EPIDEMIOLOGY AND ENDEMICITY OF PULMONARY TUBERCULOSIS (PTB) IN SOUTHEASTERN NIGERIA

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Abstract. the incidence of pulmonary tuberculosis in Southeastern Nigeria was studied using cultures and microscopic examination of sputa. The isolation of acid-fast bacilli (AFB) from sputa of some in- and out-patients in hospitals and health centers revealed the presence of *Mycobacterium tuberculosis* in 420 (31.7%) out of the 1,324 patients examined during a TB outbreak. A mortality rate of 9 (2.14%) of the 420 AFB-positive cases was observed during the study period of 10 months. The most affected age group was between 16 and 35 years, with high incidence rates found in traders (33.8%), health workers (31.0%), and food vendors (13.8%). Male subjects had a higher incidence of 35.6%, compared to 26.9% in females. Intensification of training programs for adequate numbers of medical diagnostic personnel in referral hospitals; public health education and integration of socio-political, cultural and economic frameworks are advocated in the subregion to avert an eminent TB in Southeastern Nigeria.

INTRODUCTION

Mycobacterium tuberculosis is the air-borne transmitted etiologic agent for pulmonary tuberculosis (PTB). *M. tuberculosis* appears as a slender non-sporing, short red rod when stained with the Ziehl-Neelsen's technique (Alice, 1977; Parry, 1986). A protracted cough that lasts more than three weeks and resists treatment with commonly used respiratory antibiotics may be due to *M. tuberculosis* infection. Other common symptoms of pulmonary tuberculosis are loss of weight, poor appetite, and anemia due to damages inflicted on phagocytic and underlying tissues and cells. Cough productive of purulent, blood stained sputum is an obvious sign of acute infection (Kochi, 1997).

Pulmonary tuberculosis (PTB) may be associated with human-immunedeficiency virus infection, which leads to death in many cases (WHO, 1995) when not properly treated. Common drugs for the management of PTB include streptomycin, isonicotinic acid, hydrazide (INH), theiactazone, para-amino salicyclic acid (PAS), rifampicin, ethambutol, and cyclosterine (Benson, 1985) as long course regimens. Recently, a new method of treatment, the Directly Observed Treatment Short Course (DOTS) has been developed (Chinnock, 1997; WHO, 1997). The most recent campaign using DOTS technique for the treatment of PTB commenced in June 1997 in 14 states of Nigeria, including Akwa Ibom State. This method was developed by the German Leprosy Research Agency (GLRA) in conjunction with the National Tuberculosis and Leprosy Control Program (NTBLCP).

Today, *M. tuberculosis* infections have been confirmed in many parts of Nigeria, and features among the first six causes of mortality among notifiable diseases. Earlier reports pointed to a high incidence of TB in Nigeria (WHO, 1957, 1958; Roelsgaad, 1964; Pust *et al*, 1974). This accounts for why the NTBLCP and GLRA are working relentlessly to eradicate TB in 14 states of Eastern and Midwestern Nigeria, including Akwa Ibom State. The PTB infection rate is waning in developed countries, but still constitutes a major health problem in developing countries like Nigeria (WHO, 1974; Kaufman and Van-Embden, 1993). A recent WHO report indicates that one third of the human population has *M. tuberculosis* infection, while about 9,000,000 new cases of TB exist with about 3,000,000 deaths, according to Weller (1989) and Mahler *et al* (1997). Mahler *et al* (1997) reported that *M. tuberculosis* kills more than any other infectious

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disease in developing countries where 95% of all TB cases occur, TB accounts for 25% of all avoidable deaths.

It is sadly true that 75% of TB cases in developing countries involve adults in the most productive age group, 15-50 years (Mahler *et al*, 1997; Ruck, 1997). Several countries with known TB endemicity have been identified in Asia and sub-Saharan Africa with the largest estimated numbers of new cases in the African subregion occurring in Nigeria, followed by Zaire, as reported by Kochi (1997). Kaufmann and Van-Embden (1993) observed that the declining incidence in developed countries has reversed in the past few years. For instance, an 18% increase in incidence was reported in the USA between 1988 and 1992, while increases in the European countries at during the same period ranged between 4% in the United Kingdom and 33% in Switzerland. Kaufmann and Van-Embden (1993) and Mahler *et al,* (1997) reported that the morbidity and mortality profiles of TB are increasing worldwide as the emerging trend of the global HIV/AIDS pandemic is casting a gloomy prospect on TB containment programs. It is estimated that more than 16 million people are infected with HIV globally, and about six million are concomitantly infected with TB (Kaufmann and Van-Embden, 1993; Mahler *et al*, 1997; Utsalo *et al*, 1998). Subsaharan Africa accounts for 70% of this HIV/AIDS/TB co-infection burden, while Asia accounts for 20% (Mahler *et al*, 1997). Utsalo *et al* (1998) reported that HIV is the most powerful factor known to increase the risk of progression of infection in the host to disease. These views are shared by Murray *et al* (1990), who earlier reported that the HIV/AIDS pandemic is largely instrumental in the resurgence of TB in parts of the world with effective TB control programs and the escalation of the already precarious situations in developing countries like Nigeria. This paper examines the incidence rate of PTB in Southeastern Nigeria after the DOTS laboratory techniques were introduced, and follows an outbreak in the study area in March, 2001.

MATERIALS AND METHODS

Sources and collection of samples

Sputa were collected from in- (hospitalized cases) and out- (non-hospitalized cases) patients with cough in 16 hospitals (including health centers) in Southeastern Nigeria (Akwa Ibom and Cross River States). The survey lasted for 10 months, March through December, 2001 following an outbreak in the subregion in March, 2001. Samples were aseptically collected in sterile bottles and processed for analysis within 3 hours of collection. Samples were collected at the following referral hospitals and health centers representing various communities: University of Uyo Health Center (UUHC); Infections Disease Hospital (IDHE); Iquita General Hospital, Oron (IGHO); Mercy Hospital, Abak (MHA); General Hospital, Urua Akpan (GHUA) in Essien Udim; General Hospital, Ikono (GHIK); Mary Slessor Hospital, Itu (MSHI); Leprosy Hospital, Ekpene Obom (LHEO) in Etinan; University of Uyo Teaching Hospital (UUTH) and General Hospital, Ikot Abasi (GHIA), all in Akwa Ibom State. The referral hospitals in Cross River State were the University of Calabar Teaching Hospital (UCTH), General Hospital, Calabar (GHC), General Hospital, Ikom (GHIM) and General Hospital, Obubra (GHO).

Processing of samples for microscopic examination

Each sputum was concentrated by decontaminating with an equal volume of 4% NaOH and homogenized by shaking for 15 minutes with a wrist-action shaker as earlier described (Idigbe and Onwujekwe, 1983). The homogenates were centrifuged at 4,000 rpm for 15 minutes. The supernatants were decanted and the deposit washed with sterile distilled water and recentrifuged as before. The final deposits and the unprocessed portion were then examined separately by microscopy and culture. The Ziehl-Neelsen's (ZN) staining technique was adopted (Cruickshank *et al*, 1975; Baker *et al*, 1998; Prescott *et al*, 2002) using methylene blue as a counterstain for the identification of acid-fast bacilli (AFB). This is the technique recommended for the DOTS program, with greater than 80% success.

Sputum culture and identification

A loopful of each sputum sample was aseptically inoculated into the solidified Lowenstein Jensen Glycerol Egg medium using a platinum wire loop and the cultures were incubated at 37ºC aerobically for 6-8 weeks. The culture bottles were examined weekly for growth ex-

pected to appear after 2 weeks of primary incubation. Results were regarded as negative if no colonies appeared after 8 weeks as earlier reported (Idigbe and Onwujekwe, 1983).

All the isolates were characterized and identified by microscopic examination, colonial morphology and biochemical tests, which included Gram reaction, catalase, presence or absence of endospore and sugar fermentation profile (Cowan, 1985; Holt *et al,* 1994).

The results were recorded as AFB (+) to AFB (++++) for the positive cases, depending on the number of observable AFB in each microscopic field. After three consecutive AFB negative results (*ie* sputum AFBx3) the sample was determined as negative.

RESULTS

Incidence rate

Out of the 1,324 sputa collected from hospitalized and non-hospitalized patients in the various referral hospitals and health centers, 209 (15.8%) were obtained from children 1-5 years old, 731 (55.2%) from 16-35 years old, and 384 (29.0%) from adults 36 years and above. There were 420 (31.7%) AFB-positive cultures (Table 1) with a mortality rate of 2.1% (9 patients) during the study period of 10 months. Four (44.4%) of the deaths were recorded in children 8 to 10 years old, 3 (33.3%) in adults 51 to 55 years old, and 2 (22.2%) were in adults 33 to 35 years old. Nine hundred four (68.3%) sputa yielded AFB-negative cultures. Of the 16 referral hospitals monitored, the Infectious Disease Hospitals (IDH) in Ikot Ekpene Community had the highest number of AFB-positive cases, 77 (38.5%) out of 200 screened, while Mary Slessor Hospital in Itu Community had the least 3 (17.6%) out of 17 patients screened. The highest number of positive sputa were collected from patients age 16-35 years old with 55.2% incidence, followed by

Table 1
Age-specific distribution of sputa among patients in referral hospitals in endemic communities, Southeastern Nigeria.

Hospitals and health centers[a]	Tatal no. of samples collected	Children (1-15 yrs) No. (%)	Active age (16-35 yrs) No. (%)	Adult (36 yrs and above) No. (%)	Total positive cases	Total negative cases
IDHIE	200	50 (25.0)	100 (50.0)	50 (25.0)	77	123
UUHCU	100	0 (0.0)	65 (65.0)	35 (35.0)	18	82
SLHA	122	18 (14.8)	70 (57.3)	34 (27.7)	43	79
IGHE	92	15 (16.8)	55 (59.8)	22 (23.9)	26	66
IGHO	63	10 (15.9)	38 (60.3)	15 (23.8)	16	47
MHA	56	10 (17.8)	23 (41.1)	23 (41.1)	12	44
GHI	28	5 (17.9)	14 (50.1)	9 (32.1)	7	21
MSSHI	17	0 (0.0)	10 (58.8)	7 (41.2)	3	14
LHEO	131	21 (16.0)	70 (53.5)	40 (30.5)	26	105
GHUA	120	22 (18.3)	50 (41.7)	48 (40.0)	24	96
GHIA	86	8 (9.3)	59 (68.6)	19 (22.1)	26	60
UCTHC	130	12 (9.2)	68 (52.3)	50 (38.5)	38	92
UUTHU	39	3 (7.7)	28 (71.8)	8 (20.5)	23	16
GHIM	44	12 (27.2)	30 (68.2)	2 (4.6)	35	9
GHO	28	5 (17.9)	13 (46.6)	10 (35.7)	18	10
GHC	68	18 (26.4)	38 (55.9)	12 (17.7)	28	40
Total	1,324	209 (15.8)	731 (55.2)	384 (29.0)	420	904

[a]IDHIE (Infectious Disease Hospital, Ikot Ekpene); UUHCU (University of Uyo Health Center, Uyo); SLHA (St Lukes Hospital, Anua);IGHE (Immanuel General Hospital, Eket); IGHO (Iquita General Hospital, Oron); MHA (Mercy Hospital, Abak); GHI (General Hospital, Ikono); MSSHI (Mary Slessor Specialist Hospital, Itu); LHEO (Leprosy Hospital, Ekpene Obom); GHUA (General Hospital, Urua Akpan); GHIA (General Hospital, Ikot Abasi); UCTHC (University of Calabar Teaching Hospital, Calabar); UUTHU (University of Uyo Teaching Hospital, Uyo); GHIM (General Hospital, Ikom); GHO (General Hospital Obubra); GHC (General Hospital, Calabar).

adults 36 years and above, and children 1- 15 years old with incidences of 29% and 15–8%, respectively, out of the 1,324 clinical samples screened. Fig 1 shows the percentage incidence in relation to endemic communities. Ikom community in the Cross River State had the highest AFB-positive incidence (79.6%) while Itu Community in Akwa Ibom State had the highest AFB-negative incidence (82.4%) The results of distribution of PTB among patients based on the various occupational status revealed that traders had the highest incidence (33.8%), followed closely by health workers (31.0%). The lowest incidence was found in children (2.6%) in the 420 AFB positive cases encountered. The percentage incidence for other occupationals were 13.8% in food vendors, 9.1% in business men, 9.8% in farmers, and 2-6% in children (Table 2). Studies on the sex specific distribution of the cases within the study period reveal that males were more prone to PTB infection than females, Of the 1,324 clinical samples screened for AFB, 755 (57.0%) were collected from male patients, while 569 (43%) were obtained from female patients. The incidence of TB positivity was 269 (35.6%) males and 153 (26.9%) females (Table 3). Only 5 of 17 samples from Mary Slessor Hospital in Itu Community and 8 of 28 samples from General Hospital, Obubra Community, were AFB positive, all of whom were female subjects. All the samples from the male subjects in those referral hospitals were AFB negative. All 56 (50.9%) of the positive samples out of the total of 110 sputum samples at the Infectious Disease Hospital (IDH) in Ikot Ekpene Community were males, while none were females.

DISCUSSION

Our results confirm that *M. tuberculosis* was the etiologic agent for the pulmonary tuberculosis outbreak in Southeastern Nigeria during the investigation period. The results are partly in agreement with an earlier report from the National Tuberculosis and Leprosy Control Program (NTBLCP) and German Leprosy Research Agency (GLRA) between 1996 and 1999 which included the Akwa Ibom and Cross River States of Nigeria which had an infection rate of 37%; but different in that we found an incidence rate

Table 2
Distribution of pulmonary tuberculosis infection among patients of diverse occupational status in endemic communities, southeastern Nigeria.

Endemic communities	Total AFB-positive cases	Occupational status					
		School-children	Food vendors	Businessmen	Farmers	Health workers	Traders
Ikot Ekpene	77	2 (2.6)	6 (7.8)	6 (7.8)	6 (7.8)	16 (20.8)	41 (53.3)
Uyo	18	0 (0.0)	0 (0.0)	2 (11.1)	3 (16.7)	4 (22.2)	9 (50.0)
Anua	43	1 (2.4)	4 (9.3)	4 (9.3)	5 (11.6)	20 (46.5)	9 (20.9)
Eket	26	0 (0.0)	4 (15.3)	2 (7.7)	2 (7.7)	10 (38.5)	8 (34.8)
Oron	16	0 (0.0)	2 (12.5)	13 (18.8)	2 (12.5)	3 (18.8)	6 (37.4)
Abak	12	0 (0.0)	0 (0.0)	1 (8.3)	3 (25.0)	6 (50.0)	2 (16.7)
Ikono	7	0 (0.0)	0 (0.0)	0 (0.0)	1 (14.2)	3 (42.9)	3 (42.9)
Itu	3	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (66.7)	1 (33.3)
Ekpene Obom	26	1 (3.9)	3 (11.5)	3 (11.5)	5 (19.2)	8 (30.8)	6 (23.1)
Urua Akpan	24	1 (4.2)	3 (12.5)	2 (8.3)	4 (16.7)	6 (25.0)	8 (33.3)
Ikot Abasi	26	0 (0.0)	4 (15.4)	2 (7.7)	2 (7.7)	10 (38.4)	8 (30.8)
Calabar 1	38	3 (7.9)	5 (13.3)	3 (7.9)	2 (5.3)	15 (39.5)	10 (26.3)
Uyo	23	0 (0.0)	3 (13.0)	1 (4.4)	1 (4.4)	5 (21.7)	13 (56.3)
Ikom	35	2 (5.7)	2 (5.7)	4 (11.4)	2 (5.7)	10 (28.6)	15 (42.9)
Obubra	18	1 (5.6)	4 (22.2)	2 (11.1)	1 (5.6)	8 (44.4)	2 (11.1)
Calabar	28	0 (0.0)	4 (15.4)	2 (7.7)	2 (7.7)	4 (14.3)	1 (3.6)
Total	420	11 (2.6)	58 (13.8)	38 (9.1)	41 (9.8)	130 (31.0)	142 (33.8)

Numbers in parenthesis indicate percentage incidence.

of 31.7%. This lower incidence is suggestive of the effectiveness of the DOTS method currently employed for the clinical investigation and treatment of pulmonary tuberculosis. This is in agreement with earlier reports by Chinnock (1997) and Wikinson (1997) that the WHO has recommended DOTS as the best approach for the treatment of TB against the increasing threat

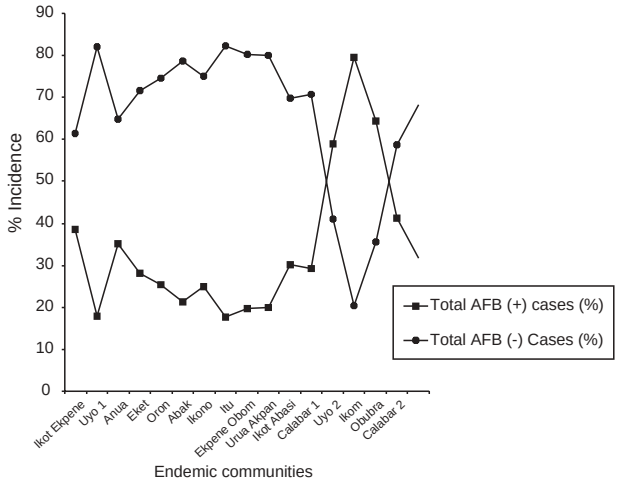

Fig 1–Percentage distribution of positive and negative cases of pulmonary tuberculosis in endemic Southeastern Nigeria.

posed by multiple drug-resistant TB. DOTS had evolved to become the standard of treatment for clinically active tuberculosis (Sbarbaro, 1995). The salient features of DOTS are its emphasis on the cost-effective diagnosis of TB and visually supervised patient compliance with a multiple drug treatment regimen as reported by Utsalo *et al,* (1998). It is important to note that equal numbers of samples could not be obtained from all the referral hospitals and health centers principally because of their geographical locations and for demographic reasons, as some communities are densely populated while others are sparsely populated. This probably contributed to the broad variations in incidence in the referral hospitals, which represent various communities in Southeastern Nigeria. The data have provided an update and reliable epidemiological information on the outbreak of pulmonary tuberculosis during the period under investigation.

The incident rate of 420 (31.7%) obtained from this work from a total of 1,324 clinical sputum samples is, however, higher than the incidence rate of 142 (21.0%) of 668 patients studied in Lagos Metropolis between January and June,1982 by Idigbe and Onwujekwe (1983). In

Table 3
Sex-specific distribution of pulmonary tuberculosis infection in endemic Southeastern Nigeria.

Hospital health centers	Total number of samples	No. of samples (%)		AFB-positive male (%)	AFB-positive female (%)
		Male	Female		
IDHIE	200	110 (55.0)	90 (45.0)	56 (50.9)	0 (0.0)
UUHCU	100	68 (68.0)	32 (32.0)	6 (8.8)	12 (37.5)
SLHA	122	52 (42.0)	70 (57.4)	27 (51.9)	16 (22.9)
IGHE	92	60 (65.2)	32 (34.8)	18 (30)	11 (34.4)
IGHO	63	33 (52.4)	30 (47.6)	6 (18.2)	10 (20.0)
MHA	56	20 (35.7)	36 (64.3)	6 (30.0)	6 (16.7)
GHI	28	10 (35.7)	18 (64.3)	4 (40.0)	3 (16.7)
MSSHI	17	12 (70.6)	5 (29.4)	0 (0.0)	5 (100.0)
LHEO	131	78 (59.5)	53 (40.5)	15 (19.2)	11 (20.8
GHUA	120	73 (60.8)	47 (39.2)	15 (20.6)	9 (19.2)
GHIA	86	32 (37.2)	54 (62.8)	15 (46.9)	13 (24.1)
UCTHC	130	93 (71.5)	37 (28.5)	32 (34.4)	18 (48.7)
UUTHU	39	28 (71.8)	11 (28.2)	18 (64.3)	5 (45.5)
GHIM	44	32 (72.7)	12 (27.3)	13 (40.6)	12 (100.0)
GHO	28	8 (28.6)	20 (71.4)	0 (0.0)	8 (40.0)
GHC	68	46 (67.7)	22 (32.3)	38 (82.6)	14 (63.6)
Total	1,324	755 (57.0)	569 (43.0)	269 (35.6)	153 (26.9)

a clinical survey, Beer and Davies (1965) reported a similarly low incidence of 24% in Lagos in 1963.These rates reflect no decline in the incidence of the disease in Lagos State, one of the most thickly populated areas in Nigeria, a former capital and the most populous commercial nerve center in Nigeria. The higher incidence rate in our work may be attributed to various reasons, paramount among them was the wider scope, a subregion comprising two states in Southeastern Nigeria, and a larger sample size (1,324 patients) in our study than in the earlier reports. The differences in geographical location and socio-economic and health factors may be responsible, as the area of the present study was more rural based than the metropolitan Lagos environment, where there are better health facilities for prompt containment and control of any outbreaks. According to Alausa *et al* (1977) and Idigbe and Onwujekwe (1983), the tuberculosis problem has had no significant decline in incidence, despite current control programs. An annual decline of 12.9% was reported in Czechoslavakia between 1965-1972 by Krivinka *et al*, (1974) while Darbyshire (1979) estimated a 24% reduction of TB incidence in Kenya from 1964-1974. These authors attributed the rapid decline to the effectiveness of case finding and the chemotherapy component of the control program.

The results of the age-specific distribution of samples in our study revealed that the highest number of samples were obtained from patients between the ages of 16-35 years old, with an incidence of 731 (55.2%) of the total (1,324) samples. This was followed by adults 36 years old and above, and lastly by children 1-15 years old. The high incidence observed in ages 16-35 years may be attributable to the fact that people from 20-36 years and above are at a very active period in their lives, and move around more for their survival. Reviglione *et al* (1996) and Mahler *et al* (1997) reported that 75% of PTB cases in developing countries involve adults during their most productive age group of 15-50 years. The results are similar to an earlier report by Idigbe and Onwujekwe (1983) where the highest incidence was among people between the ages of 20 and 39 years old, with a decline thereafter. The sex specific distribution reveals that males are more prone to TB infections than females, probably because, as bread winners, they are more exposed to carriers in society, since they interact with persons in different walks of life. This is in agreement with several other reports (Alausa, 1977; Idigbe and Onwujekwe, 1983; Utsalo *et al*, 1998). In our investigation, a lower incidence were obtained, 269 (35.5%) in males and 153 (26.9%) in females, compared to 65% in males and 35% in females reported by Idighe and Onwujekwe (1983) and Utsalo *et al* (1998). Our results also differ from an earlier report by Idigbe and Onwujekwe (1983) who reported a consistently higher incidence in male subjects. In our investigation, a 100% incidence was obtained from females at Mary Slessor Hospital (MSHI) in Itu Community in both Akwa Ibom State and General Hospital in Obubra Community in Cross River State. Of the 420 AFB-positive sputa, 142 (33.8%) of the AFB positive patients were traders, 130 (31.0%) health workers ,41 (9.8%) farmers, 38 (9.1%) businessman, 58 (13.8%) food vendors, and 11 (2.6%) children. There was intercommunal heterogeneity of the incidence of disease among the various occupational groups studied. The groups with the highest incidences are often exposed to crowded places like motor parks, markets, retail stores and restaurants, where they interact with their customers, especially during peak business periods when there is a greater possibility of inhaling contaminated air. The health workers may have inhaled AFB in the hospital environment. The relatively low incidence in children may be attributed to the high level of immunity in this age group.

There are numerous reports reiterating that the morbidity and mortality profile of TB is increasing worldwide (WHO, 1957, 1958; Pust *et al*, 1974; Kaufmann and van-Embden, 1993). Our death rate of 2.14% (9 patients) of the 420 AFB positive cases. Epidemiologically, this can be considered low, and underscores the effectiveness of the Directly-Observed Treatment Short course (DOTS) strategy adopted for the management of TB. In Nigeria, like in most other developing countries, health facilities, especially in the rural areas, are limited. Highly trained personnel for tuberculosis work are lacking (Idigbe and Onwujekwe,1983). There is also a paucity of information on the epidemiology of tuberculosis in Southeastern Nigeria, therefore comparative data for earlier outbreaks in this sub-region

is lacking. These factors, coupled with a low national income, poverty, and the long distances patients have to travel to access health care facilities, discourage the utilization of available resources. Therefore, in addition to the provision of adequate drugs, intensification of training programs for adequate medical diagnostic personnel in urban and rural areas, and continuous monitoring of carrier rates, TB programs in this sub-region should be well coordinated, taking into consideration the socio-political, cultural and economic framework to avert an epidemic of pulmonary tuberculosis in Southeastern Nigeria.

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