UNIVERSITY OF LAGOS, NIGERIA

Inaugural Lecture Series 2015

TOPIC:

THE AFRICAN BRAIN: EFFECTS OF AFRICAN ENVIRONMENT ON BRAIN DISEASES

By
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An Inaugural Lecture Delivered at the University of Lagos Main Auditorium on Wednesday, 5th August, 2015

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University of Lagos Press and Bookshop Ltd

Published

By

University of Lagos Press and Bookshop Ltd
Works and Physical Planning Complex
University of Lagos
Akoka, Yaba-Lagos
Nigeria.
Unilag P.O. Box 132

ISSN: 1119-4456

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Our dear students
Distinguished guests
Distinguished ladies and gentlemen

INTRODUCTION

I welcome you all to this inaugural lecture. This has been long overdue but I am glad to finally deliver it. I am extremely grateful to the Vice-Chancellor for giving his approval to deliver this lecture.

This is the first Inaugural lecture in the field of Clinical Neurology to be delivered at the University of Lagos.

WHAT IS CLINICAL NEUROLOGY?

Clinical Neurology is a specialty devoted to the diagnosis and Medical treatment of brain diseases as distinct from Psychiatry which is devoted to the treatment of mental illness. In many parts of the world, Neurology is a Department of its own. In USA for example, a Neurology Department is usually as big as Internal Medicine department. However, in Nigerian Institutions, Neurology, if at all available, is a unit in the Department of Medicine. Also, Psychiatry has its own separate department in Nigeria. Therefore, Neurology, as a specialty is still very much underdeveloped in Nigeria.

Neuroscience is the scientific study of the brain. It is an indispensable part of what Neurologists must be conversant with to be effective.

HYPOTHESIS FOR THE INAUGURAL LECTURE

This lecture addresses the hypothesis that African environments affect brain diseases. African environment implies both **Social and Physical Environments** in Sub-Saharan Africa. The lecture will therefore explore and discuss how **the Social and Physical environments** of Sub-Saharan Africa affect the occurrence, presentations, consequences, treatments, prevention and outcome of brain diseases in Africa.

AFRICAN SOCIAL ENVIRONMENT AND BRAIN DISEASES

Social environment is defined as the actual living conditions; (such as poverty, overcrowding etc.) as well as the norms, values, beliefs and attitudes that reflect a particular social and cultural context. To illustrate how African social environment affects brain diseases, **Epilepsy** will be used as the main model of a brain disease. Other brain diseases like *Tetanus*, *Neuro-AIDS*, and *Stroke* will also be briefly discussed.

Epilepsy

Epilepsy is a common brain disease which is usually characterized by repeated epileptic seizures. Epileptic seizures are disruptions of normal brain activities resulting in abnormalities ranging from brief loss of awareness to frank convulsions. They are usually caused by *paroxysmal (random) electrical discharges of hyper excitable brain cells* which cause disturbance of the activities of normal brain cells.

History of Epilepsy

Due to its dramatic intermittent nature; epilepsy has been shrouded in mysticism for many centuries. The Greeks considered epilepsy to be a "diseases of the gods," believing that only the gods could make someone unconscious, convulse and then recover completely from the attack. However, in 450 B.C., Hippocrates (usually referred to as the father of Medicine) disputed this line of thinking, proposing that epilepsy was caused by abnormalities of the brain. During the time of Jesus Christ, it was popularly believed that epilepsy was due to possession by demons or evil spirits. This is illustrated in the bible story detailing how Jesus Christ cast away the demons from an epileptic patient having a seizure.

In medieval Europe, epilepsy was known as the 'falling sickness' and was often ascribed to possession by evil spirits. Later, it was generally considered to be a mental illness until the 19th Century when the biological basis was proven. It was then reconsidered to be a Brain Disease just as Hippocrates suggested over 2,400 years earlier.

Epilepsy in Sub-Saharan Africa

In sub-Saharan Africa, the supernatural views still dominate the thinking about epilepsy. There are many wrong beliefs about epilepsy and negative attitudes towards epileptic patients with devastating consequences. To investigate the extent of this in Nigeria; a number of studies were undertaken in Lagos to evaluate the beliefs and attitudes of Nigerians regarding epilepsy and their consequences for epileptic patients.

A survey of Adult illiterate Nigerians in Lagos demonstrated these wrong beliefs and negative attitudes as most of them believed that epilepsy was due to

possession by demons or evil spirits. Moreover, most of them held the belief that epilepsy is contagious and can be acquired by contact with the saliva of epileptic patients. They therefore avoid contact with any person known to be epileptic.[1]

Further studies showed that general education did not appear to improve these wrong beliefs and negative attitudes. A study on Secondary School teachers' perspectives on epilepsy showed they had same wrong beliefs and poor attitudes. Most of them similarly held the belief that epilepsy is contagious and would expel from school any child who had a seizure at school to prevent the child from, "infecting other children" with epilepsy.[2,3]

A survey of employers of labour showed similar wrong beliefs and negative attitudes regarding epilepsy: over 90% of them would not employ any person known to be epileptic and would dismiss any worker who had an epileptic seizure at work.[4] About one third of them believed that epilepsy is contagious and would avoid contact with epileptic patients. Even health workers in a hospital are not exempted from this belief system.

Some time ago, in the staff dining room of a Teaching Hospital, one of the serving stewards had a seizure while people were taking their lunch. All the members of staff that were eating in the dining room ran away. Later on the Staff Unions met the management and insisted that the steward should be sacked to prevent him from infecting other workers with epilepsy.[5] Some educated epileptic patients sometimes even share the belief that epilepsy is contagious: An engineer once asked me after EEG confirmation (**Electroencephalogram confirmation**) of his epilepsy whether he could still kiss his wife; believing that epilepsy was contagious and did not want

to infect his wife. Medical Practitioners therefore have a duty to educate patients and the public about epilepsy. To do this effectively, the Practitioners must have sufficient knowledge about epilepsy. Unfortunately most practicing doctors do not have such knowledge.

In a survey of doctors in Lagos, over half of them admitted to not having sufficient knowledge about epilepsy. Most of them also displayed some of the prejudices shown by the general public.[6] Education of general doctors by Neurologists to improve their knowledge of epilepsy is therefore of utmost priority.

EXEMPTION TO THE RULES REGARDING THE USUAL NEGATIVE ATTITUDES IN AFRICA

The negative attitudes towards epileptic patients are all pervading in most countries of Sub-Saharan Africa. However, a notable exception is Senegal where epileptic patients are regarded as, 'Spiritual holy men' and are revered and even worshipped. I have often wondered why this is not so in Nigeria. This is because in Nigeria, one of the most effective ways a Traditional Medical Practitioner or a Sorcerer can demonstrate his power before a client is to 'consult the Ancestors'. This he does by going into a trance or 'simulated epileptic seizure.' When he comes out of it, he delivers the message from 'the Ancestors.' Similarly, some spiritualists in certain Christian sects, when consulted by a client go into such 'simulated seizures' to consult 'the Holy Spirit' and equally emerge from the seizure to declare what "the Holy Spirit" said.

CONSEQUENCES OF SOCIETAL ATTITUDES TOWARDS EPILEPSY

Patient Perspectives on Epilepsy

In a survey of epileptic patients in Lagos, to evaluate how they perceive their epilepsy, most of them felt stigmatized by the condition.[7] Over 75% of them felt that people generally fear epilepsy and avoid contact with epileptic patients. Consequently most of them would not accept the diagnosis of epilepsy if they were told by their doctor that they had epilepsy. Many of them would accept other diagnosis such as, 'convulsions' called 'Giri' in Yoruba dialect which is socially more acceptable than epilepsy - "Warapa" in the Yoruba dialect. Even among those who accept the diagnosis of epilepsy, over 70% would hide their epilepsy and would not disclose the conditions to others including their close friends. Many of the patients usually feel offended if we insisted that they had epilepsy but would accept any other diagnosis. In Lagos, we now generally use the term, 'seizure disorders,' instead of epilepsy.

SOCIAL PROBLEMS OF EPILEPTIC PATIENTS

Judging by the negative attitudes of the public regarding epilepsy; we set out to evaluate the social problems of Adolescent and Adult Nigerian epileptic patients including problems associated with schooling, social interaction, occupation and employment.[8]

Schooling

Most of the adolescent epileptic patients evaluated attended or were attending schools; only very few never attended school. Poor performance, poor school attendance and premature withdrawal from school were the adverse effects of epilepsy on epileptic patients. Among those attending school 63%, were withdrawn

prematurely from school by their parents on account of frequent seizures and the fear that their family name might be brought into public disrepute if their children had epileptic seizures in the public (while in school).

Interestingly, despite teachers' negative attitudes towards epilepsy; only 13% of the epileptic children were expelled from school by their teachers. Those affected were presumably those who had seizures while in school.

Social Interaction

Despite societal unfavourable attitudes towards epilepsy, over 75% of the epileptic patients had good social interaction. Only 17% of them lost their friends and 8% didn't interact because they were scared of rejection. This is very different from the picture painted by earlier writers in Africa who wrote that epileptic patients were treated by the public as outcasts.

A very important observation in the study was the strong family support which most of the epileptic patients had. This was a psychosocial stabilizing factor in their life and is a reflection of the nature of African family which is characterized by strong family bond.

Employment

Despite the negative attitudes of Employers regarding epilepsy, over 90% of the epileptic patients we studied were working[4,8]: over 65% of them were employed in public or private organizations while 25% were self-employed. This paradox of their being employed despite the negative attitudes of employers towards epilepsy is explained by the fact that most of them did not accept that they had epilepsy in the first place and even those who accepted hid it and did not disclosed their condition to their employers. Although their non-acceptance of

epilepsy, as well as, their hiding the condition protected them from being jobless, it exposed them to the hazards of doing dangerous jobs not recommended for epileptic patients: 33% worked with machines and 25% drove motor vehicles including taxis and commercial buses. These are challenges that must be addressed in the interest of safety of the patients and the public.

Psychological Problems

Because most epileptic patients feel stigmatized by the disorders; depression may occur as a consequence. In a study of epileptic patients in Lagos using Zung Depression self-rating Scale, depression was found in 26% of the epileptic patients compared to 9.7% of controls.[9] Careful handling of epileptic patients is therefore very important. Some time ago one of my patient with epilepsy, a young girl was seen in an emergency outpatient clinic by a general doctor following series of seizures. The doctor in an apparent attempt to educate the patient told her that she had an incurable disease and would therefore be required to take treatment for life. The patient then thought that there was no need to continue to live if she had an incurable disease so, she committed suicide.

AFRICAN SOCIAL ENVIRONMENT AND TREATMENTS OF EPILEPSY

First Aid Measures in a Convulsing Epileptic Patient

For the purpose of first aid, it is usually advised that when an epileptic patient is having a generalized convulsive seizure, the area should be cleared of harmful substances such as nails or broken bottles. Worn items such as a tie should be loosened and eye glasses should be removed. The patient should then be left alone for the seizure to run its course.

Most convulsive seizures usually last not more than 3 minutes with post-ictal sleep for another 5 minutes. In Nigeria however, most people would run away when they encounter an epileptic patient having convulsion on the street. Those who don't run away but want to help the patient usually give wrong first aid measures. Sometimes, they would hold the patient down forcibly and injure the poor patient. Moreover, there is the popular belief that if the teeth of a convulsing epileptic patient are allowed to touch each other, the patient will die. Therefore, any object available ranging from a spoon to a stick are usually inserted between the teeth with disastrous consequence ranging from the object breaking the teeth or choking the patient. A young girl who had a seizure in public was given such wrong first aid: one of her shoes was inserted into her mouth, consequentially, the shoe choked her to death.

ROUTINE TREATMENT OF EPILEPSY

The Use of Alternative Medicine by Epileptic Patients

In contrast to developed countries which have unitary system of science based Medicines with alternative Medicine at the fringe, African Traditional Medicine competes with or complements the Western types of Medicine in African countries.[10] The health seeking behaviour of Africans evidences the multiple systems of medical care available. Patients with epilepsy in Nigeria show strong preferences for traditional Medicine over orthodox Medicine especially in rural areas. In many African countries epilepsy is believed to have supernatural causes such as visitation by evil spirits or effects of witchcraft; traditional medicine and spiritual healing are therefore widely used by epileptic patients. To assess the use of these alternative treatments modalities in Nigeria, 265 epileptic patients in Lagos,

were evaluated for their health seeking behaviour, use of African Traditional Medicine and Spiritual healing.[11]

African Traditional Medicine

Result showed that 71.7% had used African Traditional Medicine (47.6% alone, 24.1% in combination with Spiritual Healing) for 1 to 5 years before seeking orthodox medical treatment in the hospital. The African Traditional Medicine used by most patients consisted mainly of Herbal preparations for drinking, although a few patients used other modalities such as ritual sacrifices, incantations, and wearing of charms.

Most of the herbal preparations were decoctions made by boiling different herbs in a pot of water. Many of them were probably harmless. A notable harmful preparation among them was a cold infusion using cow's urine. The infusion contained several herbs including onion bulbs, bark and stem of trees, and most importantly tobacco leaves. The cow's urine served as a source of ammonia which, with the corn-steeped Liquor assisted in extracting the Ether Extractable Alkaloids from the onion bulbs. Many convulsing children who ingested cow's urine preparations developed brain damage. According to a study in Ibadan,[12] the toxicity was not due to cow's urine but from nicotine poisoning from the extracts of the tobacco leaves. Cow's urine preparation is therefore very dangerous and should never be used.

Most of the patients who had earlier used African traditional Medicines abandoned their use after commencing the more efficacious anti-epileptic drug treatment: only 14.6% continued to use them.

Type of alternative medicine	n/% of total (n = 265)
Traditional medicine	190/71.7
Herbal therapy	190/71.7
Herbs to drink	173/65.0
Herbal baths	74/28.0
Cow's urine preparation	5/1.9
Herbs rubbed on scarification	19/7.2
Nonherbal traditional medicine therapy	28/10.5
Protective charms	3/1.1
Magical forms of therapy	25/9.4
Spiritual healing	118/44.5
Fasting and prayer	91/34.3
Use of holy water	62/23.4
Use of holy oil	32/12.1
Islamic spiritual healing	24/9.1
Faith healing	7/2.6
Use of "green water"	5/1.9
Exorcism	3/1.1
Combined traditional/spiritual healing	64/24.1
Other treatments	21/7.5
Acupuncture	9/3.4
Homeopathy	6/2.3
Nature cure	2/0.75
Combinations of several	4/1.5

Fig. 1: Types of Alternative Medicines and the Percentage of Users

Spiritual Healing

Since epilepsy is often regarded as a manifestation of possession by evil spirits or effects of witchcraft, the management of epilepsy is commonly assumed to be in the domain of spiritual healers who hold out the attractive promise of a complete cure of the epilepsy by magical spiritual therapies. Spiritual healers are magico-religious practitioners whose therapeutic powers derive mainly from the fact that the patients believe they have supernatural healing powers.

Most patients who consult spiritual healers have faith that the healers possess special powers, 'to deal' with the 'evil spirits or other evil forces' disturbing them. About

44.5% had used Spiritual healing (20.4% alone and 24.1% in combination with Traditional Medicine) for 1to 5 years before seeking hospital treatment. Most patients were treated in spiritual healing houses or spiritual churches where they engaged in worship healing activities such as singing and dancing, spirit possession, exorcism, fasting, prayers and use of holy water.

Occasionally some spiritualist may perform magical feats to impress their clients. One epileptic patient who consulted a spiritualist told me that he was told by him that his enemies had planted two reptiles inside his body; one moving up and the other one moving down. Whenever they jam each other; he would have epileptic seizures. Consequently, he went ahead to remove the reptiles from his body. Although he saw the 2 reptiles when they were removed; he however still continued to have epileptic seizures, hence, he consulted me. Although spiritual healing does not stop the epileptic seizures, most patients appeared to derive considerable psychological satisfaction from them.

In this study, over 72% of the epileptic patients who had earlier used spiritual healing continued to use these forms of treatment in combination with hospital treatments. This is so because they derived certain benefits from spiritual healing not provided by orthodox hospital treatment with Anti-Epileptic Drugs (AEDs). However most of them tended to discontinue AEDs while receiving treatment in spiritual homes because they were told they had spiritual attacks and not epilepsy. We treated several of such patients after they developed Epileptic crisis (Status Epilepticus) while in spiritual homes and were rushed to the hospital emergency by their relatives. Because of its psychotherapeutic value; spiritual healing cannot be said to be irrelevant in the

treatment of epilepsy in Africa. We do not discourage their use by epileptic patients but we usually advise the patients to continue taking anti-epileptic drugs as well.

The Influence of Social Network on Epileptic patients

In our study, the influence of family members, friends and neighbours on health seeking behaviour was striking: most of the epileptic patients sought traditional Medicine or spiritual healing on the advice of friends, neighbours or relatives. This is a common observation all over the world but is particularly striking in Africa.

Sociologists like Igun and Janzen independently demonstrated that the process of becoming a patient and availing oneself of use of various health services encompasses a series of decisions and events involving interactions of several person including family, friends and professionals.[13,14] In African situations, the family is not only involved in decision making, but also tends to become involved in the therapeutic process at every stage of a member's illness. The influence of social network in health seeking behaviour of Africans therefore, underscores the need to promote epilepsy education programmes not only amongst patients and their relatives but also amongst the general public in Africa to educate the public on the causes of epilepsy and the value of hospital treatment with anti-epileptic drug treatment.

ORTHODOX DRUG TREATMENT IN HOSPITAL

Delivery of Epilepsy Care in Nigeria[15]

Primary Care and Epilepsy

The primary healthcare service of the national health system is provided by the local governments. These

include village healthcare clinics and district health centres. Services at the village Clinics are provided by Community Health Officers.

In primary healthcare setting in Nigeria, there are no drugs for treatment of epilepsy (AEDs) or even acute convulsions on the official drug list of the village dispensary. Patients with convulsion cannot therefore be treated in village health clinics and are usually referred to district health centres. At the district health centre health workers can only treat acute convulsions with *paraldehyde* or *diazepam* but theycannot treat epileptic seizures. Suspected cases of epilepsy are referred to the general hospital, which may be several kilometers away. This is an obvious deficiency that contributes to poor utilization of hospital treatment by epileptic patients.

Secondary Health Care and Epilepsy: State Governments are responsible for secondary healthcare. The state general hospitals serve as referral centres for the district health centres. There is a full range of AEDs in the essential drugs list for secondary care levels. Of these, *Phenobarbital* and *Phenytoin* are readily affordable while *Carbamazepine* and *Sodium Valproate* are too expensive for the majority of patients.
There are no facilities for investigations such as EEG and patients are usually referred to Tertiary hospitals for such investigations.

Tertiary Health Care and Epilepsy
There are many Teaching Hospitals and Neuropsychiatric hospitals providing tertiary care for epileptic patients in Nigeria. Most routine AEDs are available in tertiary care centres, but high cost of certain drugs like *Valproate* is a limitation for poor patients.

Majority of epileptic patients in tertiary centres are seen as out-patients. Admissions for epilepsy are uncommon. There are no special centres for epilepsy in Nigeria. The development of efficient tertiary care for epilepsy in Nigeria is hampered by the inadequacy of specialists in clinical Neurology and poor funding.

Private Medical Practitioners

Individuals and private groups own over one third of health establishments in Nigeria. These profit health facilities are most often staffed by a single medical doctor in solo practice. Some private hospitals have more than one doctor. Private Hospitals are mostly concentrated in urban areas with very few in rural areas. Most cases of epilepsy in urban areas seen by general practitioners in private practice are usually promptly referred to Tertiary Hospitals. Many private practitioners are not willing to manage epileptic patients on their own because of their poor knowledge of epilepsy.

Doctors' attitude to management of epilepsies

Suggested attitudes	*Number*	*% of total*
Satisfied with their knowledge about management about epilepsy	32	20.6
Would accept responsibility to manage an epileptic patient	102	65.8
Would refer epileptic patients to Physician/Neurologist	155	100
Would initiate anti-epileptic drugs before referring to Physician/Neurologist	142	91.5
Would initiate treatment with Phenobab	104	67
Would initiate treatment with Carbamazepine	4	2.5
Would initiate treatment with Sodium Valpreate	12	7.8
Would initiate treatment with Diazepam	29	18.7
Would initiate treatment with Chlorpromazine	6	3.9

Fig. 2: Doctors' Attitude to Management of Epilepsies

Health Financing System: There are no effective health insurance systems in Nigeria. Patients therefore pay for

healthcare cost from their pockets. One legacy of Economic Austerity Programmes such as the Structural Adjustment Programme (SAP) introduced in Sub-Saharan Africa is the widespread institution of "user fees" in public health institutions; for health services that were formerly free of charge, with the intention of generating revenue for the health sector. Instead of revitalizing the health sector however, user fees often sharply reduce the ability of the poor to access medical care.

Through the BAMAKO initiative in 1987 drug revolving fund was established. This consists of provision of drugs to district and village health management committees. These drugs are then sold to the public at a profit which is then theoretically used to buy back the initial stock of drugs. Apart from the fact that antiepileptic drugs are unavailable in village and district health centres; experience has shown that many poor epileptic patients are unable to purchase good quality anti-epileptic drugs in sufficient quantities to maintain drug compliance. This contributes to poor control of their seizures.

Underemployment and Income of Epileptic Patients

Although, most of the epileptic patients in our survey were employed; they were most often in low income group because most of them had low education as a result of premature withdrawal from school. This has an affect on their ability to purchase antiepileptic drugs and many of them could not afford regular antiepileptic drugs. This often resulted in non-compliance with their drugs and poor seizure control as a consequence.

Prognosis of Epilepsy Following Treatment

In developed countries, a one year seizure remission rate of between 58% and 95% has been reported. In a study of epileptic patients in Lagos, only 36.5% were seizure

free after 2 years of treatment.[16] The poor rate of seizure control among our patients is due to poor drug compliance.

Many epileptic patients were not compliant with antiepileptic drugs because of poverty and inability to purchase drugs regularly as stated above. Many Epileptic patients therefore need help. Making antiepileptic drugs very cheap by subsidizing their cost would help many epileptic patients in Africa obtain regular treatment.

Epilepsy Treatment Gap in Sub-Saharan Africa: In sub-Saharan Africa a very high percentage of patients with epilepsy may not receive any treatment at all. As a consequence, they continue to experience morbidity related to seizures and the psychological consequence of stigma and discrimination. Treatment gap is usually defined as, "the difference between the number of people with active epilepsy and the number whose seizures are being appropriately treated in a given population at a given point in time expressed in percentage."[17] The reported size of the treatment gap of epilepsy varies from 70.3% to 98%.[18]

Leading Causes of Treatment Gap include:

1. Inadequate supplies and prohibitive cost of anti-epileptic medications.
2. Lack of primary health workers trained in diagnosis and treatment of epilepsy.
3. Limited access to health facilities particularly in rural areas.
4. Social stigma, misinformation and traditional beliefs.

Cultural and Structural Factors

Cultural values affect people's health seeking behaviour. If people see epilepsy as being caused by something that

is not natural or biomedical, then, treatments through Western Medicine may not be sought. In many African countries since epilepsy is perceived as a manifestation of supernatural forces, the family and patient first consult the traditional healers and follow their recommendation for a long period of time.

As demonstrated in our study, the mean duration before seeking modern medical care can be several years. Specialist care for epilepsy is usually unavailable at the community level and patients frequently need to travel long distances for proper diagnosis and treatment. The median number of neurologists in Sub-Saharan Africa is estimated to be 3 per 10 million populations.[19] This is in contrast to Europe where there are 484 neurologists per 10 million populations.[20] Because of deficiency in Neurologists, it is not possible to undertake widespread neurological training of primary care physicians, Clinical officer's nurse and community health workers to enable them treat epilepsy effectively.

EFFECT OF AFRICAN SOCIAL ENVIRONMENT ON PREVALENCE AND CAUSES OF EPILEPSY

Prevalence of Epilepsy

The prevalence of epilepsy in the United States is generally reported to be 5 to 10 per 1000, when only chronic epileptic conditions are considered.[21] Prevalence data shows that epilepsy is two or three times more common in Sub-Saharan Africa than in industrialized countries in non-tropical areas.[22]

In Sub-Saharan Africa, the prevalence of epilepsy can be quite variable even in the same country. Studies in Nigeria and other parts of Africa, have consistently established a higher prevalence of epilepsy in rural than

in urban areas using identical methodologies. Two studies in Ibadan, Nigeria, using the same protocol, found a prevalence of 5·3 per 1000 in Igbo-Ora Town[23] and 37·0 per 1000 in Aiyété Village, 20 km away from Igo-Ora.[24]

This discrepancy was due to better sanitary conditions and health care facilities in Igbo-Ora compared to Aiyete village with resultant prevention of neonatal infection and birth trauma in Igbo-Ora. Epilepsy is therefore, a potentially preventable non communicable disease

Causes and Risk Factors: Information regarding the causes and risk factors for epilepsy has implication for decision-making about development of preventive measures for epilepsy. In our study in Lagos, the commonest cause of epilepsy was childhood febrile seizures followed by head and birth injuries.[25]

A study in Ibadan also showed that childhood febrile seizure was strongly associated with epilepsy.[26] A study in Benin identified risk factors for epilepsy as febrile seizures, birth Asphyxia, and brain infections.[27] The reason for the high prevalence of epilepsy in Africa compared to developed countries is the high incidence of these risk factors in Africans as a result of poor maternal and child care in Africa. Improvement of obstetrics' care will prevent birth trauma. Childhood immunization will prevent childhood infections and febrile convulsions while the implementation of road safety measures will prevent head trauma resulting from road accidents.

SOME OTHER NEUROLOGICAL DISEASES IN SUB-SAHARAN AFRICA

Tetanus

Tetanus is a vaccine preventable disease. It is caused by *Clostridia tetani* whose spores are commonly present in the environment where they contaminate deep and open wounds to cause Tetanus in those who have not been vaccinated against the disease.[28] In Europe and America, tetanus is very rare since virtually everyone has been vaccinated against tetanus as part of childhood routine immunization.

In Nigeria, Tetanus is common as most people have not been vaccinated against it. In Lagos, adult patients with tetanus admitted to Lagos University Teaching Hospital between 2000 and 2009 were reviewed.[29]

Most of the patients were young people below 40 years. Risk factors for tetanus included deep wounds from nail puncture or injuries from accidents, which encouraged the growth of the tetanus spores to vegetative forms. There was male predominance with male: female ratio of 3:1. Males have greater exposures to activities with greater risk of injuries. Moreover, females who have had children in hospital recently are more likely to have been immunized against tetanus during pregnancy.

Interestingly, we observed that commercial motorcyclists were the occupational groups at highest risk since commercial motorcycling was the commonest form of occupation in our patients admitted for tetanus between 2000 and 2009.

The importance of this finding is that compulsory immunization could be enforced on this group of people

before they are licensed to operate. We also observed that treatment of compound fractures by traditional bone setters was one of the causes of tetanus; due to unsterile equipment used. More worrying however was the observation of some tetanus which occurred as complications from surgery in private hospital. On investigations it was found that these hospitals boiled their instruments as a means of sterilization. Tetanus spores are resistant to boiling but can be killed by *autoclaving*. There is now widespread education of doctors to always sterilize their instruments using autoclave.

New Management Protocol for Tetanus

A case fatality in tetanus has been very high in the past ranging from 45.5% to 70.1%.[30] In a review of mortality from Tetanus in Lagos from 1990 – 1999.[31] the case fatality rate was 37%. On close scrutiny of the treatment method and pattern of death, it was observed that many of the deaths could have been due to treatment with *diazepam* at the latter days when the diazepam requirement dropped suddenly. This caused respiratory arrest when the high dose that was usually given was no longer required.

Consequently, in the year 2000, we introduced a novel management protocol for Tetanus.[32] This consisted mainly of introduction of flexibility in the use of diazepam: giving diazepam on demand every 2 hours when spasm is observed and maintaining constant diazepam infusion at much lower dose. The result of the use of the new protocol was tested out when mortality from tetanus between 2000 and 2009 was reviewed. Mortality fell drastically from 37% to 16.3%, as a result of its use. Arrangement for the use of this protocol is planned for

several centres in the country to test its efficacy nationwide.

Age group (Years)	Group A (1990-1999) N	(CFR %)	Group B (2000-2009) N	(CFR %)	Significance difference (group A
<40	85	(31.8)	26	(17.2)	X^2=9.8, P<0.01
40-49	15	(48.4)	3	(15.0)	X^2=4.6, P<0.05
≥50	29	(56.9)	2	(10.5)	X^2=10.2, P<0.01
Overall	129	(37.0)	31	(16.3)	X^2=24.2, P<0.001

Fig. 3: Various Age Groups and CFR Percentage

HIV /AIDS in Sub-Saharan Africa and Neuro-AIDS

In developed countries, prior to the availability of highly active *anti-retroviral* drugs (HAART), neurological disease was the heralding manifestation of AIDS (Aquired Immune Deficiency Syndrome) in 7-20% of patients with HIV, (Human Immunodeficiency Virus) and prevalence of neurological diseases complicating AIDS varied from 39 – 70%. Following the introduction of HAART, (Highly Active Antiretroviral Therapy), neurological diseases declined significantly.[33]

In Sub-Saharan Africa, however, AIDS related neurological diseases continue to represent a significant burden.[34] Much of the global burden of Neuro AIDS is borne by Sub-Saharan Africa where limited resources have hindered efforts at diagnosis, treatment and prevention.

The spectrum of AIDS – related neurological diseases in many African countries parallel that reported in pre-HAART era in developed countries. Neuro AIDS which has virtually disappeared in developed countries still constitute a serious problem in Africa. Much of the global burden of Neuro AIDS is borne by Sub-Saharan Africa

where limited resources have hindered efforts at diagnosis treatment and prevention.

Stigma and discrimination are other significant barriers to Neuro-AIDS care and prevention in Sub-Saharan Africa. Stigmatization of people living with HIV/AIDS occur across all strata of society and was reported by 22-25% of people living with HIV AIDS (PLWHA) in Northern Nigeria.[35] In Uyo, Akwa Ibom State of Nigeria, 37.3% of women attending antenatal Clinic expressed negative attitudes towards PLWHA, (People Living with AIDS); suggesting that stigmatization is not merely a perception of PLWHA.[36] Stigma and discrimination induce fear, denial and social isolation of PLWHA thereby limiting the efficacy of HIV-testing and control programme.

Neurological Dysfunctions

In a study of 250 HIV sero – positive patients in Lagos, 58.4% had neurological dysfunctions: 26% had *neurocognitive dysfunction*, 16.4% had *distal sensory neuropathy*, 6.4% had *meningitis*, 5.2% had *myopathy*, 2.4% had *myelopathy* and 2% had *cerebrovascular diseases.*[37]

Opportunistic Infections –Toxoplasmosis

Toxoplasma encephalitis is the most common causes of intracranial mass lesion in AIDS. The use of HAART has reduced the incidence drastically in Europe. In U.K., during 1996-2007 when HAART was already widely available Toxoplasma encephalitis affected only 0.6% of 31,000 patients with HIV.[38]

In Lagos, study of HIV patients: 85.5% were *sero positive* for Toxop*lasma Gondi 1gG*. Among these patients, 32.6% of those with CD4 Count less than 200 had lateralizing signs suggesting focal brain lesion from Toxoplasma while only 7.1% of those with CD4 Count

greater than 200 had evidence of focal lesion from *Toxoplasmosis.*[39]

HIV Sensory Neuropathy

Among 323 patients studied in LUTH (Lagos University Teaching Hospital) and LASUTH, (Lagos State University Teaching Hospital), 39% had sensory neuropathy characterised by aching, stabling or burning pain, paraesthesia and numbness of lower limbs.[40]

SOCIAL ENVIRONMENT AND ACUTE STROKE

Prevalence and Incidence of Stroke in Nigeria: In 2007, following a grant from the central research committee of University of Lagos, we carried out a community based studies using house to house survey in Surulere, Lagos to determine the prevalence of stroke in a typical Urban Nigeria.[41] The prevalence of stroke was 1.14 per 1000.

We also carried out a one year prospective study in Lagos using a community based Stroke Registry to determine the incidence of stroke in Nigeria.[42] The age adjusted incidence of stroke in our study was 54.7 per 100,000. This is currently the only community based incidence study of International Standard that has been carried out in Sub-Saharan Africa. The last time such a study was carried out was the WHO (World Health Organization) sponsored community based stroke Registry carried out in Ibadan in 1977.[43]

In the 1977 study, the age adjusted incidence was 46 per 100,000.0. Interestingly, the current age adjusted incidence of stroke in France is 54 per 100,000.0.[44] This shows that the incidence of stroke in France is similar or slightly lower than the current incidence of stroke in

Nigeria. In 1977, the age adjusted incidence of stroke in France was greater than 100 per 100,000.0. Therefore, while incidence of stroke has been falling in the developed countries; incidence is still rising in African countries as a result of poor knowledge of risk factors by the people and lack of community based preventive measures. It is very urgent therefore to embark on stroke awareness and public education to halt this observed rising incidence of stroke in Nigeria.

Risk Factors for Stroke in Nigeria: In a case controlled study of risk factors for stroke in Lagos; modifiable risk factors for stroke found included *hypertension*, *diabetes mellitus*, and *cigarette smoking.*[45] Interestingly, we also found that people with low income and low education had significantly increased risk of stroke. Poor people have poorer healthcare and have tendency to neglect or not detect hypertension, diabetes mellitus or other risk factors for stroke until they cause stroke.

Another important factor associated with poverty is infection (acute or chronic) which has recently been found to be a prominent risk factor for stroke. Infection is commoner among the low income group.[46] Although, foods rich in saturated fats causing high Cholesterol is generally considered risk factors for stroke in developed world; poor nutrition with low vitamin intake is a more important risk factor for stroke in Africans.

Diet low in Vitamin B6, B12 and *Folate* has been associated with increased in the level of *Homocysteine* in the blood.[46] High *Homocysteine* is associated with stroke. Poor nutrition is associated with poverty and low education. Although a study in Maiduguri found high *Homocysteine* among stroke patients in rural areas where there is considerable poverty and illiteracy, a

similar study in Lagos, did not demonstrate high *Homocysteine* in stroke patients in Lagos presumably because of widespread use of multivitamins by most people in Lagos.[47]

Stroke Mortality

The mortality rate of stroke patients in Nigeria hospitals is generally between 30 and 45%.[48] This high mortality is not due to lack of sophisticated equipment in Nigeria but lack of adequate manpower with adequate knowledge of Neurology to manage stroke successfully. This was proven in the community based stroke registry in Lagos.

Mortality from stroke in the study was reduced to only 16.2% (similar to mortality in developed countries) by simply managing the stroke patients in the various hospitals according to international guidelines without the need for sophisticated equipment.[42] The high mortality of stroke patient in Nigerian hospital is therefore not due to lack of sophisticated equipment but lack of adequately trained neurologists.

Treatment Gap in other Brain Diseases

There are treatment gaps in many brain diseases in Africa arising from ignorance; poor knowledge of Neurology by general doctors, and lack of adequate manpower trained in Neurology. The extent of these and the causes are research questions that need further studies.

Until recently, there were very few Neurologists in Nigeria. Very few Medical School had Neurologists among their academic staff to teach Neurology to undergraduate medical students. There are many Medical Practitioners in Nigeria today who have never been taught by a Neurologist in Medical school. They are

therefore not adequately knowledgeable about Brain diseases. This may indirectly contribute to treatment gap in Brain diseases.

Some time ago, I treated a patient who had paralysis of both upper and lower limbs arising from spinal cord disease. He had earlier been seen by a general practitioner who told the patient to seek traditional medicines or spiritual healing as there was no effective treatment for such condition in the hospital. His brother (a Lawyer who had just returned from U.K.) however decided to seek a second opinion. The patient was effectively treated by us in Lagos University Teaching Hospital and walked he home. It is not a well-known fact even by doctors that majority of such paralyzed patients in Nigeria usually suffer from T.B spine or Transverse myelitis. With Correct treatments most of them usually walk home. We also suspect that many old people with *Parkinson's disease* or *Dementia* may not be coming for treatment in hospitals because the conditions are usually attributed to old age, *parasomnias* such as sleep paralysis with hallucinations may be attributed to spiritual attacks.

African Physical Environment and Brain Diseases

The physical environment is defined as the physical attributes of a place such as climate, rainfall, amount of environmental sunshine, temperature and other geographical features. In Sub-Saharan Africa the physical environment is characterized by Tropical climate. The most distinguishing features of tropical climate are the large amount of environmental sunshine and high temperature throughout the year. This lecture will be addressing the hypothesis that high amount of environmental sunshine that characterize the physical environment of sub-Saharan Africa affects the African

brain. How this affects the African brain will be discussed starting with Epilepsy which again is the main model of brain disease to study this phenomenon.

EPILEPSY IN AFRICA AND THE REST OF THE WORLD: SIMILARITIES

Classification of Epilepsy: Prior to 1970, clinical characterisation of different types of epilepsy was not uniform and varied with each clinician. To address this anomaly, in 1970, under the auspices of the International League against Epilepsy, the first International Classification of Epilepsy was proposed and adopted.[49]

Epilepsy was classified using the Clinical and Electroencephalographic (EEG) criteria into Generalized and Partial Epilepsies. Studies in India[50] and Europe[51,52] evaluated the classification and concluded that it was useful. To evaluate the classification in Nigeria, the relative frequency of different types of epilepsy in Nigerians with epilepsy was determined using carefully designed prospective systematic clinical and EEG study of 945 consecutive epilepsy patients seen in at the Lagos University Teaching Hospital over a period of 5 years.[53] This study found that partial epilepsy was commoner than generalized epilepsy in Nigeria, like the rest of the world, However, on close scrutiny, it was observed that in the Sub classifications of adults and children into *Grand Mal*, *Petit Mal*, *Myoclonic epilepsy* and the various types of *partial epilepsies* by the various studies, some of the differences observed for the different countries could not be explained totally on the basis of aetiological and genetic factors. The criteria used by the different countries were not uniform. There appeared to be differences in the criteria for categorisation by the different countries.

The criteria for categorisation used in the classification being evaluated were vague and not clear cut resulting in arbitrary criteria of categorisation being utilized in the classification by different countries. Conclusion on the Classification was that although it was useful and relevant, there was a need to revise it to define more clearly criteria for categorisation of the different types of epilepsy. This suggestion appeared to have been accepted. The International classification was revised shortly after the publication of this study.

	Present series (n = 945) (%)	Joshi et al. (1977) (n = 1,000) (%)	Gastaut et al. (1975) (n = 6,000) (%)
Total cases	100	100	100
Unclassifiable cases	3	19	24
Classifiable cases	97	81	76
Generalized epilepsy	23.4	20	38
Primary generalized epilepsy	20.4	15	28
Grand mal	17.9	7	11
Petit mal	11.2	3	10
Juvenile myoclonus	0.98	2	4
Others	0.33	3	4
Secondary generalized epilepsy	3.0	5.0	10
Lennox-Gastaut syndrome	1.5	4	6
West syndrome	1.3	0.2	1
Others	0.2	0.8	3
Partial epilepsy	76.6	80	62
With elementary symptomatology	25.4	58	10
With complex symptomatology	34.0	7	40
With secondarily generalized seizures	17.2	15	12

Fig. 4: Epilepsy Cases and Classifications

EEG Abnormalities in Epilepsy: The electroencephalography (EEG) i.e. recordings of the electrical discharges from the brain) is the most important diagnostic test for epilepsy. The pattern and location of inter-ictal Epileptiform abnormalities not only help to make a diagnosis of epilepsy but also help to characterise the type of epileptic disorder or epileptic syndrome. In a study of EEG records of epileptic patients in Lagos, 54.19% of a cohort of epileptic patients who had EEG recorded for the first time had interictal Epileptiform activities in their first study while 30.4% had normal EEG tracing similar to findings in other parts of the world.[54]

Among patients with epilepsy and interictal psychosis we recently studied, *Epileptiform discharges* occurred in 47%.[55] Further yield of *interictal discharges* can be obtained by repeat EEG or by one or more forms of activation methods or following sleep deprivation. A well-known activation method is hyperventilation which elicits spike and wave discharges in patients with absence epilepsy.

Another activation method is *intermittent photic stimulation* of the eyes with a *Stroboscope*, which can induces spike and wave discharges in the brain called *photo paroxysmal discharges* in patients who are photosensitive.

EPILEPSY IN AFRICA AND THE REST OF THE WORLD: DIFFERENCES

Lower Incidence of Photosensitive Epilepsy in Nigerians

In a preliminary study of 362 epileptic patients in Lagos, 2.76% had television induced or photosensitive epilepsy.[56] This was lower than the 8.6% of epileptic patients found to have Television induced epilepsy in U.K.[57] When these patients had EEG done, in response to intermittent photic stimulation, photoparoxysmal discharges (PPD) occurred in 1.6% of them. This was lower than the incidence of 5% reported in U.K patients.[56,57]

Direct Comparison of British and Nigerian Patients: A Commonwealth fellowship enabled me to take up an appointment at the Institute of Neurology of the University of London and the National Hospital for Neurology and Neurosurgery, Queen Square London. This made it

possible for me to undertake a direct comparison of Nigerian and British epileptic patients for photo paroxysmal discharges by studying their EEG recordings.

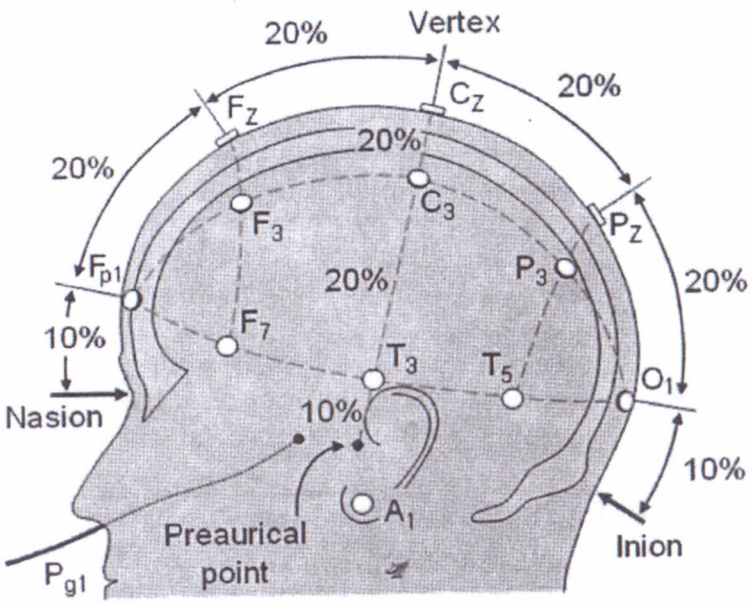

Fig. 5: EEG Recording of a Patient's Head

The routine EEG recordings at both the Lagos University Teaching Hospital and the National Hospital for Neurology and Neurosurgery were usually done in the waking state using a 16-channel EEG machine, and electrode placement was in accordance with the 10-20 system of the International Federation. Each recording included 3 minutes of hyperventilation as well as photic stimulation. The standard method of photic stimulation was used with the stimulation lamp placed directly in front of the patients' eyes at about 30 cm from the nasion in a darkened room.

Stimulation was done in trains with flash frequencies ranging from I to 50 Hz. Photoparoxysmal discharges (PPD) are generalized spike and wave discharges, consistently elicited by intermittent photic stimulation, not frequency locked to the stimulus and outlasting the stimulus train by at least 100 milliseconds.

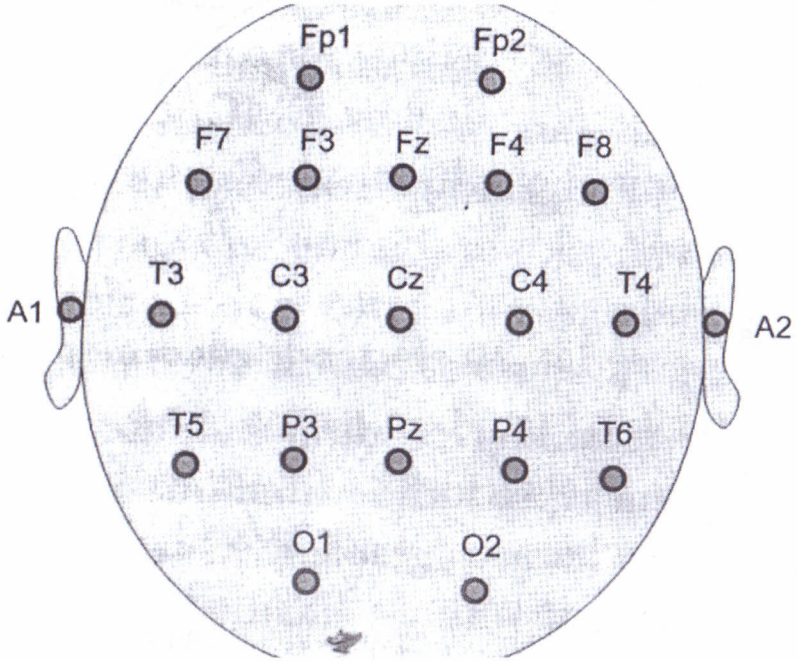

Fig. 6: EEG Recording Montage

When EEG records of 242 Nigerian patients with a clear diagnosis of grand mal epilepsy seen at the Lagos University Teaching Hospital were directly compared with those of 846 British patients with grand mal epilepsy seen at the National Hospital Queen square London; incidence of photoparoxysmal discharges among British patients was significantly higher (10.5%) compared to that of Nigerian patients (1.24%).[58]

Photoparoxysmal Response to Photic Stimulation (PPD)							
	Nigerian			British			Significance of differences
	No.	PPD	%	No.	PPD	%	Nigerian < British
All	242	3	1.24	846	91	10.8	$X^2 = 18.0, p < 0.001$
Male	152	1	0.7	484	40	8.6	$X^2 = 9.4, p < 0.001$
Female	90	2	2.2	362	51	13.4	$X^2 = 6.7, p < 0.001$
Adults	149	1	0.7	796	67	8.7	$X^2 = 9.2, p < 0.001$
Children	93	2	2.1	50	24	48.0	$X^2 = 27.1, p < 0.001$

Fig.7: Photoparoxysmal Response to Photic Stimulation (PPD)

Photoparoxysmal Discharges and Cerebral Neuronal Excitability

From animal studies, it has been suggested that the presence of PPD is a significant pointer to increased *cerebral neuronal excitability.*[59] In agreement with this suggestion, the result of the comparative study of PPD in Nigerian and British Epileptic patients indicated that cerebral neuronal excitability was lower in Nigerians compared to the British patients.

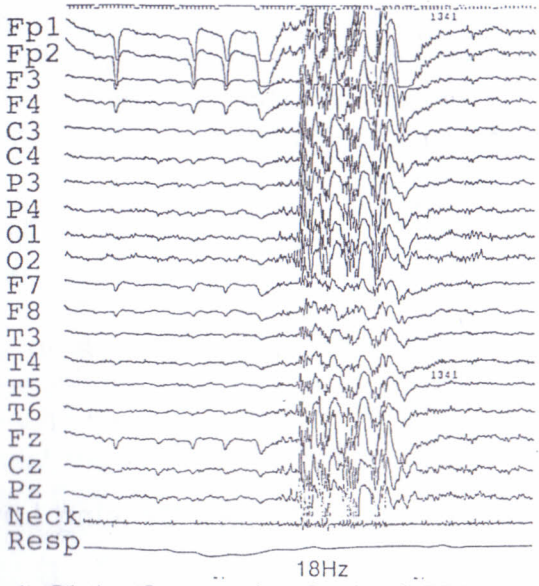

Fig. 8: Result Of the Comparative Study of PPD in Nigerian and British Epileptic Patients

Single Seizures and Neuronal excitability

In an investigation of neuronal excitability in patients with single seizures, EEG recordings of 480 British patients who were investigated after a single seizure were compared with 3,161 patients with clear diagnosis of epilepsy. for incidence photoparoxysmal discharges.[60] Photoparoxyamal discharges occurred in 6.4% of patients investigated after a single seizures compared to 5.9% of patients with established epilepsy. These were not significantly different.

This finding suggested that patients with single seizures had similar degree of neuronal excitability as patients with clear diagnosis of Epilepsy. At a time when there was controversy whether single seizures should warrant any treatment at all, result of this study suggested that patients who had single seizures derived from the same genetic pool as epileptic patients and should be treated with AEDs like epileptic patents especially if their EEGs show abnormalities. This suggestion was confirmed by subsequent studies and accepted. Single seizure has now been incorporated into the new definition of epilepsy.

	Isolated seizure			Epileptic patients		
	No.	No. with PPD	%	No.	No. with PPD	%
All patients	408	26	6.4	3161	187	5.9
Male	235	13	5.53 **	1721	81	4.7 **
Females	173	13	7.5 **	1440	106	7.4 **
Adults	386	23	6 *	2946	146	5 *
Children	22	3	13.6 *	215	41	19.1 *
Patients with:						
Generalised seizure	175	21	12	1015	129	12.7
Partial seizure	233	5	2.1	2146	58	2.7

* PPD in children > adults.
** PPD in females > males.

Fig. 9: Epileptic Patients and Siezures

My Hypothesis on the Factors Causing Low PPD in Africans

Several suggestions have been made to explain the reason for the lower incidence of PPD in black Africans compared to Caucasians. De Graaf, who observed such

a lower incidence in black South African suggested an Ethnic factor (a peculiarity of the black race) as an explanation for the difference.[61]

Janice Stevens had suggested that a pigmentation difference in the eyelids and retina of black Africans were relevant to the observed differences.[62] Bental in a study 70 African black albinos did not find PPD. He concluded that degree of pigmentation of Black Africans was not a relevant factor in the low incidence of PPD in black Africans.[63]

I suggested an environmental factor. My hypothesis was that the high level of environmental sunshine in Africa reduced the cerebral neuronal excitability of the epileptic patients living in Africa and explained the lower incidence of PPD in Nigerians compared to British epileptic patients.

Seasonal Variation in PPD among British Patients

My hypothesis would be proven if it was shown that the higher degree of environmental sunshine associated with summer would reduce cerebral neuronal excitability among British epileptic patients. I therefore set out to study British epileptic patients for incidence of PPD during the various seasons of the year.

A Study of the EEG recordings of over 2000 British epileptic patients for incidence PPD showed seasonal variation with the lowest incidence (2.5%) in summer and the highest incidence (10.8%) in winter.[64,65] A study of 408 British patients investigated after a single seizure for PPD, showed similar seasonal variation with the lowest incidence (1.85%) in summer and the highest incidence (11.2%) in winter.[66]

Table *Seasonal variation in the incidence of photoparoxysmal discharges*

Season	*No of patients*	*No with PPD*	*Incidence (%)*
Winter	89	10	11·2
Spring	99	6	6·1
Summer	108	2	1·85
Autumn	112	8	7·3

The lowest incidence (1·85%) occurred in summer and the highest incidence (11·2%) occurred in winter. The difference in the two incidences was statistically significant ($\chi^2 = 5{\cdot}2$, $p < 0{\cdot}05$).

Fig. 10: Seasonal Variation in the Incidence of Photoparoxysmal Discharges

To confirm this observation of the relative rarity of PPD among British patients in summer compared to winter, I studied clearly *diagnosed photosensitive epileptic patients* for seasonal variation in their incidence of PPD[67]. The 49 patients studied were unselected epileptic patients who were referred for routine EEG recordings at the Department of Clinical Neurophysiology, The National Hospital for Neurology and Neurosurgery, Queen Square, London.

All the patients had more than one EEG recording, and showed evidence of laboratory photosensitivity during at least one of the routine EEG recordings. Both initial and repeat EEG recordings were done at various seasons of the year. Twenty two recordings were done in summer, 35 recordings in winter, 17 recordings in spring and 16 recordings in autumn. All the patients had been diagnosed as photosensitive because their EEG records showed evidence of photoparoxysmal discharges. During the period of investigations all the patients were on treatment with routine anticonvulsive drugs and there was no evidence of change in therapy during this period. EEG records of the patients were examined and the proportion of the patients who showed evidence of photoparoxysmal discharges was obtained for the various seasons. The significance of the differences in the proportions of PPD between recordings in summer

and winter was tested using *chi-square test* or *Fisher's exact test.* There were 11 patients who had EEG recordings done in summer and winter.

The Results showed seasonal variations in incidence of PPD among the photosensitive patients with the lowest incidence of PPD occurring among summer recordings (9.1%) and the highest incidence occurring among winter recordings (96%). Incidence among spring recording was 70.5% and autumn recordings 68.75%. The incidence of PPD in summer recordings was significantly lower than the incidence found in winter recordings ($P<0.01$).

Table *Details of the 11 patients who had EEG recordings in summer and winter*

Patient's data			*EEG in summer*		*EEG in winter*	
Age	*Sex*	*Type of epilepsy*	*Date*	*Result of IPS*	*Date*	*Result of IPS*
42	F	GE	4 July	NAD	23 Dec	PPD*
44	F	GE	27 Aug	NAD	13 Jan	PPD*
17	F	GE	1 June	NAD	22 Feb	PPD*
			28 July	NAD		
20	F	GE	5 July	NAD	10 Dec	PPD*
			16 Aug	NAD		
16	F	GE	6 July	PPD*	30 Jan	NAD
			30 July	NAD		
14	F	GE	26 June	PPD*	7 Dec	PPD*
13	M	GE	27 June	NAD	16 Feb	PPD*
30	F	PE	15 Aug	NAD	22 Jan	PPD*
20	M	PE	17 Aug	NAD	13 Jan	PPD*
15	M	PE	27 June	NAD	8 Feb	PPD*
19	F	PE	11 June	NAD	22 Feb	PPD*

IPS = intermittent photic stimulation.

Fig. 11: Details of the 11 Patients who had EEG Recordings in Summer and Winter

Among the 11 patients who had EEG recorded both in summer and winter; 10 of them had PPD in winter but only 2 out of 14 that received diagnosis had PPD in summer. I obtained from the British Meteorological service in Kew, daily sunshine figures for one year. From these, the average lengths of bright sunshine during the various seasons of the year were calculated. There was inverse relationship between the average length of bright sunshine and incidence of PPD. In winter with average daily bright sunshine less than 2 hours PPD was 96% and in summer with average daily length of bright sunshine greater than 6 hours PPD was 9.1%.

This study conclusively proved that environmental sunshine in summer reduced cerebral neuronal excitability among British patients with epilepsy. It confirmed my hypothesis that the relative rarity of PPD in Nigerian epileptic patients was due to the high environmental sunshine in Nigeria which reduced their cerebral neuronal excitability.

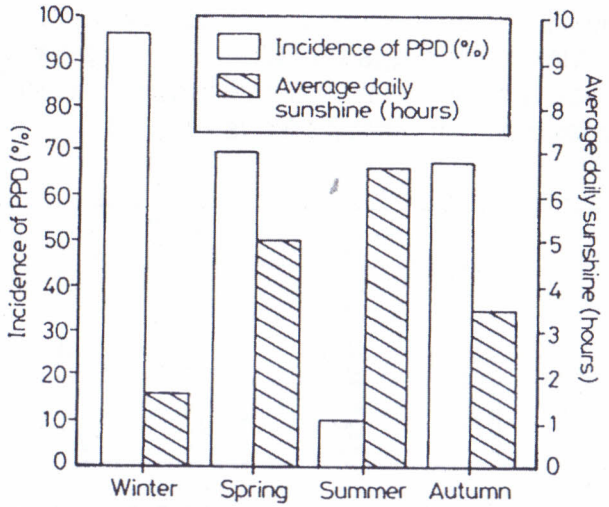

Fig. 12: Histogram of PPD Plotted against Average Periods of Bright Sunshine in Different Seasons

MECHANISMS FOR REDUCED NEURONAL EXCITABILITY ASSOCIATED WITH SUNSHINE

Noradrenaline and Dopamine

Several studies have shown that sunlight is associated with increased output of *noradrenaline* and *dopamine*. Noradrenaline and *alpha adrenergic receptor* binding in rats' cerebral cortex showed circadian rhythm with highest concentration in daylight and lowest concentration at night. They also showed a seasonal

rhythm with highest concentration in summer between June and October.[68]

Diurnal variation in *dopamine* and *noradrenaline* has also been shown in humans confirming animal findings.[69] *Noradrenaline* and dopamine inhibit spontaneous neuronal activity in central nervous system, medicated via CAMP as a second messenger. *Noradrenaline* also depress the nerve terminal release of *acetylcholine* increase GABA output by 60% and enhances GABA inhibitory action by activity Chloride conductance.[70] Increased output of *Noradrenaline* and dopamine associated with large amount of sunshine are therefore associated with reduced neuronal excitability.

Sunshine and Vitamin D

Environmental sunshine is associated with increased vitamin D levels in the body. Low Vitamin D has been shown to be associated with increased excitability of cerebral neurons leading to epilepsy.

A recent study showed that epilepsy was associated with low level of vitamin D in the blood and normalization of vitamin D level has anticonvulsant effect. The participants who were 13 subjects had vitamin D levels ranging from 4ng/ml to 34 ng/ ml with median level of 11.8ng/ml. After treatment the vitamin D levels improved to 23-45 ng/ml with median level of 38ng/ml. After this, 10 of the 13 subjects had a decrease in number of seizures. One of the patients who had dangerously low level of 4 ng/ml had 45 seizures in 3 months but after raising the vitamin D levels to 43 ng/ml the seizures dropped to 30 in 3 months.[71]

IMPLICATIONS OF THE REDUCED CEREBRAL NEURONAL EXCITABILITY IN AFRICANS BY SUNSHINE: EPILEPSY

Visual Sensitivity in Photosensitive Epilepsy

In an international workshop on "Visual Sensitivity and Epilepsy in the Modern Environment" held in France, it was concluded that children and adolescent with epilepsy were at risk of television or videogame induced epileptic seizures and needed to be protected apart from medication. Wearing of special glasses (with red filter) while watching television or playing video game, was recommended for such patients for protection. However, because of my findings of relative rarity of PPD among Africans, it was concluded that African Children or Adolescents did not need such glasses.[72, 73]

Manifestations of Epilepsy in Africa

Epilepsy appears to be less severe in manifestations among Africans living in Tropical environments when compared to Caucasians living in temperate environment. This may be due to the reduced cerebral neuronal excitability from the high environmental sunshine in Africa. These are evidence that epilepsy is less severe.

1. **Spontaneous Remission:** Spontaneous remission can occur in some untreated cases of epilepsy in Africa. In our community study in Surulere, Lagos, spontaneous remission was found in patients with epilepsy who had never had treatment. About 48% of patients with history suggesting generalized epilepsy had such spontaneous remission.[74] Watts found similar spontaneous remission of seizures in African epileptics in Malawi.[75]

2. **Hospitalization Rates and Status Epilepticus - Ongoing Study**: In our ongoing study in L.U.T.H, Hospitalisation rate of epilepsy in Nigeria appears very low compared to observations in Europe suggesting rarity of epilepsy severe enough to warrant admission.

   Status Epilepticus is relatively rare in Nigerians with epilepsy. We have recorded only very few cases in Lagos despite widespread noncompliance with AEDs and treatment gap for epilepsy. Only one case was admitted to our emergency department in the past one year.

3. **Mesial Temporal Sclerosis - Preliminary Observations - Ongoing Study.** Typically this usually causes temporal *lobe epilepsy* with severe intractable complex partial seizures. It usually results from repeated childhood febrile convulsions. It is the commonest cause of partial epilepsy in Europe or USA. It is usually effectively treated by temporal *lobectomy.*

There are many centres carrying out temporal *lobectomy* in developed countries. In Nigerians with epilepsy, there is an ongoing study in Lagos to determine the occurrence of *mesial temporal sclerosis* among patients with intractable partial epilepsies, with a working hypothesis that it is relatively rare. This is because the genesis of *mesial temporal sclerosis* is related to kindling phenomenon from excitable cells. Such phenomenon is greatly reduced in Africans as a result of reduced neuronal excitability.

Our preliminary findings appear to agree with our hypothesis. This very important study when completed

and our hypothesis proven, will, apart from redefining for the world the map of *mesial temporal sclerosis* will have a far reaching implication on the proposed epilepsy surgery programmes for Africa.

OTHER NEUROLOGICAL DISEASES AFFECTED BY SUNSHINE

Multiple Sclerosis: *Multiple sclerosis* is a very common neurological diseases in the temperate regions but extremely rare in sub-Saharan Africa. Recently, it was observed in Nigerian patients seen in Lagos that multiple sclerosis, presented in a different way from the usual way it presents in the temperate regions and also appeared easier to treat responding very well to *Prednisolone treatment.*[75]

There is an ongoing study following this observation, to clearly elucidate the peculiarity of Multiple sclerosis in Nigeria resulting from high amount of sunshine in Nigerian physical environment. Esparza et. al. found in their studies that mortality from multiple sclerosis was directly related to the distance from the equator suggesting that lower amount of environmental sunshine was associated with Multiple sclerosis.[76]

In USA, Freedman et al. looked at the effects of sunlight on multiple sclerosis. He found that people with high occupational exposure to sunlight were only 24% as likely to die from multiple sclerosis as those with low sun exposure.[77]

Goldberg in his earlier studies felt that not getting sufficient sunlight to form vitamin D could be the trigger for multiple sclerosis.[78] In 1986, he compared relapses in patients with multiple sclerosis before and after

supplementation with 5000 units per day of vitamin D. Relapse was 2.7 times as many in the year before vitamin D supplementation.[79] The difference was significant with a P value <0.01.

In a recent study, there was a strong association between sunlight exposure and serum Vitamin D concentration as well as multiple sclerosis severity. Patients reporting frequent sunlight exposure had a lower Multiple sclerosis severity.[80]

Migraine: In a study in Lagos, We investigated the 1-year prevalence, clinical features and mode of treatment of headache in medical students of the University of Lagos, Nigeria, using a self-administered headache questionnaire.[81]

Prevalence of tension-type headache was higher than that of migraine (18.1% vs. 6.4%). Migraine was three times more common in women (10.9% vs. 3.2%). Only 4.6% sought medical assistance, whereas 68.2% took non-prescription drugs, mainly simple analgesics. Specific drugs for migraine and tension-type headache were rarely used. The low consultation rate and the rarity of usage of specific anti-headache drugs probably reflect migraine not severe enough to warrant seeking hospital treatment.

Motor Neurone Diseases: *Motor Neurone Disease* (MND), worldwide has shown geographically defined distinct and puzzling variations. Among Caucasians, MND, when it presents with *Amyotrophic lateral sclerosis* has a poor prognosis with most patients dead within three years of onset. In certain parts of the world such as Guam, parts of India and Nigeria, MND appears to run a

benign course.[82] These are areas with large amount of environmental sunshine.

THE AFRICAN BRAIN AND HEMISPHERIC SPECIALIZATION: RIGHT AND LEFT BRAIN FUNCTIONS

Brief Overview of Right Hemisphere Properties: The right hemisphere, in general, seems to express itself in a non-linguistic manner and preferentially processes affective material. The right hemisphere is also dominant for tactile and proprioceptive sensations, orientation in space, artistic and musical endeavors, body image and recognition of faces. It processes information more diffusely than does the left hemisphere, being specialized for the integration of many inputs at once. Its mode of operation has been termed holistic, relational, simultaneous, and appositional.[83] The right brain is the brain of the Artists.

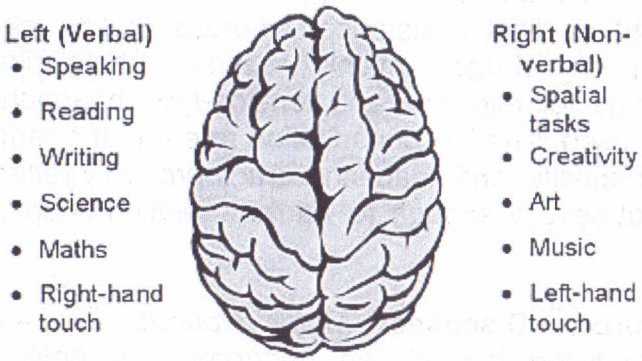

Fig. 13: Left and Right Hemisphere of the Human Brain

Brief Overview of Left Hemisphere Properties: The left hemisphere is most notable for containing the neural substrate for the expression and comprehension of language (Broca's and Wernicke's areas respectively). It

specializes in the perception and labeling of material that can be coded linguistically. It organizes and categorizes material into discrete temporal and sequential units, processes mathematical and analytical functions and mediates verbal concept formation. Its mode of operation has been described as linear, sequential, analytical and logical.[84]
The left brain is the brain of the scientist.

Functions of Artist and Scientists: Their functions and orientation are very different and they may hardly understand each other. To put it in my words: A scientist carries a touch light in the dark searching for the hidden truth in nature, culminating in scientific discovery.

Scientists rarely work in isolation because they need more than one touch light to search in the dark for the hidden truth in nature, hence, a scientific research is usually a collaborative effort of many researches and scientific papers naturally have multiple authors.

An Artist carries a mirror reflecting the realities of our gross material world, represented in creative writing, visual arts or paintings, sculptures, dramatic arts, music and dancing. A creative artist usually works alone. Performers such as actors or musicians, however, work in groups.

African Tonal Language: Yoruba Language is a tonal language, that is why it can be expressed with a talking drum. We have on ongoing research based on the hypothesis that the right brain (which is the brain for appreciating tones) may contribute to understanding or expressing Yoruba language.

A preliminary observation suggests that there may be some truth in the hypothesis and that research is required. The observations are from two patients: the first patient, a well-educated patient had transient inability to express himself in English following transient damage in the language area of the left brain by *status Epilepticus*, but he could understand and speak Yoruba.

A second patient who has *Primary Progressive Aphasia* (a condition brought about by selective degeneration of the language area of the left brain) lost the ability to express herself in English language but can still express herself to some extent in Yoruba language. She now watches only Yoruba movies. We are currently undertaking further studies on this phenomenon by studying all patients with left brain damage for aphasia (language disturbance). In future, when functional MRI is available in Nigeria, the phenomenon can be further studied.

The Brain Tendency of the Africans: Past and present evidences suggest overwhelming dominance of activities of right brain in Africans as evidenced by Africans excelling in the Arts: Nobel Prize in literature and several book prizes by African authors, Nigerians excelling in Drama (Nollywood), music and entertainment, very important work of Art originating from Africa are to be found in Museums all over the world.

Is the right brain tendency of African determined by the social environment of Sub-Saharan Africa or is it a genetic endowment of the Africans brain? These are research questions that require answers by further studies.

Conclusions and Recommendations

The social environment of sub-Saharan Africa has adverse effects on African Brain Diseases:

1. The wrong beliefs and poor public attitudes regarding epilepsy have negative impact on management of epilepsy.
2. Tetanus has virtually disappeared in advanced countries because of effective immunization, but is still very common in Africa.
3. Neurological complications of HIV are now very rare in advanced countries but still common in African countries.
4. Stroke incidence is rising in Sub-Saharan Africa, whereas, it is falling in developed countries. Mortality from stroke is very high because of poor management but was reduced in our study patients when we managed them according to international guidelines.
5. Many people with brain diseases do not come out for treatment. This is due to paucity of trained manpower to diagnose and treat them at primary care level and poor knowledge of general doctors about brain diseases.
6. The physical environment of Sub-Saharan Africa, especially the abundant sunshine is beneficial to the African brain and brain diseases. It reduces cerebral neuronal excitability which in turn reduces the severity in the manifestations of epilepsy, modifies the manifestation of diseases like multiple sclerosis making it less severe and more easily treatable. It modifies the manifestation of *Motor Neurone disease* and, migraine making them less severe. Exposure to sunshine is therefore beneficial to the brain. This is due to the influence of sunshine in increasing the beneficial vitamin D levels in our body.

7. The right brain is the brain of an artist while the left brain is the brain of a scientist. Artists and Scientists hardly understand each other. Many Africans appear to have right brain tendency as evidence by our excelling in the Arts, music and drama. Is this as a result of our social environment or genetic endowments? Does the right brain contribute to tonal African languages like the Yoruba language? These are research questions that require further studies.

Neurology Education in Nigeria

As stated earlier in the lecture, median number of neurologists in Sub-Saharan Africa is estimated to be 3 per 10 million populations.[19] This is in contrast to Europe where there are 484 neurologists per 10 million populations.[20] In 1998, there were only 7 practicing Neurologists in Nigeria as there was no curriculum for training Neurologists in Nigeria.

I was made Chairman of the Neurology Committee of National Postgraduate Medical College and members of the committee were Prof. Ogunniyi, Prof. Bwala, and Dr. Roberts. We drew up the 27 page document, which was accepted by the College as the 1st curriculum for training Neurologist in Nigeria. This document was also adapted by the Neurology of West African College of Physicians and is now used for training Neurologist in West African Sub-region.

We have been training Neurologists and at present have over 70 Neurologist in Nigeria: the highest in any African country.

Future Direction of Neurology Education in Nigeria:

To develop Neurology training and research in Sub-

Saharan Africa, there is a need for a strong Neuroscience background by Neurologists and trainees. We are developing a Master of Science programme in Clinical Neuroscience. This programme is modeled after the Msc Clinical Neuroscience of University College, Landon and Kings College Hospital, London, and will be uniquely adapted for Nigeria with four pathways. When approved, it will attracts students not only from Nigeria but from other parts of Africa.

GENERAL RECOMMENDATIONS

1. Improving our social environment will have a favourable impact on the occurrence, treatment and outcome of African brain diseases.
2. Education of general doctors, patients and the public will improve outcome of epilepsy by removing the stigma attached to the condition, improving proper health seeking behaviour by patients and enabling correct treatment for epilepsy by doctors.
3. Epilepsy is a potentially preventable condition. Good antenatal and obstetrics' care to prevent birth asphyxia, childhood immunization to prevent childhood infections and febrile convulsions, can reduce incidence of Epilepsy.
4. Immunization of all children and relevant adults against Tetanus will greatly reduce the incidence of Tetanus in Nigeria.
5. Neuro-AIDS can be greatly reduced by widespread availability of highly active antiretroviral drugs (HAART) for treatment of all patients with HIV/AIDS. If stigma is reduced widespread voluntary testing to detect HIV will be carried out as most people will come out to be tested. This will also make it possible for many affected patients to be treated with HAART thereby reducing Neuro AIDS.

6. Stroke incidence can be reduced by educating the public about its causes and prevention. Such enlightenment campaigns should highlight the need to treating hypertension, diabetes mellitus, avoid smoking, have regular physical exercises in order to improve nutrition and reduce infections.
7. Continuing Medical Education of general doctors to teach them how to manage stroke correctly in accordance with the International guidelines will reduced the mortality from stroke.
8. Regular exposure to the sun is recommended. Exposure to Sunshine is better than vitamin D supplements because sunshine produces natural vitamin D3 which is superior to vitamin D2 in supplements. Vitamin D3 is 87% more potent in raising and maintaining vitamin D concentration than vitamin D2. Sunshine protects the brain.
9. Neurology is an emerging Medical specialty in Africa. Although there is a need for genetic research to be carried out along with the rest of the world, the major focus should be directed towards the influence of our social and physical environment on brain diseases. There are still very many research questions to be addressed in this area, although, we may not reinvent the wheel, but we can remodel the wheel to suit our peculiar environment.
10. Doctors and health workers should be educated by Neurologists on brain diseases to improve their ability to manage these diseases. In order to make this possible, Government should encourage training of more Neurologists by providing facilities for such training in all the training institutions in Nigeria. Important steps to improve doctors' knowledge about brain diseases, will be continuing education of practicing doctors by Neurologists and teaching of Neurology in all Medical School.

11. The brain is the only organ in the body that we actively use. As users, the public should take interest in the brain and make effort to understand how it works. This will help to reduce the wrong beliefs associated with brain diseases. We should expose students to Neuroscience early in their career like in USA where students in high school are exposed to Neuroscience.
12. The University of Lagos should assist in the growth of Neuroscience. We implore the University to support the proposed Master of Science programme in Clinical Neuroscience that is being developed when it is ready.

ACKNOWLEDGEMENTS

I wish to acknowledge and appreciate the Vice-Chancellor Professor R.A. Bello, the Deputy Vice-Chancellors, the Registrar and all the members of the management team for their untiring efforts in steering the affairs of the University thereby giving it direction and focus that has continued to make University of Lagos number one in the country.

I appreciate the efforts of previous Vice-Chancellors: Late Professor Tokunbo Shofoluwe (May his soul rest in peace), Professor Oye Ibidapo Obe, Professor Tolu Odugbemi and Professor Jelili Omotola.

I also acknowledge and appreciate the Provost College of Medicine Professor Folashade Ogunsola and past Provosts of the College. They have maintained very good leadership at the College of Medicine in areas of research, teaching and curriculum development. I also acknowledge the Dean Faculty of Clinical Sciences; Professor Afolabi Lesi. He is a child Neurologists and we collaborate.

My appreciation goes to my Neurology Colleagues Professor Adesola Ogunniyi, Professor Bwala and Dr. Roberts who worked with me to develop the first Neurology training curriculum of the National Post graduate Medical College, when I was Chairman of the Neurology subspecialty committee.

My profound appreciation also goes to Professor Nwosu; the current chairman of Neurology committee of the college, Professor Yomi Ogun; past President of the Nigerian Society of Neurological SciencesProfessor Ogunrin; the current president and all members of the Nigerian Society of Neurological Sciences.

My special appreciation goes to my colleagues in Neurology unit of the Department of Medicine Professor Frank Ojini, Professor Njide Okubadejo and Dr. Lara Ojo. I also appreciate all my current Senior Residents in Neurology and past Senior Residents all of whom are Consultant Neurologists across the country and Lecturers in various Universities. I appreciate my Neurology colleagues in LASUTH Dr. Dawodu and Dr. Oshinaike who were part of us as Resident and still collaborate with us in research.

I thank all members of the Department of Medicine; I have enjoyed a good working relationship with all of them and collaborated with many of them. I appreciate all the Resident doctors of the department; most of whom I have a close working relationship with as Chairman of the Residency Training committee. I acknowledge also all my retired senior colleagues in the Department whom I worked closely with in the past.

Professor Femi-Pearse was instrumental to my coming to work at the University of Lagos. When I was working in the British National Health service, he wrote a personal letter to me as Head of Department of Medicine, thereafter, I applied to work at Lagos University Teaching Hospital. I appreciate Professor Elebute who was the Provost of the College when I was appointed Lecturer.

I also acknowledge my colleagues who I have collaborated with outside the Department of Medicine, Professor S. R. A. Akimbo, Dr. Tokunbo Akeredolu and Dr. Adewole.

I acknowledge all my colleagues that I have worked with also in various committees of the University and College

of Medicine in the past and those I am working with at present including Central Research Committee, Advancement Board and Curriculum Review Committee.

I wish to specially acknowledge the President and members of Etsako Club 81; the Foremost Socio-cultural Club in my Senatorial district-Edo North. I also acknowledge the youth wing; Etsako Youth Club, not forgetting also my neighbours at the Christmas Close, and my classmates at the Medical School in U.I.

I wish to specially acknowledge and appreciate my brother; His Royal Highness, Oba Aliyu Danesi, the Aidonogie of South Ibie andthe Patriarch of the Danesi family; Chief K.O. Danesi.

I acknowledge all my brothers and sisters from the Danesi family. My profound appreciation also goes to my four daughters - Oshioriame, Osonela, Otsemobor and Oshiobugie; they have all been wonderful.

I want to specially acknowledge and appreciate my darling wife; Dr. Rosemary Adishetu Danesi, a Lecturer at the Faculty of Business Administration. She is not only my wife but my girlfriend; I still toast her because he is the most beautiful girl in the world. She is four times a great Akokite, with 2 bachelor's degrees: BSc in Sociology and LLB; 2 Master degrees; MSc in Industrial relation and Personnel Management and LLM. She has also, a PhD in Law at the University of Essex U.K. Thank you for sticking it out with me all these years.

Finally I wish to appreciate and thank the Almighty God for making this day possible; I dedicate this inaugural lecture to Him. Distinguished ladies and gentlemen; thank you for listening.

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