | 253 | 100.0 | |

Table 6 shows various body damages during seizure. Results reveal that 32.8% of the respondents have damaged on the leg during seizure, and 25.3% of the respondents have damage on the tongue during seizure, and 17.8% of the respondents have damage on the hand during seizure, and 15.4% of the respondents have damage on the face during seizure, while 8.7% of the respondents have damage on other parts of their body during seizure.

Table 7: Palm and nails examination for nutrient deficiency

| Palms color | | Frequency | Percent | P values |
|---|---|---|---|---|
| Valid | pale white | 121 | 47.8 | 1.7233 |
| | brittle white | 81 | 32.0 | |
| | Others | 51 | 20.2 | |
| | Total | 253 | 100.0 | |

The table above shows the palm and nail examination for nutrient deficiency. Table 7 shows the palm color of the respondents. The results reveal that 47.8% of the respondents have pale white palms, 32% of the respondents have brittle white palms, and 20.2% of the respondents have other palm colors apart from pale white palms and brittle white palms.

Table 8 shows the various hair colors of the respondents. Results reveal that 47.8% of the respondents have brown hair, 24.9% of the respondents have grey hair, and 18.6% of the respondents have black hair, while 8.7% of the respondents have other colors apart from the listed colors above.

**Table 8: Hair color of respondents.**

| | | Frequency | Percent | P values |
|---|---|---|---|---|
| Valid | Brown | 121 | 47.8 | 1.8814 |
| | Grey | 63 | 24.9 | |
| | Black | 47 | 18.6 | |
| | others | 22 | 8.7 | |
| | Total | 253 | 100.0 | |

**Table 9: Subjective and objective data (A)**

| | | | | |
|---|---|---|---|---|
| **Avoided some foods due to the condition?** | | | | |
| | | Frequency | Percent | P values |
| Valid | Yes | 195 | 77.1 | 0.9 |
| | No | 58 | 22.9 | |
| | Total | 253 | 100.0 | |
| **Are there some limitations that have been put around you by people around you?** | | | | |
| Valid | Yes | 228 | 90.1 | 0.3 |
| | No | 22 | 8.7 | |
| | Total | 250 | 98.8 | |
| Total | | 253 | 100.0 | |
| **Does the condition make you feel free to interact with friends and other people?** | | | | |
| Valid | Yes | 14 | 5.5 | 0.1 |
| | No | 236 | 93.3 | |
| | Total | 250 | 98.8 | |
| Total | | 253 | 100.0 | |
| **Does the level of seizures affect your physical well-being and academic performance?** | | | | |
| Valid | Yes | 236 | 93.3 | 0.1 |
| | No | 14 | 5.5 | |
| | Total | 250 | 98.8 | |
| Total | | 253 | 100.0 | |
| **Have seizures more than 3 times a day and last for at least 5 minutes?** | | | | |
| Valid | Yes | 248 | 98.0 | 0.9 |
| | No | 5 | 2.0 | |
| | Total | 253 | 100.0 | |
| **Did the family have no money last month to buy food?** | | | | |
| Valid | Yes | 238 | 94.1 | 0.9 |
| | No | 15 | 5.9 | |
| | Total | 253 | 100.0 | |
| **Smoke cigarettes or chew tobacco?** | | | | |
| Valid | Yes | 231 | 91.3 | 0.9 |
| | No | 22 | 8.7 | |
| | Total | 253 | 100.0 | |
| **Family watches TV during meals?** | | | | |
| Valid | Yes | 14 | 5.5 | 0.5 |
| | No | 239 | 94.5 | |
| | Total | 253 | 100.0 | |
| **Take mineral, vitamin, herbal, or dietary supplements?** | | | | |
| Valid | Yes | 14 | 5.5 | 0.9 |
| | No | 239 | 94.5 | |
| | **Total** | **253** | **100.0** | |

### 3.3 Subjective and objective data

Subjective and objective data obtained in this study are summarized in Table 9. The table gives the reasons why respondents avoid some foods because of their current condition. Results reveal that 77.1% of the respondents avoid some foods because of their condition, whereas 22.9% of the respondents do not avoid some foods because of their condition. It was noticed from the individual interview of each client that their parents or caregivers always restricted them from eating some types of foods, which, according to them, they believe will provoke

more epileptic attacks. For example, many of the clients stated that they have been permanently restricted from eating chicken and anything that has blood, wings, and flies in the sky.

Table 9 shows whether there are some limitations that have been put on the respondents by persons around them. Results from the findings reveal that 90.1% of the respondents accept that there are some limitations that have been put on them by relatives. On the other hand, 8.7% of the respondents do not accept that there are no limitations that have been put on them by any other person.

Moreover, Table 9 in addition shows information on whether respondents take mineral, vitamin, herbal, or dietary supplements. Results reveal that 94.5% of the respondents don't take mineral, vitamin, herbal, or dietary supplements. While 5.5% of the respondents do take mineral, vitamin, herbal, or dietary supplements.

## 4. DISCUSSION

From the results in Table 2, it was noticed that most of the Christians in the Batibo area believed that epilepsy can't be a medical problem and that it can only be caused by some superstitious powers from Satan and his agents, which is the reason why they don't take their anti-epileptic drugs and also don't eat what people around them tell them not to eat. These results have proven some of the reasons why most epileptic school-age people and other epileptics were found to be malnourished. This result was similar to that of Anurag et al. (2015), who carried out similar studies in the Batibo area in 2015.

From the results of this study, according to the health and disease control center, there are stipulated weights at each age of growth; anything below the stipulated weight is termed underweight, and anything above the stipulated value is termed overweight. According to the stipulated weight standards by WHO, school-age people of 4-5 years are expected to weigh between 16-18kg, school-age people between the ages of 6-8yrs are expected to weigh between 20-26kg, school-age people between the ages 8-10yrs are expected to weigh between 26-32kg, school-age people between the ages of 10-14yrs are expected to weigh between 32-50kg and school-age people of ages above 14 years are expected to weigh 50 kg and above. From the results obtained, most of the weights at the different school ages didn't match with that of WHO.

Boys of school age 11-13 years, according to ICMR growth standard, are expected to have a height of 1.40-1.53 m, and girls of the same ages are also expected to have a height of 1.42-1.50 m, but from the results obtained, it was noticed that 34.8% of the respondents were also far within this age range, and 18.5% of the 34.8% had heights that were less than the expected value and showed signs of stunted growth and had a greater number of epileptic attacks per month compared to others of the same age range suffering from the same disease condition. Around sixty (16.3) % out of the 34.8% of the respondents falling among these age ranges had a height that matches that of ICMR and had fewer epileptic attacks in a month compared to their age mates, as stated above (Anurag et al. 2015). Boys aged 14-16 years, according to ICMR standards, are expected to have a height of 1.60-1.71 m, while girls of the same age group are expected to have a height of 1.55-1.62 m. Results showed that 34.8% of the respondents still fall within this age range, and the majority of them still had a height that was not up to the stipulated standard (20.7% of the 34.8%) and were stunted, while 14.1% of the 34.8% had heights that were up to the expected standard. Boys aged 17-18 years and above are expected to have a height of 1.75-1.90 m, while girls of the same age range are expected to have a height of 1.63-1.80 m (Enes et al. 2021). From the obtained results, it was noted that 15.8% of the respondents fell within this age range, the majority having normal heights as expected (9.3% of the 15.8%), while 6.5% of the 15.8% had heights that did not meet the expected standard. It was found that the restrictions that were placed on the eating habits of school-age people with epilepsy affect their growth, and this could be seen from their stunted growth and the number of epileptic attacks they have per month. School-age people with epilepsy who had little to no restriction on their diet tended to grow normally and had fewer epileptic attacks at the end of the month and performed better in school and other aspects of physical work in life compared to those who were restricted from eating well (Anurag et al. 2015).

The nutrient requirement and recommended dietary allowance chart of weight and height for school-age people, as recommended by the Food Safety and Standards Authority of India (FSSAI), stipulates that there are expected heights for each individual based on their sex and age. This, however, sets the baseline to know whether school-age people are growing well or have a nutritional problem. According to the stated value, girls of school ages 5-7 years are expected to have a height of 1.08-1.21 m, and boys of the same ages are expected to have a height of 1.09-1.22 m (FSSAI 2016), but from the results obtained, it was seen that 14.6% of the respondents were of this age group, and the majority of them (10.6% of the 14.6%) had a height of less than 1 m; hence, they fell short of the speculated standards for a normal growing school age of this age group (Enes

et al. 2021). Boys of school age between 8-10 years old are expected to have a height of 1.27-1.38 m, while girls of the same age group are expected to have a height of 1.26-1.37 m (Enes et al. 2021). From the results obtained in this study, 34.8% of the respondents are in these age groups and had a height that was far less than the expected heights (32.6% of the 34.8%), hence showing signs of stunted growth.

The results of Table 4 show that something needs to be done because the majority of the respondents have epileptic attacks frequently. Adequate nutrient intake has been proven to improve the immune system of an individual and the entire brain functioning as well as affect the ability to perform physical work (Wei & Guoxun 2014). From the results obtained, it was noticed that the majority of the epileptic cases (up to 90%) had very poor eating habits. Most of them feed only on a single staple food that is highly dense with a single nutrient or two, and most of the time their diet is mostly made of lipids and carbohydrates, with no minerals, no vitamins, no proteins, and a small quantity of water. Some of them, throughout the week and throughout the month, might not eat any protein or minerals or vitamins, and these, however, turn out to affect their immune system as well as brain activities since essential proteins that are needed for normal growth and repairs in the body are absent. Moreover, essential minerals like Zn, Ca, P, K, Mg, Fe, etc., needed for nervous impulses in the brain and the entire nervous system are absent, and essential vitamins like the B complex, vitamin C, and even the fat-soluble vitamins (ADEK) are absent; hence, leading to high levels of malfunctioning of electrical activities of the brain, which also exposes them more to the disease condition (Wei & Guoxun 2014). From our findings, it was noticed that those who ate regularly across the different food groups and also had little or no restriction to their diet had a lower number of epileptic attacks in a month, looked healthier than those who don't eat across the different food groups, and had better school performance as well as physical performance than those who had restrictions and don't feed properly. This, therefore, can be seen as nutrition having a role to play in the electrical activities of the brain and influencing epilepsy directly.

According to the results of Table 5, when the diet is highly condensed with carbohydrates and deficient in proteins, vitamins, minerals, and essential lipids, the body reacts to these deficiencies by a change in color, which indicates a nutrient deficiency (Tarang et al. 1997). From the results obtained, it was very clear that most of the respondents eat mostly carbohydrate foods, and even though some of them have other sources of food that are highly rich in the other nutrients, they do not eat them due to a lot of restrictions placed by those around them; hence, most of the epileptic cases tend to stick to only what they have been asked to eat by those around them. This always results in nutrient deficiencies and most of the time expresses itself through a change in tongue color, and most of the tongue color seen in the respondents was cream white, as stated above. Most of them also had very poor mouth hygiene, which exposes the entire mouth content to bacterial infection and also changes in tongue color. It was observed that most participants used harsh objects like sticks, charcoal, palm oil, salt, etc. to clean their mouths, and when asked, they reported that they don't have money to buy toothbrushes and toothpaste. It was still observed that during an epileptic attack, those around them always used hard and harsh objects like spoons and sticks to insert into the mouth of the affected victim who is under an epileptic attack. This often results in damage to their tongue as well as other parts of the mouth, like the gums and the lips. Sometimes, those around the victims during epileptic attacks become very scared during the scene because of the scary expression that they see; hence, they turn away and allow the victims to suffer by themselves until they manage to regain consciousness. This often results in the victims biting their tongues and mouths, which always results in serious damage, as stated in Table 9 above (Anurag et al. 2015).

From the results of Table 6, most of the respondents have damage to their legs during seizures. Every epileptic attack is always traumatic for the victims because it always ends up with minor to major damage to the body of the individual (Anurag et al. 2015). The victims reported that they sometimes have attacks when they are alone at home or on the farm. When this happens, they tend to fall on hard and dangerous objects like open fires, water, hard and rough floors, and sharp objects. This most of the time results in fatal accidents that limit the individual's ability to perform better in physical work or in school and even death in some cases. Additionally, some burn scars could be seen on some of the victims.

The results of Table 7 imply that most of the respondents have pale white palms. Different colors of the human palm give an idea about the health status of the person. The color of a normal palm is light red or pinkish red with a shiny, smooth texture. If the color appears either darker or lighter than normal, this may indicate that the condition of health is abnormal (Colin 2007). A palm appearing pale white in color indicates anemia or possibly occult bleeding. Brittle White palms usually indicate lung disease or inflammation in the body. A blue palm usually indicates intestinal obstruction; a palm with a dark green color usually indicates obstruction in the circulation of the blood. A greenish palm that is not dark may indicate anemia or spleen/stomach disease (Colin

2007). From the findings of this research, it was noticed that most of the respondents who had pale and brittle white palms mostly don't eat food that contains enough iron to help boost their level of red blood cell production, like green leafy vegetables, whole grains, nuts, legumes, etc. Most of them testified that they milled most of their grains, like maize, before consumption because it was believed that unmilled maize provoked seizures, and so milling will help to reduce the trigger of epilepsy in maize. They also testified that they were restricted from eating some legumes like red beans, nuts, and some green leafy vegetables like eru, okra, okonghobong, fresh fish, and meat. These foods are rich in iron, but since these school-age people were restricted from consuming them, they were anemic and stunted and hence presented with the palm color stated above. Those who had normal palm color were proven to have little or no restriction on their diet; hence, they had normal palm color and turned out to have better school and physical work performance compared to those with abnormal palm color who were anemic. This is because red blood cells are needed to carry oxygen from the lungs to the brain, which helps in regulating electrical activities of the brain. Shortage of oxygen supply to the brain might lead to electrical misfiring in the brain, which results in frequent epileptic attacks and a decrease in school and physical work performance.

Childhood malnutrition is known to be associated with visible lightening of the hair color (hypochromotrichia). Nevertheless, no systematic investigations have been carried out to determine the biochemical basis of these changes in hair color. According to the findings of this research work, it was noticed that more than 80-85% of the respondents who participated in the research work do not meet their daily protein intake needs. This could be seen from their response to the questionnaires, as most of them testified that they hardly eat protein sources of food like meat, fish, beans, soybeans, etc. Some of them also said they don't eat animal proteins at all because of the restriction that has been put on their diets as a result of their conditions. Proteins have been known for the repair and buildup of body cells and tissues and for the production of melanin, which is the chemical component of hair color (Pinckard & Stanford 2019). Because of the gap between protein intake and use in the body in the epileptic population, the majority of them tend to have the abnormal hair colors stated above, which is an indicator of malnutrition. They also tend to have more epileptic attacks within the month because the proteins, lipids, minerals, and vitamins that are needed to coordinate neurological activities in their brains, like omega-three and omega-six fatty acids, potassium, vitamin B6, etc., are absent in their diets. On the other hand, just a smaller percentage of the epileptic population met their daily protein intake, and they had normal hair color (black) and had fewer epileptic attacks in a month and better school and physical work performance than those who were protein deficient and had abnormal hair color. This could be because of the high level of melanin production and other proteins in their bodies, as adequate protein intake has been proven to improve melanin production, which is responsible for the hair and skin color of an individual (Pinckard & Stanford 2019).

Table 9 shows that physical exercise has been proven by many authors to have many health benefits for an individual, such as burning down excess fats in the body that help in blocking blood vessels that carry blood from the heart to vital organs of the body like the brain, kidneys, liver, etc., and also transporting blood from these organs back to the heart (Wencui et al. 2012). Physical exercise has been proven to help restore the physical fitness of many sick individuals, and even in epileptic cases. When a sick person exercises, dead cells and other waste products of metabolism from different activities, even from drugs, are sent out through body sweat, and the body becomes well ventilated, and oxygenated blood flows from the lungs easily to the brain and other vital organs of the body. That helps in controlling and coordinating activities in the entire system of the body. From recent studies, it was shown that school-age people with epilepsy who got themselves involved in little physical activities like gardening, running, swimming, football, walking with friends, etc., had fewer epileptic attacks in a month and looked healthier and happier than those who are confined in one spot or are restricted from exercise (Wencui et al. 2012). As stated in Table 9 from the results obtained, most of the respondents hardly get involved in any physical exercise apart from farming. This was because their caregivers don't want them to move around the community. Some of them believed that epilepsy is contagious and can be transmitted to friends during play. This too has been seen to be one of the reasons why most school-age people with epilepsy in these communities are sent away from school by their teachers and schoolmates or isolated in class during lessons. All these restrictions help in traumatizing the individual as they begin to feel inferior and rejected by friends and loved ones. Once again, this too contributes a lot to the multiple and frequent epileptic attacks and sudden death that occur in these people with epilepsy, poor physical work, and school performance (Anurag et al. 2015). From the results obtained in this study, it was noticed that the number of epileptic attacks among those who had no restrictions was small, and the individuals were more active and lived longer than those who were often restricted from playing with their friends and doing what they liked at any time in their

life. It is with this note that the researcher of this work is calling upon all the caregivers of school-age people with epilepsy in these communities and beyond to stop restricting these people from doing what they like. Teachers, classmates, and other persons connected to these affected school-age people with epilepsy should learn how to show love, respect, and support to them, as this might go a long way in dealing with the problem of the trauma of the disease and the reduction in the number of epileptic attacks in a month.

As stated above, there is a lot of stigmatization that has been placed on people with epilepsy, including school-age people with epilepsy, by persons around their communities and even some of their intimate family members, who openly show discrimination in every condition to these epileptic-affected people. This is one of the major reasons why persons with epilepsy don't interact freely with people in their communities except their family members or among themselves. Stigmatization of epilepsy is what really kills faster in these communities and even beyond. Epileptic patients most of the time are looked upon by the people in their communities as cursed persons from the gods of the land who have nothing to offer to the community they belong to and also are to suffer their punishment alone through the series of epileptic attacks they get until they die (Jiloha 2010). This makes most of the affected people feel like they are really cursed by the gods of their land and see no reason to interact with other people freely; hence, they either stay lonely or interact only with family members. This was proven to increase the number of epileptic attacks in the individuals at the end of the month compared to those who freely interact in the community. This is because once these epileptic individuals are left alone to themselves, they turn to having thoughts of a series of epileptic episodes, and before it is noticed, the thoughts found in their subconscious minds begin to send signals to the brain, and electrical activities become disrupted, and the individual goes into the condition again, and it keeps happening over and over and might result in sudden, unexpected death (Jiloha 2010). It is with this notice that everyone is called upon to show love to these epileptic school-age people and others above and below this age with the same disease condition. Love may create a sense of belongingness in the subconscious minds of these epileptic-affected individuals and may reduce psychological trauma and pain in them, and before it is noticed, electrical activities of the brain may become normal, and a decrease in the number of epileptic attacks may set in, and the individuals may turn out to be happy and live longer than expected.

As stated earlier above, most school-age people with epilepsy are always at home with their parents instead of being in school during school hours or being at work during working hours. This, as explained earlier above, is because the teachers tend to send them away from school. Likewise, too, are the owners of the vocational training centers, who could, on the other hand, accommodate these school-age people with epilepsy (Jiloha 2010). With all these disappointments from teachers in school and owners of vocational training centers on the side of the epileptic school-age people and their parents, they are left with no option but to stay at home and engage in farming, or at times, some of them turn to get involved in some criminal activities in their communities, like stealing, smoking, and excessive drug abuse, just to name a few, as a result of too much idleness. Those who manage to be in school or vocational centers still complain of always lagging compared to their mates who are not suffering from the disease. This is because they are psychologically disturbed because of their present everlasting condition, and this also affects their performance at work and in school.

Table 9 still shows whether respondents have seizures more than 3 times a day and if they last for at least 5 minutes. Results reveal that 98.0% of the respondents do have seizures more than 3 times a day, and they do last for at least 5 minutes. On the other hand, 2.0% of the respondents reported that they have seizures less than 3 times a day and that they last for at least 5 minutes or less. From the information gathered from individual interviews with the clients, it was noticed that those who had seizures more than three times a day that lasted for more than 5 minutes were the same people who were restricted from physical exercise, had limitations in their diet, skipped breakfast in the morning, ate only plant proteins and pig as the only animal protein, etc. Those who had seizures less than three times a week that lasted for 5 minutes or less were those who had little or no limitation in all the aspects stated above.

Our results show that the main economic activity that these school-age people with epilepsy and their parents are involved in is farming. They carry out subsistence farming in small farmlands, which can sustain just their households, and the little income they might generate from the little sales of the farm products, they turn to buy medications for themselves or other sick family members, making them not have enough money to buy other foodstuffs that they don't cultivate, and when there is a poor harvest, the client's whole family will have to go hungry till the next farming season, where they will hope to have a good harvest. On the other hand, those who said their families had money throughout last month to buy food for them and other family members were those who were engaged in economic activities other than farming, such as teaching, business, vocational

training, etc. These economic activities are not seasonal like farming. They tend to have some income at least at the end of the month, which they use to buy food and even enough medication for themselves and other family members. This makes them at least have food throughout the month and feed well and have a lesser number of epileptic attacks in the month compared to those that depend only on farming for a means of living. It is with this note that the government and other nongovernmental financial organizations are called upon to give financial support to these families with school-age people suffering from epilepsy so as to have another source of income apart from farming in order to have food throughout the month. This can be done by giving educational and training assistance to them, where these school-age people with epilepsy are encouraged to go back to school or learn a trade that will help them to become financially independent; disciplining any staff or mate who tries to intimidate them or send them away from school or work; and giving free food that is not common in the communities of these epileptic school-age people to supplement their diets. With this, the rate of starvation among these school-age people with epilepsy will reduce throughout the month; everyone will put on a smiling face, and society will be a better place to be.

Stigmatization and too much restriction on the lives of these epileptic school-age people, as stated above, are the leading factors as to why most of these school-age people get involved in tobacco addiction. Most of them stated clearly that they get addicted to tobacco to forget their worries during their lonely months of rejection and pain. Some said chewing tobacco will help clear their brains of debris blocking their brains that causes them to have a series of epileptic attacks, but, of course, this has no scientific proof. Tobacco has long been known for its adverse effects on human health, like lung cancer, brain damage, and many others (Mohammad 2013). This shows clearly that those who smoke or chew tobacco tend to have a series of epileptic attacks compared to those who don't smoke or chew tobacco at all. Therefore, most of the respondents need to be educated on the disadvantages of smoking cigarettes or chewing tobacco.

Watching TV is a good means of getting distracted from our common worries and being happy for a single moment. Once one is distracted by a movie on TV and is carried away by joy from the scenes in the movie, the problem of trauma about their present conditions and other evil thoughts might gradually be wiped out from their subconscious minds. An individual might even turn to learn a new thing that he or she will practice to help manage their present situation from the TV. From the results obtained, it was noticed that those who often watch TV looked happier than their friends who don't watch TV at home. When asked why they looked happy, most of them stated that they just remembered a funny scene they watched on TV the previous day back at home, but when asked what made the others sad, they responded that they had a boring day at home full of thoughts of their present conditions the previous day. This, however, contributes to the general fitness and well-being of the individual and is gradually linked to the number of epileptic attacks they tend to have in a month. This is because once they keep on having thoughts of a series of epileptic attacks without being distracted even for a moment, they will continue to have the series of attacks as stated earlier above.

Intake of dietary supplements is very important in meeting the body's needs for its normal metabolic activities. It was seen from other authors in the literature that frequent intake of mineral and vitamin supplements has helped a lot in reducing the frequency of epileptic attacks in people with epilepsy and also in treating the adverse effects of antiepileptic drugs on the epileptic patients (Mung 2008). From the results obtained in this study, it was noticed that those who always take mineral, vitamin, or herbal supplements presented with fewer epileptic attacks in a month and also with fewer side effects from antiepileptic drugs compared to those who don't take them at all. Supplementation can be done by adding fresh vegetables and fruits to every meal of an individual. It was noticed that the majority of the respondents who were affected by epilepsy do not even love eating fresh fruits and vegetables. They believed fruits and vegetables are only eaten during critical periods of illness, and they don't see themselves as being critically ill since they can do some things for themselves; hence, they had no need for these fresh fruits and vegetables. This is a call for concern in the community, as nutritional education needs to be reinforced in the minds of every individual about the benefits of supplementing their diets with fresh fruits and vegetables in order to improve their general health status.

It has been shown that family history is strongly associated with epilepsy in this Cameroonian population, and this is similar to findings in other countries in the Social Security Administration (Ryan et al. 2014, Ewan et al. 2015, Matuja et al. 2001, Georges et al. 2003). A family history of epilepsy may also be due to the likelihood of exposure to the same environmental risk factors in people sharing the same household; this does not seem to apply in this study because living in the same house with someone with epilepsy was not significantly associated with epilepsy in school-age people or older people. Consanguineous relationships could increase the risk of epilepsy because of the increased likelihood of offspring inheriting familial genes that predispose them to

epilepsy. In this study, being the offspring of related parents was associated with a reduced risk of epilepsy in school-age people and adults, and this contrasts with findings in a study in Tanzania where having consanguineous parents was significantly associated with epilepsy (Georges et al. 2003). The reasons for the negative association are not clear, but unknown social and cultural factors related to marriage and epilepsy in Batibo could be involved. Some of the differences could also result from misclassification due to interviewer bias; questions on consanguineous relationships can be complex in the African setting and are subject to diverse interpretations by both the interviewer and the respondent (Anurag 2015).

Living in a house where pigs are kept was not significantly associated with an increased risk of epilepsy. A similar observation was made in another study in a community in Tanzania where neurocysticercosis was strongly linked with epilepsy (Ngoungou et al. 2006). This is not surprising given that, as discussed above, other more important factors such as proximity to a Taenia solium carrier and the level of personal hygiene are essential for the transmission of cysticercosis. Sustained contact with dogs and cats generally increases exposure to toxocariasis and toxoplasmosis, both of which are associated with an increased risk of epilepsy in LMICs as well as HICs (Graziella et al. 2012, Ngoungou et al. 2015). The lack of association between having these animals and epilepsy in this study does not necessarily imply that the zoonoses associated with them are not involved in epilepsy in this community.

In the multi-center African study, whereas no significant association was found between having these animals and epilepsy, both toxocariasis and toxoplasmosis were significantly associated with epilepsy (Alfred et al. 2008). This is not surprising given that in LMICs, the risk of toxocariasis and toxoplasmosis may depend more on poor personal and food hygiene than on contact with these animals (cats and dogs) since they are usually not treated as pets and have relatively limited direct contact with humans who keep them, compared with HICs. Both parasitic infestations need to be investigated in future studies of the risk factors for epilepsy in this population. They are, however, unlikely to explain the high prevalence of epilepsy reported in this population.

In this study, neither the lack of latrines nor the latrine holes not being covered was significantly associated with epilepsy. This was also the case for lack of a reliable water source. These basic factors of hygiene and sanitation are implicated in the transmission of certain food- and waterborne parasitic infestations associated with epilepsy, and although they have not been associated with epilepsy in this study, they must be considered as part of any strategy to prevent epilepsy through parasite control (Anurag 2015).

Head injury was not significantly associated with epilepsy in this study, and this corroborates most studies in SSA (Ryan et al. 2014, Ewan et al. 2015). A few other studies in Africa found a significant association between head injury and epilepsy (Alfred et al. 2008). Differences in the characteristics of the study sites could explain these inconsistencies. Batibo is largely rural with hardly any proper road infrastructure, and most movement is either by foot or motorbike through narrow bush roads. Compared to urban centers, therefore, people living here are less likely to suffer from head injuries due to road traffic accidents. Consequently, head injury is unlikely to be an important risk factor for epilepsy in this population. It should be noted that studies investigating head injury as a risk factor for epilepsy retrospectively may be biased because of confounding effects of falls during seizures (Anurag 2015).

In this study, epilepsy seems to have a significant negative effect on education and physical performance in school-age people with epilepsy compared to school-age people without epilepsy. Epilepsy was associated with poor school attendance and performance and physical work performance; about 90% of school-age people were not attending school or vocational training, and, for 74% of them (adults above school age), epilepsy was the reason why they dropped out of school. Significantly fewer people with epilepsy attained post-secondary education than controls. Reports from community leaders in Batibo suggest that some parents opt to withdraw their children from school to avoid the embarrassment the child may face when seizures occur at school. Some school-age people are expelled from school by teachers with instructions that the child's seizures should be well controlled before they are readmitted. This is consistent with previous reports in this community showing a high level of stigma and discrimination towards people with epilepsy, especially school-age people (Alfred et al. 2008). This unfortunate situation emphasizes the importance of involving teachers in tackling epilepsy in Batibo and similar communities in Cameroon (Anurag 2015).

## 5. CONCLUSION

These cross-sectional and case-control studies have generated important new evidence on the epidemiology and clinical characteristics of epilepsy in Cameroon. There is a high prevalence and incidence of active epilepsy in Batibo (a rural health district in the North-West Region), which is endemic for onchocerciasis and

cysticercosis. Malnutrition was found to be very common among school-age people with epilepsy due to many food restrictions that have no scientific justification placed on their dietary habits. Sudden unexpected death, poor school attendance and performance, and poor physical work were also found to be common among school-age people with epilepsy in the Batibo area. It is with the findings of this research that we can make these suggestions below:

The government should create a law that protects people with epilepsy so that all the discrimination and restrictions that society shows to people with epilepsy should be controlled. For sudden unexpected death to be controlled among people with epilepsy, there is a need to provide nutrition education to them on the proper use of antiepileptic foods in the control of the disease and improvement of well-being. At home, they should be encouraged to maintain nutritional control, which predisposes people to epilepsy and other dangerous diseases. Physical work should be encouraged, and financial activities should also be encouraged so that these school-age people will be physically fit, nutritionally sound, and financially stable.

**STATEMENT OF ETHICS.** We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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**DATA AVAILABILITY STATEMENT.** Data are available for this journal.

## REFERENCES

Angwafor SA, Bell GS, Ngarka L, Njamnshi TN, Njamnshi AK and Sander JW (2021). Incidence and prevalence of epilepsy and associated factors in a health district in North-West Cameroon: a population survey. *Epilepsy & Behavior* 121(Part A), 108048. https://doi.org/10.1016/j.yebeh.2021.108048

Anwar H, Khan QU, Nadeem N, Pervaiz I, Ali M and Fayyaz F (2020). Epileptic seizures. *Discoveries* 8(2), e110. https://doi.org/10.15190/d.2020.7

Asif M (2013). Role of various vitamins in patients with epilepsy. *International Journal of Pharmacological Research* 3(1). https://doi.org/10.7439/ijpr

Bowman J, Dudek FE and Spitz M (2001). Epilepsy. *Encyclopedia of Life Sciences*, Nature Publishing Group.

Chekol YT, Arefaynie M and Kassa AA (2022). Determinants of wasting among children aged 6-59 months in North-East Ethiopia: a community-based case-control study. *BMJ Open* 12, e057887. https://doi.org/10.1136/bmjopen-2021-057887

Chen W and Chen G (2014). The roles of vitamin A in the regulation of carbohydrate, lipid, and protein metabolism. *Journal of Clinical Medicine* 3, 453-479.

Dhakal M (2015). Study on nutritional status of 6 months to 59 months children in Panchgachhi VDC and factors associated with it. BND dissertation, Central Campus of Technology, Tribhuvan University, Nepal.

Food Safety and Standards Authority of India (FSSAI) and Ministry of Health and Family Welfare, Government of India (2016). Food Additives 2016. New Delhi, India.

Guo W, Wu J, Wang W, Guan B, Snape D, Baker GA and Jacoby A (2012). The stigma of people with epilepsy is demonstrated at the internalized, interpersonal and institutional level in a specific socio-cultural context: findings from an ethnographic study in rural China. *Epilepsy & Behavior* 25(2), 282-288. https://doi.org/10.1016/j.yebeh.2012.08.013

Hunter E, Burton K, Iqbal A, Birchall D, Jackson M, Rogathe J, Jusabani A, Gray W, Aris E, Kamuyu G, Wilkins PP, Newton CR and Walker R (2015). Cysticercosis and epilepsy in rural Tanzania: a community-based case-control and imaging study. *Tropical Medicine & International Health* 20(9), 1171-1179. https://doi.org/10.1111/tmi.12529

Jiloha RC (2010). Biological basis of tobacco addiction: implications for smoking-cessation treatment. *Indian Journal of Psychiatry* 52(4), 301-307. https://doi.org/10.4103/0019-5545.74303

Joshi PC (2012). Malnutrition in children: a serious public health issue in Nepal. *Health Prospect* 11, 61-62.

Katz AR (2013). Non-communicable diseases: global health priority or market opportunity? An illustration of the World Health Organization at its worst and at its best. *International Journal of Health Services* 43(3), 437-458. http://dx.doi.org/10.2190/HS.43.3

Matuja WB, Kilonzo G, Mbena P, Mwango'mbola RL, Wong P, Goodfellow P and Jilek-Aall L (2001). Risk factors for epilepsy in a rural area in Tanzania: a community-based case-control study. *Neuroepidemiology* 20(4), 242-247. https://doi.org/10.1159/000054797

McKenzie CA, Wakamatsu K, Hanchard NA, Forrester T and Ito S (2007). Childhood malnutrition is associated with a reduction in the total melanin content of scalp hair. *British Journal of Nutrition* 98(1), 159-164. https://doi.org/10.1017/S0007114507694458

Mung'ala-Odera V, White S, Meehan R, Otieno GO, Njuguna P, Mturi N, Edwards T, Neville BG and Newton CRJC (2008). Prevalence, incidence and risk factors of epilepsy in older children in rural Kenya. *Seizure* 17(5), 396-404. https://doi.org/10.1016/j.seizure.2007.11.028

Ngoungou EB, Quet F, Dubreuil CM, Marin B, Houinato D, Nubukpo P, Dalmay F, Millogo A, Nsengiyumva G, Kouna-Ndouongo P, Diagana M, Ratsimbazafy V, Druet-Cabanac M and Preux PM (2006). Epidemiology of epilepsy in sub-Saharan Africa: a review. *Cahiers de Santé*. https://doi.org/10.1684/san.2007.0051

Ngoungou EB, Bhalla D, Nzoghe A, Dardé ML and Preux PM (2015). Toxoplasmosis and epilepsy: systematic review and meta-analysis. *PLOS Neglected Tropical Diseases* 9(2), e0003525. https://doi.org/10.1371/journal.pntd.0003525

Njamnshi AK, Angwafor SA, Tabah EN, Jallon P and Muna WFT (2008). General public knowledge, attitudes, and practices with respect to epilepsy in the Batibo Health District, Cameroon. *Epilepsy & Behavior*. https://doi.org/10.1016/j.yebeh.2008.09.012

Nsengiyumva G, Druet-Cabanac M, Ramanankandrasana B, Bouteille B, Nsizabira L and Preux PM (2003). Cysticercosis as a major risk factor for epilepsy in Burundi, East Africa. *Epilepsia* 44(7), 950-955.

Pinckard K, Baskin KK and Stanford KI (2019). Effects of exercise to improve cardiovascular health. *Frontiers in Cardiovascular Medicine* 6, 69. https://doi.org/10.3389/fcvm.2019.00069

Quattrocchi G, Nicoletti A, Marin B, Bruno E, Druet-Cabanac M and Preux PM (2012). Toxocariasis and epilepsy: systematic review and meta-analysis. *PLoS Neglected Tropical Diseases* 6(8), e1775. https://doi.org/10.1371/journal.pntd.0001775

Sheth TN, Choudhry NK, Bowes M and Detsky AS (1997). The relation of conjunctival pallor to the presence of anemia. *Journal of General Internal Medicine* 12, 102-106.

Srivastava A, Mahmood SE, Srivastava PM, Shrotriya VP and Kumar B (2015). Nutritional status of school-age children - a scenario of urban slums in India. *Archives of Public Health* 70, 8.

Stafstrom CE and Carmant L (2015). Seizures and epilepsy: an overview for neuroscientists. *Cold Spring Harbor Perspectives in Medicine* 5, a022426. https://doi.org/10.1101/cshperspect.a022426

United Nations Children's Fund (UNICEF) (1986). The State of the World's Children 1986. Oxford University Press, Oxford, United Kingdom.

United Nations Children's Fund (UNICEF) (2012). The State of the World's Children 2009: Maternal and Newborn Health. UNICEF, New York, USA.

United Nations Children's Fund (UNICEF) (2015). Health Systems: Improving Performance. UNICEF, New York, USA. ISBN 92 4 156198 X.

Wagner RG, Ngugi AK, Twine R, Bottomley C, Kamuyu G, Gómez-Olivé FX, Connor MD, Collinson MA, Kahn K, Tollman S and Newton CR (2014). Prevalence and risk factors for active convulsive epilepsy in rural northeast South Africa. *Epilepsy Research* 108(4), 782-791. https://doi.org/10.1016/j.eplepsyres.2014.01.004