# Epidemiology of epilepsy in Nigeria: a community-based study from three sites

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Abstract

**Background:** We determined the prevalence, incidence, and risk factors for epilepsy in Nigeria.

**Methods:** We conducted a door-to-door survey to identify cases of epilepsy in three regions. We estimated age-standardized prevalence adjusted for non-response and sensitivity and the one-year retrospective incidence for active epilepsy. To assess potential risk factors, we conducted a case-control study by collecting sociodemographic and risk factor data. We estimated odds ratios (ORs) using logistic regression analysis and corresponding population attributable fractions (PAFs).

**Results:** We screened 42,427 persons (aged ≥ 6 years), of whom 254 were confirmed to have active epilepsy. The pooled prevalence of active epilepsy per 1,000 was 9.8 (95% CI: 8.6–11.1), 17.7 (14.2–20.6) in Gwandu, 4.8 (3.4–6.6) in Afikpo and 3.3 (2.0–5.1) in Ijebu-Jesa. The pooled incidence per 100,000 was 101.3 (95% CI: 57.9–167.6), 201.2 (105.0–358.9) in Gwandu, 27.6 (3.3–128.0) in Afikpo and 23.9 (3.2–157.0) in Ijebu-Jesa. Children's significant risk factors included febrile seizures, meningitis, poor perinatal care, open defecation, measles, and family history first-degree relatives. In adults head injury, poor perinatal care, febrile seizures, family history in second-degree relatives, and consanguinity were significant. Gwandu had more significant risk factors. The PAF for the important factors in children was 74.0% (71.0%–76.0%) and 79.0% (75.0%–81.0%) for adults.

**Conclusion:** This work suggests varied epidemiological numbers, which may be explained by differences in risk factors and population structure in the different regions. These variations should differentially determine and drive prevention and health care responses.

**Keywords:** Seizures, Survey, Prevalence, Incidence, Risk factors, Sub-Saharan Africa

## Introduction

Despite several epilepsy reports from different parts of the world recently,[1] there is still a need to collect region- and country-specific data for two reasons. Firstly, the available data shows wide variations. Secondly, these variations could determine and drive healthcare policies.[2] Despite modelling attempts by the Global Burden of Disease study,[3] it is challenging to extrapolate epilepsy data from other regions, due to differences in sample sizes, screening tools, definitions and risk factors.[4]

The epilepsy burden in Nigeria is uncertain at the national level, with only seven prevalence surveys conducted over the last four decades.[5-11] These screened a pooled population of 49,000 people in Southern Nigeria and reported prevalence between 4.3 and 37/1,000. There are no cohort studies on risk factors in sub-Saharan Africa (SSA). Case-control studies suggest that infectious and non-infectious factors are associated with epilepsy.[12-17] The susceptibility of developing epilepsy from these factors depends on age, immunity and genetic differences between sites.[18] A correlation between epilepsy prevalence and social deprivation is known,[19] reflecting increased exposures to poverty-driven risk factors.[20] The most critical risk factors from two Nigerian hospital-based case-control studies are febrile seizures, birth-related complications and family history,[21,22] if they provide adequate evidence is debatable.

We determined the prevalence, retrospective incidence and potential risk factors and their contributions to epilepsy from three regions of Nigeria. If differences exist in the prevalence and incidence between sites, could they be explained by differences in the risk factors? These estimates could help provide information on preventive strategies.

Methods

**Study Design, Population and Pre-study training**

This study consisted of cross-sectional door-to-door and case-control designs, conducted at Oha-isu and Nkpoghoro wards in Afikpo North local government area (LGA) Ebonyi State, Ijebu-Jesa ward in Oriade LGA Osun State and ten wards in Gwandu LGA Kebbi State (Figure 1). We chose these sites because of the stable population and the availability of willing collaborators. The tertiary hospitals, primary health care and immunization coordinators within these sites' network helped provide logistics and experienced field workers. The National Population Commission provided enumeration area maps to assist the surveys.

We conducted fieldworker's training workshops before the survey to provide information on epilepsy and study tools. The reference diagnosticians were four neurologists (MMW, MAK, MBF, and SAB) and a neuropsychiatrist (SCI). The team standardized terminologies, definitions and diagnostic concepts to ensure uniformity across sites.[4]

**Procedures for the census and screening, and recruitment of cases and control**

We conducted a population census in the communities alongside the epilepsy screening. The periods for the door-to-door censuses were 12th February-15th March

2018 (Ijebu-Jesa), 17th February-8th March 2018 (Afikpo) and 3rd March-30th March 2018 (Gwandu). We selected the last census date as the prevalence date. The screening process was a two-phase survey. In the first stage, each household was interviewed using a nine-item screening questionnaire in the local language to identify people with a potential epilepsy diagnosis. We described the development and validation of the questionnaire elsewhere.[23] Trained health workers administered the questionnaires to heads of individual households or a senior member who answered on behalf of the whole household. Physicians conducted a second stage confirmatory evaluation for any household member with a positive response to at least one screening question. Those confirmed to have epilepsy had a detailed interview using a modified version of an epilepsy questionnaire developed for use in Africa.[24]

*Epilepsy* was defined as two or more unprovoked seizures occurring at least 24-hours apart.[4] The *lifetime prevalence* of epilepsy considered people who had epilepsy at any point in their life up to the survey time.[4] Those with *active epilepsy* were people with at least one seizure in the last year or were currently on antiseizure medication. We chose a one-year rather than two- to five-year period, due to increasing recall bias with time.[4] The one-year retrospective incidence was defined as the number of persons whose seizure onset occurred in the previous 12 months. We hypothesized that the prevalence of active epilepsy would be around 1%.[13]

For the case-control study, cases were people with active epilepsy recruited and interviewed from the cross-sectional study. Simultaneously, twice as many age- and gender-matched controls were randomly selected from the same communities. We collected sociodemographic information, including age, gender, education, religion, marital status, employment, water supply, toilet facilities, and pork consumption (or

keeping pigs). We examined data on febrile seizures, perinatal care, family epilepsy history (among first- and second-degree relatives), sickle cell disease, meningitis, measles, and head-injury. Among adults, data on history of hypertension, diabetes, stroke, alcohol consumption and smoking were also collected. Appendix e-1 provides critical aspects of the definition of terms and ascertainment. We obtained information from parents or caregivers; particularly from mothers, where, the participant was a child or cognitively impaired. The research team verified local terms and meanings from the health workers in these communities and from hospital records to get accurate information. UCL Ethics (Project ID: 11229/001) and the National Health and Research Ethics Committee (NHREC) in Nigeria (Protocol Number: NHREC/01/01/2007-4/12/2017) scrutinized and approved the protocol. All subjects or their next of kin gave written informed consent or assent by children explained in local languages.

**Statistical analysis**

We double entered census and screening data into Microsoft Excel (2013), and corrected deviations afterwards. The crude prevalence per 1,000 and the one-year retrospective incidence per 100,000 for each site and pooled estimates were estimated using the *R epitools* epidemiological calculators. The household census figures provided the denominator. Age-standardization to the standard Nigerian population was performed and the age- and sex-specific prevalence rates computed in five-year age-bands. We adjusted the prevalence estimates for non-response and sensitivity of the screening questionnaires. Using the Oxford Poverty and Human Development Index data, we correlated the multidimensional poverty index (MPI) with the prevalence estimates from these sites. The MPI is a function of the intensity

of deprivation at the individual level regarding education, health, living standard, income and employment.[25]

The case-control data was analyzed using Stata 15 (StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC). We used a Chi-squared test to compare categorical variables between cases and controls, and between sites. We used the Wilcoxon-rank sum and the Kruskal-Wallis tests to compare continuous variables between cases and controls and sites. Following univariate analysis, covariates with P-values > 0.2 were removed, and a multivariate logistic regression model fitted to get the odds ratios (ORs) adjusted for age and gender. We did multiple imputations by chained equation (MICE) to deal with missing data and potential non-response bias. Population attributable fractions (PAF) were computed to assess the public health impact and quantify the contribution of factors to epilepsy. PAF assumes the proportional reduction in the disease that would occur if exposure to a risk factor were reduced to an alternative ideal exposure scenario.[26]. We analyzed the pooled data and for the individual sites, stratified based on age into children (< 16 years) and adults (≥ 16 years). We used Venn diagrams to illustrate the distribution of the significant risk factors between sites.

## Results

### Census: Population

We screened 50,438 (25,864 females) persons from 10,449 households from the three sites (average ≈ five persons per household), of whom 42,427 (21,134 males) were aged ≥ 6 years (Afikpo 15.738, Ijebu-Jesa 10,316, Gwandu 16,373) (census detail in Table e-1).

**The first stage, second stage screening and case ascertainment**

Of those screened, 104 (0.7%) were positive in Afikpo, 121 (1.2%) in Ijebu-Jesa and 384 (2.3%) in Gwandu (Table 1). The individual questions' performance and response rates varied between sites, with questions screening mainly convulsive seizures having most positive responses (Table e-2). Of those screen-positive invited for the second stage screening, 61 (58.7%) in Afikpo, 104 (86.5%) in Ijebu-Jesa and 278 (72.4%) in Gwandu effectively made it for assessment. Afikpo had the highest non-response rate of 41.3%, followed by Gwandu (27.6%) and Ijebu-Jesa (13.5%). There was a wide variation in the response rates between wards and communities (Table e-2). By the end of the screening process, 280 (43 in Afikpo, 26 in Ijebu-Jesa and 211 in Gwandu) were diagnosed with lifetime epilepsy and 254 (42 in Afikpo, 24 in Ijebu-Jesa and 188 in Gwandu) persons with active epilepsy (Table 1).

**Prevalence of epilepsy**

Gwandu had the highest crude lifetime prevalence and prevalence of active epilepsy, while Ijebu-Jesa had the lowest (Table 1). With age-standardization and adjustment for attrition and sensitivity, the active epilepsy prevalence increased by 78% in Afikpo, 43% in Ijebu-Jesa, and 54% in Gwandu. The adjusted pooled prevalence from the three sites was 9.8 (8.6–11.1) per 1,000. The adjusted prevalence in Gwandu was 3.7 and 5.4 times higher than in Afikpo and Ijebu-Jesa. The prevalence was marginally higher in males than females in Ijebu-Jesa and Gwandu, while in Afikpo, the prevalence was approximately 40% higher in males (Table 2). The peak prevalence varied between sites, 50–54 years in Afikpo, 25–29 years in Ijebu-Jesa and 10–14 years in Gwandu. When sites' data were pooled, the chart smoothened

out showing bimodal distribution, with the highest peak in the age groups 6–14 years and a second but smaller at 55–59 years (Figure 2).

When we correlated MPI of the respective States with the corresponding prevalence, the MPI was directly proportional to epilepsy prevalence r = 0.86 (95% CI: -0.6–1.0). Table e-4 and Table e-5 shows a list of prevalence studies conducted in Africa and where our estimates lie.

**Incidence of epilepsy**

The estimated one-year crude incidence was highest in Gwandu and lowest in Afikpo. The incidence more than doubled in Afikpo and Gwandu age-standardization and increased by 23% in Ijebu-Jesa. The age-adjusted incidence in Gwandu was seven and 8.4 times higher than in Afikpo and Ijebu-Jesa. Women had a higher one-year crude incidence in Afikpo and Ijebu-Jesa, the difference widened with standardization. In Gwandu, the crude incidence was 12% higher in males and became 40% higher with standardization (Table 3). Figure 3 illustrates a bimodal pattern of the age distribution of one-year incidence combining data from the three sites, with most incident cases occurring in the younger age groups.

**Potential risk factors for epilepsy**

The sociodemographic characteristics of cases and controls by sites is shown in Table e-6. There were no significant age or gender differences between the 252 (females 49.2%) cases and 586 (females 49.1%) controls available for assessment of potential risk factors from the three sites. The most important factor among children (Table e-7) were: febrile seizures (OR 12.64, 95% CI: 4.75–33.58; P < 0.001), meningitis (12.32, 1.84–82.39; P = 0.010), poor perinatal care (10.85, 3.98–29.57; P < 0.001), open defecation (5.12, 1.67–15.65; P = 0.004), measles (4.50,

1.42–14.27; P = 0.011) and family history in first-degree relatives (3.08, 1.05–8.99; P = 0.040). The most important factors for adults (Table e-8) were head injury (14.36, 3.84–53.63; P < 0.001), poor perinatal care (12.09, 5.57–26.24; P < 0.001), febrile seizures (9.33, 4.57–19.06; P < 0.001), family history in second-degree relatives (7.00, 2.11–23.21; P = 0.001) and consanguinity (3.28, 1.74–6.18; P < 0.001). Figure 4 shows that Gwandu had more significant risk factors than other sites. Febrile seizures and poor perinatal care among adults were the most significant factor across the three areas. Simultaneously, a history of measles was important in Afikpo and Gwandu (Details of the results for each site are shown in Table e-9: a-f). Stroke, hypertension, diabetes, sickle cell disease, smoking, and alcohol use were not significant factors. Pork consumption was rare among cases and controls. Factors with higher PAF in children across sites include febrile convulsion (38%), poor perinatal care (29%) and measles (18%). The highest PAF across sites for adults was febrile seizures (39%), followed by poor perinatal care (32%), family history (32%), and measles (21%). Family history of epilepsy for first- and second-degree relatives (39%), consanguinity (21%), open defecation (14%), and meningitis (4%) in children and consanguinity (36%) and meningitis (14%) in adults were higher from Gwandu. The PAF for the use of well water and use of pit latrines varied considerably across sites. The PAF for the two vaccine-preventable diseases (measles and meningitis) combined was 21% and 24% in children and adults. The PAF for the six most important factors in children (febrile seizures, meningitis, poor perinatal care, open defecation, measles and family history first-degree relative) and the five in adults (head injury, poor perinatal care, febrile seizures, family history second-degree relative and consanguinity) accounted for 74.0% (95% CI: 71.0–

76.0%) and 79.0% (95% CI: 75.0–81.0%) (Details of the PAF results are shown in Table e-10 and Table e-11).

## Discussion

Using validated screening tools, a standard criterion for definitions and classifications, with estimates age-standardized and corrected for attrition and sensitivity this work constitutes an essential step in understanding epilepsy in three Nigerian regions. The epilepsy prevalence and incidence varied considerably between sites, substantially higher in Gwandu, Northern Nigerian. Factors most likely linked to epilepsy in children and adults included: febrile seizures, poor perinatal care, family history and childhood measles, while head injury was associated with risk of epilepsy in adults. We observed variable potential risk factors across sites and significantly more in Gwandu, explaining the variability in prevalence and incidence estimates.

The prevalence, we report, falls within the range of estimates reported in Africa.[1] A recent meta-analysis of eight Nigerian studies reported a lower pooled prevalence of (8.0, 6.0-10.0) per thousand compared to the prevalence we report.[27] Our finding of a higher prevalence in childhood and early adulthood is consistent with previous Nigerian studies,[5,6,8,10] and African studies.[13,28,29] The reason for the higher peak prevalence in late adulthood in Afikpo is unknown; the significantly higher risk of head injury among adults may partly explain this.

We provide one of the first estimates of adjusted incidence rates from Nigeria. The higher rates in Gwandu is similar to previous reports,[17,30,31] while the rates from Ijebu-Jesa and Afikpo were much lower than previously reported.[32] The pooled rate was higher than the median and pooled incidence rates from the more recent meta-

analysis.[1] The bimodal peak incidence rates observed is consistent with these reports. The discrepancy between high incidence and the prevalence in Gwandu may suggest higher childhood mortality or premature mortality in people with epilepsy. The reason for the variation in the prevalence and the incidence rates between the sites is not fully known but could be due to differences in risk factors, the dynamics of the recruitment strategy, the size of the population and inherent differences in the population, screened.[4] Stigma may have contributed to the lower estimates in southern Nigeria. Culturally negative attitudes towards epilepsy and mental disorders appear more entrenched among the Yoruba people of Southwest Nigeria.[33,34] The effect of stigma on response to community-based study could be an area of further studies. A likely cultural reason for the lower prevalence of epilepsy in Ijebu-Jesa may be due to the "diagnostic" labels for epilepsy. One particular label in southwest Nigeria is "*Ogun Oru*" (nocturnal warfare); which includes nocturnal seizures and sleep disturbances. It is a common belief for females to be possessed during sleep by a feud between earthly and spiritual spousal interactions.[35] It is culturally not considered an epileptic condition. Women may have been missed during the census, and these socio-cultural contexts should be considered in future studies.

Risk factors like febrile seizures, poor perinatal history, family history and head injury reported are consistent with previous studies.[12-17,21,22] Delay in prompt pre-hospital treatment for conditions such as febrile seizures and the unavailability, inaccessibility and failure to use antenatal care are antecedents for epilepsy particularly among the rural poor and less-educated, worse in Northern Nigeria.[36] Trained traditional birth attendants could help bridge the perinatal care gap.[36]

We found some unique factors. Consanguinity was important among adults in Gwandu, a region with high consanguineous rates.[37] The link between consanguinity and epilepsy is uncertain and the effect of assortative mating needs to be considered. A Jordanian study where consanguinity is common failed to establish a relationship with epilepsy.[38] The association may likely be due to shared genetic, socioeconomic and environmental risk factors. Meningitis was unique to Gwandu, located within the 'meningitis belt' of Africa, where meningococcal meningitis occurs in epidemics with severe consequences.[39] The link between measles and epilepsy in Afikpo and Gwandu is not entirely known. Still, it could be associated with febrile seizures, measles-associated encephalitis and post-encephalitic complications requiring further research. The Integrated Disease Surveillance and Response (IDSR) records showed that measles is still endemic in Nigeria and North-west Nigeria had some of the highest measles attack rates. The attack rate was lower in Ebonyi, but it had one of the highest case fatality rates.[40] The two conditions (measles and meningitis) are vaccine-preventable. Studies have shown that an incomplete immunization history was a significant risk factor for epilepsy.[21] Immunization rates in Nigeria are low, with three out of four Nigerian children unlikely to complete all necessary immunizations; this is far worse in northern Nigeria.[41, 42] Ineffective primary health care services and the logistics in the supply of vaccines affect coverage. Still, the greatest challenge to accepting immunization is a religious one, especially amongst northern Nigerian Muslims. Vaccination programs in the past have been hampered by religious extremism targeting immunization workers.[41] The role open defecation has on epilepsy among children in Gwandu is unknown. Reports from rural India and Peru failed to identify a clear association.[43-45] Open defecation may simply reflect lower SES and sanitation associated with a parasitic

infestation. Pork consumption and keeping pigs as a possible risk factor of neurocysticercosis was rare in this study. Neurocysticercosis often goes undiagnosed in SSA because of the lack of neuroimaging facilities. Parasite control programs could help prevent development of epilepsy, but the potential impact needs assessing in future studies.[46] Reports have shown that epilepsy occurrence reduced years after implementing Community-Directed Treatment with Ivermectin.[47] Northwest Nigeria has one of the worse MPIs and may explain why Gwandu had more significant risk factors and possibly higher prevalence and incidence. The MPI is a function of educational attainment and economic capacity influenced by socio-cultural and religious aspects.[25] Epilepsy is now considered a condition associated with low SES and social deprivation.[20] It was challenging to assess socioeconomic needs in this work, as most did not respond to monthly income questions. Non-response is typical and predictable.[48] For future studies, consumption-based rather than monetary-based expenditure should be assessed as this may be a more consistent predictor of SES. Income-based measures for appraising living standards in rural SSA can be problematic due to the seasonal variation.

Head injury was positively associated with epilepsy in adults from Gwandu and Afikpo. Studies have reported an increase in head injuries due to commercial motorbike accidents and enforcement of wearing crash helmets could help.[49, 50]

**Limitations:** The door-to-door design, despite its advantages, has inherent limitations and subjectivity. Despite correcting attrition, the variability of non-response between the sites may have influenced the differences in the estimates. The reason for some of these differences may have been affected by stigma as highlighted. We combined data from the three sites to get a 'national' figure. The combined figures should be interpreted with caution because of the heterogeneity

between sites and the marked difference in the total number diagnosed with epilepsy. Gwandu has a larger number of cases recruited and may have increased overall national estimates and led to increased risk factors. The incidence rate we found may be challenged, as the follow-up time is relatively short to get a reliable incidence estimate as to the disease process's dynamics over a short period is uncertain. The exclusion of children less than six years of age was done to address the concern of including children with febrile convulsions only may have led to an underestimate.

The inherent limitation of every case-control design, which includes the potential for recall bias and the historical reliability of the information, especially for febrile seizures, meningitis, measles and perinatal issues in adults is acknowledged. This systematic error may lead to wrong estimates of the association. The sample size, particularly from Ijebu-Jesa and Afikpo, could be faulted, as they may be inadequate to provide reliable information about the importance of each risk factor. The lack of serological and neuroimaging tests to investigate parasitic infestation such as neurocysticercosis and onchocerciasis was a limitation. Absence of neuroimaging also limited the investigations of strokes, brain tumors, and space-occupying lesion as causes of epilepsy. PAF is useful from a public health perspective for preventable factors, buts its limitations must be considered. A large PAF may simply reflect a broad exposure rather than any valuable measure of causality, and the cumulative PAF from individual exposures considered one at a time usually exceeds 100%.[26]

**Conclusion**

We showed that the prevalence and incidence estimates vary across sites, which may be due to differences in risk factors. Febrile seizures, poor perinatal care, family

history, measles, meningitis, open defecation, consanguinity and head injury were significant factors in this study with substantial PAF. These findings suggest a need for targeted preventive interventions taking into cognizance these differences. Research is required to understand how the various risk factors interact in the complex etiology across sites; however, this can only reliably be done in a cohort study. The extent a risk factor can be determined depends on the diagnostic facilities and resources available, which vary across regions. With about 50,000 contacted, they could be an excellent resource for a future cohort study.

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**Figure 1: Map of Nigeria showing the sites and summary of their characteristics**

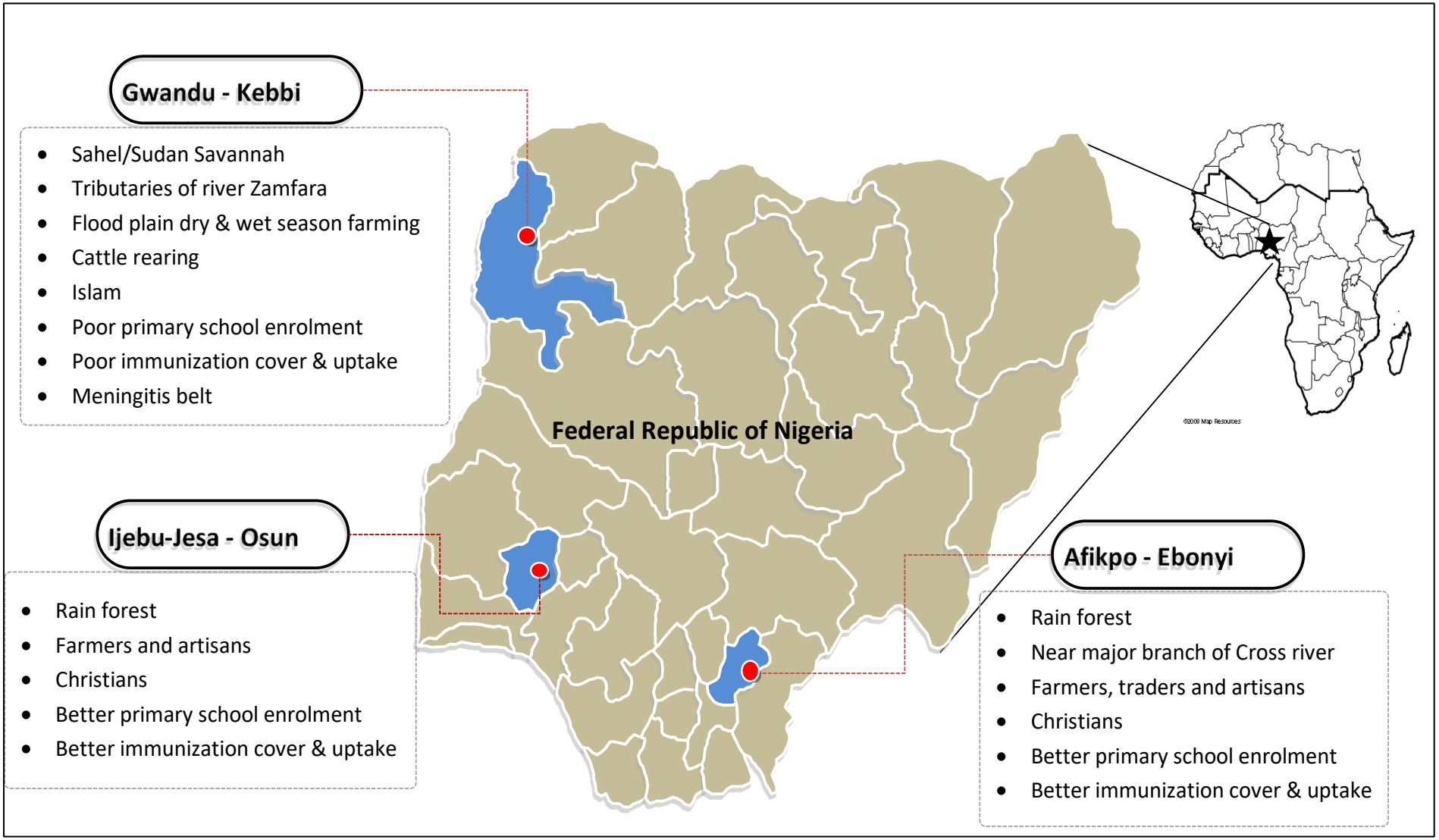

**Table 1: Prevalence of epilepsy from the three sites**

| Sites | **Population (≥ 6 years)** | **Number positive stage 1** | **Responded and screened in stage 2** | **Gender response (females)** | **Diagnosed after stage 2** | **Crude Lifetime prevalence (per 1,000)** | **Crude prevalence active epilepsy (per 1,000)** | **Age standardized Prevalence of active epilepsy** | **Prevalence of active epilepsy adjusted for attrition and sensitivity (per 1,000)** | **Prevalence ratios** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Afikpo** | 15,738 | 104 (0.7%) | 61 (58.7%) | 57.4% | 43 (70.5%) | 2.7 (2.0–3.7) | 2.7 (2.0–3.6) | 2.5 (1.8–3.5) | 4.8 (3.4–6.6) | 1.0 |
| **Ijebu-Jesa** | 10,316 | 121 (1.2%) | 104 (86.5%) | 51.0% | 26 (25.0%) | 2.5 (1.7–3.7) | 2.3 (1.6–3.5) | 2.6 (1.6–4.0) | 3.3 (2.0–5.1) | 0.7 (0.4–1.1) |
| **Gwandu** | 16,373 | 384 (2.3%) | 278 (72.4%) | 41.7% | 211 (75.9%) | 12.9 (11.3–14.7) | 11.5 (10.0–13.2) | 11.5 (9.8–13.5) | 17.7 (14.2–20.6) | 3.7 (3.0–4.3) |
| **Total** | 42,427 | 609 (1.4%) | 443 (72.7%) | 50.0% | 280 (63.2%) | 6.6 (5.9–7.4) | 6.0 (5.3–6.8) | 6.2 (5.5–7.1) | 9.8 (8.6–11.1) | - |

The Nigerian census figure of 2006 was used for the age standardization. Attrition was corrected by dividing with a factor of 0.587, 0.865 and 0.724 for Afikpo, Ijebu-Jesa and Gwandu. For the total (combined) dataset, attrition was corrected by calculating a weighted attrition factor based on the number of subjects per regions [Attrition_factor = (#N_regionX * 0.587 + #N_regionY * 0.865 + #N_regionZ * 0.724) / #N_total = 0.7075]. The values were also adjusted for the screening questionnaire's sensitivity, dividing by a factor of 0.9. Percentages are those of the preceding column. Figures in parenthesis are the 95% confidence intervals.

**Table 2: Prevalence of lifetime and active epilepsy by site and gender**

| Gender | Total number of people Screened | Age-standardized lifetime prevalence adjusted for attrition and sensitivity (95% CI) | Age-standardized prevalence of active epilepsy adjusted for attrition and sensitivity (95% CI) | Prevalence Ratio of active epilepsy (95% CI) |
|---|---|---|---|---|
| **Afikpo** | 15,738 | 4.8 (3.5–6.7) | 4.8 (3.4–6.6) | |
| **Female** | 8,019 | 4.5 (2.7–7.3) | 4.3 (2.6–7.1) | 1.0 |
| **Male** | 7,719 | 4.9 (3.1–8.2) | 5.9 (3.7–9.0) | 1.4 (0.9–2.1) |
| **Ijebu-jesa** | 10,316 | 3.6 (2.3–5.4) | 3.3 (2.0–5.1) | |
| **Female** | 5,398 | 3.2 (1.6–6.0) | 3.2 (1.6–6.0) | 1.0 |
| **Male** | 4,918 | 3.9 (2.1–7.1) | 3.3 (1.6–6.3) | 1.03 (0.5–2.0) |
| **Gwandu** | 16,373 | 19.8 (17.1–22.9) | 17.7 (14.2–20.6) | |
| **Female** | 7,876 | 17.1 (13.7–21.4) | 16.7 (13.3–20.9) | 1.0 |
| **Male** | 8,497 | 22.6 (18.4–27.7) | 17.9 (14.2–22.5) | 1.07 (0.9–1.3) |
| **Combined** | 42,427 | 10.8 (9.6–12.3) | 9.8 (8.6–11.1) | |
| **Female** | 21,293 | 9.4 (7.8–11.3) | 9.3 (7.7–11.2) | 1.0 |
| **Male** | 21,134 | 12.6 (10.6–15.0) | 10.2 (8.4–12.4) | 1.1 (0.9–1.3) |

CI – confidence interval

**Figure 2: Prevalence of active epilepsy by age group for each site and combined**

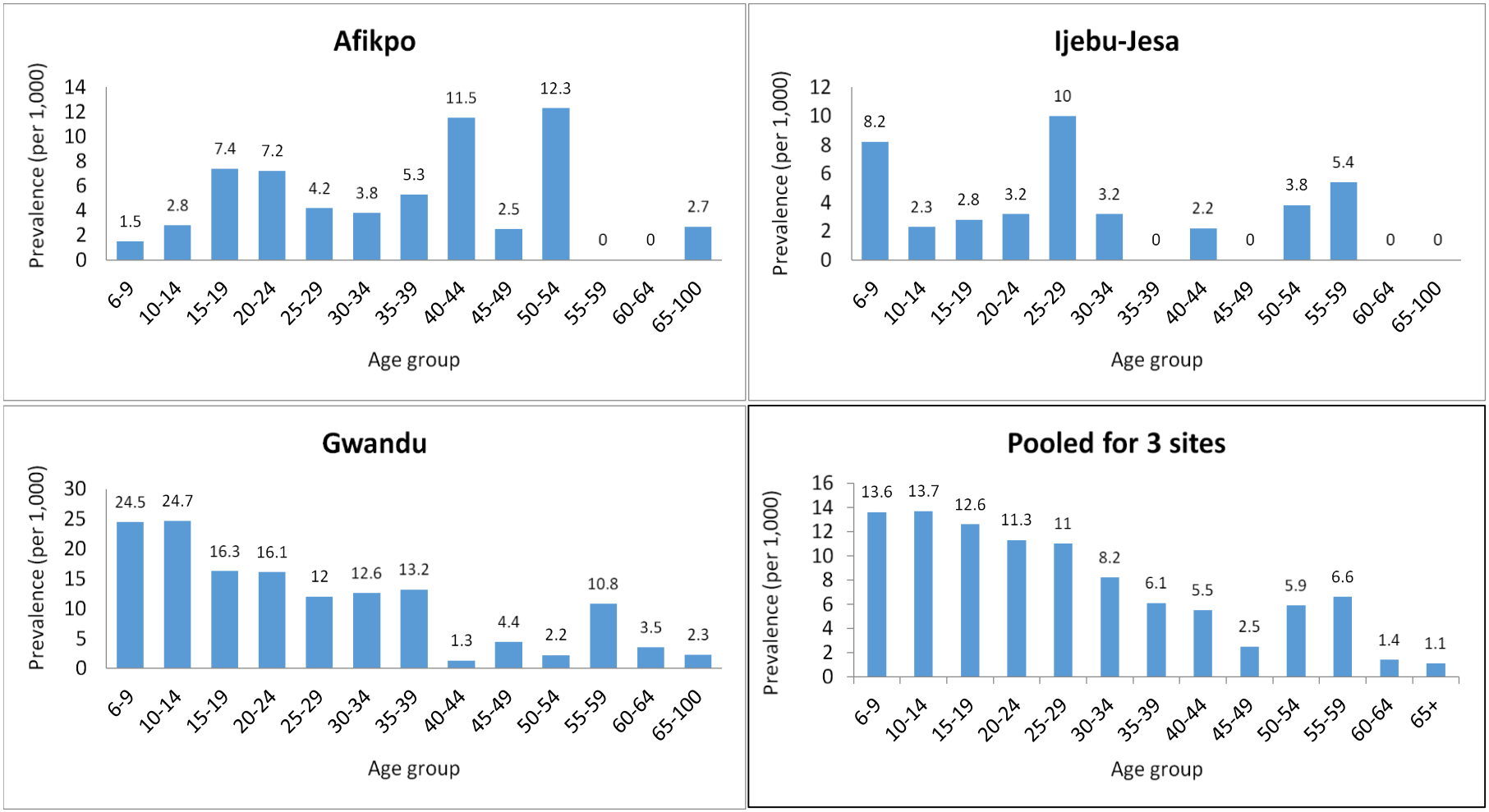

**Table 3: One-year retrospective incidence by center and gender**

| | Total Screened | Number of new cases | Crude one-year incidence (95% CI)* | Age-standardized incidence (95 % CI)* |
|---|---|---|---|---|
| **Afikpo** | 15,738 | 2 | 12.7 (3.5–46.3) | 27.6 (3.3–128.0) |
| **Female** | 7,719 | 1 | 13.0 (2.3–73.4) | 33.0 (0.8–199.6) |
| **Male** | 8,019 | 1 | 12.5 (2.2–70.6) | 25.6 (0.6–263.2) |
| **Ijebu-Jesa** | 10,316 | 2 | 19.4 (5.3–70.7) | 23.9 (3.2–157.0) |
| **Female** | 5,398 | 2 | 37.1 (10.2–135.0) | 76.5 (5.7–348.8) |
| **Male** | 4,918 | 0 | 0.0 | 0.0 |
| **Gwandu** | 16,373 | 14 | 85.5 (50.9–143.5) | 201.2 (105.0–358.9) |
| **Female** | 7,876 | 6 | 76.2 (34.9–166.1) | 168.3 (56.9–397.2) |
| **Male** | 8,497 | 8 | 94.2 (47.7–185.7) | 236.7 (92.3–518.8) |
| **Total (combined)** | 42,427 | 18 | 42.4 (26.8–67.1) | 101.3 (57.9–167.6) |
| **Female** | 21,293 | 9 | 42.3 (22.2–80.3) | 95.1 (41.5–191.0) |
| **Male** | 21,134 | 9 | 42.6 (22.4–80.9) | 110.4 (46.5–230.7) |

**Per 100,000; CI – Confidence intervals.*

**Figure 3: Pooled retrospective incidence by age group**

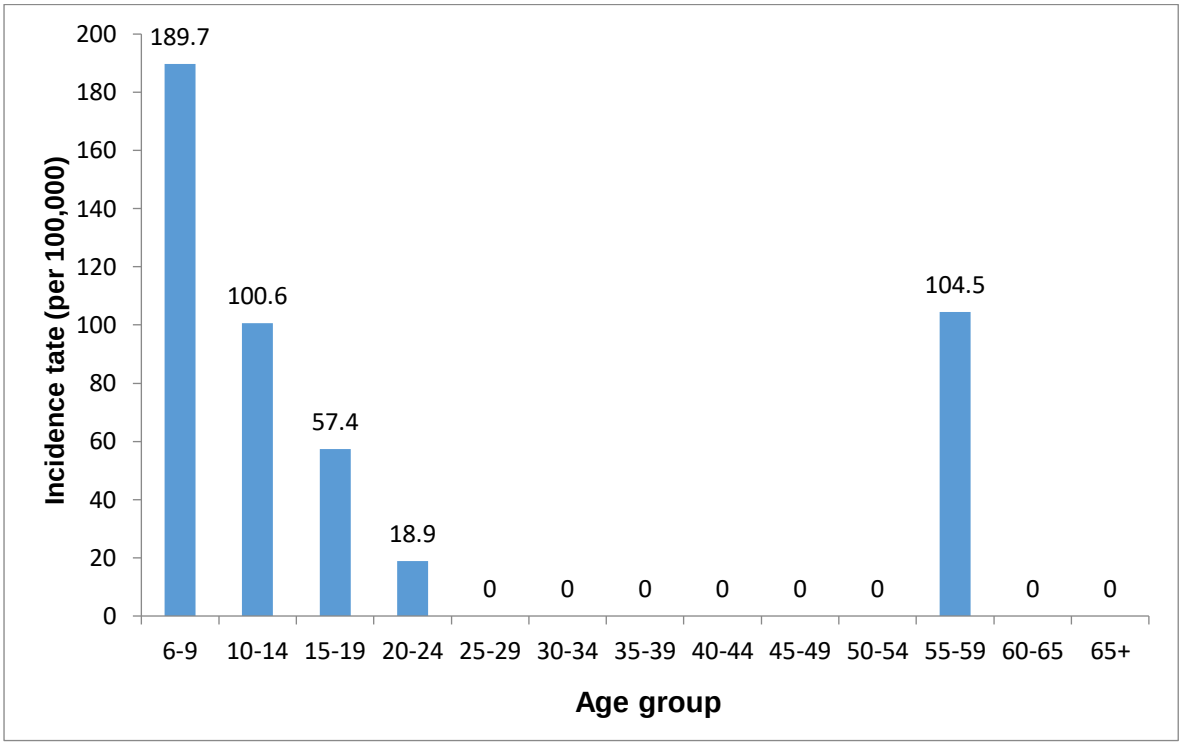

**Figure 4: Venn diagram illustrating the distribution of important risk factors across sites**