**Impact of political conflict on tuberculosis notifications in North East Nigeria, Adamawa State: a seven-year retrospective analysis**

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**Conflict of interests**

The authors declare that they have no conflict of interest.

**Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Ethics approval and consent to participate**

Approval for the study was granted by the Federal Medical Centre Yola, which is responsible for issuing ethical approval for medical research in Adamawa State (issued 18th January 2018). All analysis was conducted as aggregate data and individual consent was not required.

**Consent for publication**

Not applicable

**Authors contributions:**

EP, SJ, LEC, KH and NTH designed the study. EP and SJ acquired the data. LEC, SPD and EP analyzed the data. KH, LEC, SPD, SJ, EP, NTH interpreted the data. LEC, NTH and KH supervised the study. EP, SJ, ABU, NLV, AE, SPD, SM, NTH, LEC, and KH reviewed and revised the draft. All authors critically reviewed the paper and approved the final version of the paper for submission.

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**Abstract**

**Objective**

We assessed the impact of political conflict (Boko Haram) on Tuberculosis (TB) case notiﬁcations in Adamawa State in Northeast Nigeria.

**Design** A retrospective analysis of TB case notifications from TB registers (2010-2016) to describe changes in TB notification, sex and age ratios by the degree of conflict by local government area.

**Setting** Adamawa State

**Participants** 21,076 TB cases notified

**Results**

21076 cases (62% male) were notiﬁed between 2010 and 2016, of which 19,604 (93%) were new TB cases. Areas affected by conflict in 2014 and 2015 had decreased case notification while neighboring areas reported increased case notifications. The male to female ratio of TB cases changed in areas in conflict with more female cases being notified. The young and elderly (1-14 and > 65-year-old) had low notifications in all areas, with a small increase in case notifications during the years of conflict.

**Conclusion**

TB case notifications decreased in conflict areas and increased in areas without conflict. More males were notified during peace times and more female cases were reported from areas in conflict. Young and elderly populations had decreased case notifications, but experienced a slight increase during the conflict years. These changes are likely to reflect population displacement and a dissimilar effect of conflict on the accessibility of services. TB services in conflict areas deserve further study to identify resilient approaches that could reach affected populations.

**Limitations and strengths**

* Being aggregated data, the study lacks socio-demographic granularity and individual patient information to warrant detailed exploration of associations and confounders.
* The data was collected from passive TB case finding which does not allow estimating the real burden of TB in the State.
* We have shown that case notifications in LGAs in conflict areas decreased during the period of insurgency with compensating increases in case notifications in areas with low conflict, possibly reflecting population movement.
* To our knowledge, this is the first study assessing the impact of conflict on TB services in Nigeria
* Short time span of TB data was utilized to highlight challenges in TB services during conflict and stimulate research for resilient approaches.

**INTRODUCTION**

Tuberculosis (TB) continues to be a major public health problem in Africa, especially in poor and insecure areas with limited access to services.[1](#_ENREF_1) TB services are especially at risk in areas with political disruption and conflict, and refugee and internally displaced populations (IDPs) frequently have limited access to diagnosis and treatment.[2](#_ENREF_2) There is a poor documentation of how TB trends change over a prolonged period in areas of conflict and scrutinizing the case notifications trends in these areas may improve our understanding of the performance of TB services when operating under severe strain.[3](#_ENREF_3)

Adamawa State, in North-east Nigeria, has experienced several years of conflict with disruption of health service delivery because of the Boko Haram insurgency.[4-6](#_ENREF_4) Boko Haram, which in Hausa means "*Western education is forbidden*",[7](#_ENREF_7) is a militant group made up of dispersed cells and factions, which aims to make northern Nigeria an Islamic state.[7](#_ENREF_7) The movement was founded in 2002, initially targeting government institutions (police stations, security officers, military barracks) and conducting large-scale operations targeting religious and civil buildings and schools since 2010 to revenge the killing of its leader in 2009. In 2013, Adamawa, Yobe and Borno states of Nigeria declared states of emergency [8](#_ENREF_8),[9](#_ENREF_9) and by 2014, sixteen Local Government Areas (LGAs) had been captured by the insurgents in the North east [10](#_ENREF_10),[11](#_ENREF_11) with a severe disruption of public health activities[4-6](#_ENREF_4) and an estimated 1.7 million population displaced by June 2017 (Figure 1).[12](#_ENREF_12) Some of the displaced persons moved to relatively safer sites within the affected areas while others entirely left the affected areas as shown by the displacement tracking matrix produced by the UN International Organization for Migration.[13-15](#_ENREF_13)

In Adamawa State, seven LGAs (Gombi, Hong, Maiha, Mubi North and South, Michika and Madagali) experienced the brunt of the violence, and these remained under the control of Boko Haram until their progressive recapture by the Nigerian Army (Hong, Gombi, Maiha and Mubi by December 2014, Michika by January 2015 and Madagali by March 2015).[16-21](#_ENREF_16)

Though the state of emergency was lifted in Feb 2014, the insurgents persisted until their dislodgment from Madagali from the aforementioned affected LGAs.[16](#_ENREF_16)

In order to guide health operational intervention / implementation, all the LGAs in the State (Adamawa) were categorized into high, moderate and low conflict by health policy makers and development partners in the State ministry. The categorization was based on proximity of the LGAs to Boko Haram Strongholds in Borno, the number of IDP camps, the estimated number of fatalities and damage to life and properties.

Two LGAs (Madagali and Michika) in the high conflict areas are the closest to the Boko Haram stronghold in Borno State, followed by the 5 LGAs (Mubi North, Mubi South, Maiha, Hong and Gombi) in the moderate conflicts area and then finally the 14 farthest LGAs (Song, Girei,Yola North, Yola South, Fufore, Mayo-belwa, Jada, Ganye, Tongo, Numan, Guyuk, Lamurde, Demsa and Shelleng) are considered the low conflict areas. Thus, the conflict initially progressed from the the Northern to the Southern part of the state, which is farthest from the main Boko Haram camp.[17](#_ENREF_17),[22](#_ENREF_22)

We conducted an analysis to assess the TB case notiﬁcation trends and their spatio-temporal distribution in Adamawa State, one of the states most affected by the violence, and explored the impact that the insurgency on TB case notification.

**MATERIALS AND METHODS**

**Study design and setting**

This was a retrospective study based on TB cases notifications (TB surveillance data) from 2010 to 2016 in Adamawa State, in North east Nigeria (Figure 1). Adamawa has an estimated 4.2 million population, and is divided into 21 semi-autonomous LGAs.[23](#_ENREF_23) Of the three ‘BAY’ states (Borno, Adamawa and Yobe) experiencing major political instability in the North east, Adamawa was the second most affected by the insurgency. It was chosen for this study for its peculiarity of progressive recapture by the military and relative safety of travel at the time of data collection. Yobe in turn was not selected because it did not have a functional airport and insurgents abounded episodically on the highway and thus data was unreliable or not collected. Though an airport existed in Borno state, targeted bombings continue and some LGAS are still under the control of Boko Haram rendering impossible to access data.

**Data sources and acquisition**

Data from the TB registers of the 196 TB centers of all the LGAs of Adamawa State were collected by health workers under supervision of the State and LGA TB supervisors. Data collected included age, sex, treatment outcome and patient category. Aggregated data was collated at quarterly program review meetings and submitted to the National TB, Leprosy and Buruli Ulcer Control Program (NTBLCP). All the data for this research were obtained following approval to carry out research on anonymous aggregated data by the state ethics committee, and by September 2018, all data were sorted and ready for in-depth analysis.

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**Data analysis**

Data were entered and cleaned in Microsoft excel sheets and statistical analysis was performed using STATA version 13.1. Case notiﬁcations in different LGAs, areas of conflict, and time points were evaluated. Case counts instead of rates were used as population census was not available and population changes were not quantified. We were thus unable to use rates due to the difficulty in having accurate population figures. Nigeria’s last population census took place in 2002 and since then only population estimates are and utilized. However they are likely to be inaccurate in areas of protracted conflict with cumulative displacement of population. The projected population estimates therefore were considered to be unlikely to provide a reliable denominator to build the true picture of the burden of TB. The trends in numbers of case notification were therefore analyzed by area of conflict, age-group (0-4, 5-I4, 15-24, 25-34, 35-44, 45-54, 55-64 and ≥ 65 years), sex, forms of TB (Extra pulmonary TB, Smear-positive (+ve) and Smear-negative pulmonary TB (PTB), and treatment category (New, Relapse, Treatment failure, Loss to follow-up and Others). Chi-square (χ2) and χ2 for trend tests were used to analyze all the categorical data. P<0.05 was considered statistically significant.

**Ethical approval**

Approval for the study was granted by the Federal Medical Centre Yola, which is responsible for issuing ethical approval for medical research in Adamawa State (issued 18th January 2018, Ref number FMCY/SUB/S.128/VOL.1/ABC/I). Since all analysis was conducted as an aggregate data, individual consent was not required.

Patient and public involvement'.

No patients were involved and all data utilized for analysis was anonymous aggregated TB statistics.  
The results of this research will be disseminated to the state to assist in decision making regarding the State TB program.

**RESULTS**

**Overall TB case notifications in Adamawa State, Nigeria**

A total of 21,076 TB cases (13,074 [62%] male) were notiﬁed by Adamawa State between January 2010 and December 2016 (Table 1). Of these, 19,604 (93%) were new TB cases, 671 (3.2%) relapses, 124 (0.6%) treatment failures and 200 (0.9%) were lost to follow-up (LTFU). Patients aged 25–34 years represented 26% of all cases and the lowest proportion of cases occurred in 0-4-year-old children (498, 2.4%) (Table 1). In total, 11,859 (56.3%) and 7,743 (36.7%) were smear-positive and smear-negative PTB while 1,474 (7.0%) had extra-pulmonary TB.

**TB case notifications by LGAs and period of conflict**

Before the time of conflict, from 2010 to 2013, there were no significant changes in the notification trends in the high (χ2 for trend, p = 0.3), moderate (p = 0.6) and low conflict areas (p = 0.97) (Figure 2). However, during the conflict years, LGAs experiencing conflict reported lower numbers of cases from 2013 onwards, with a significant decrease in case notifications in the high (χ2 for trend, p = 0.0001) and moderate conflict areas (p = 0.0001), and a corresponding increase in case notifications in the low conflict areas (χ2 for trend, p = 0.0001). In Madagali, the LGA with the most severe conflict, the number of cases reported declined from 103 in 2013 to 50, 0 and 28 in 2014, 2015 and 2016, respectively (Table 2). Similarly, neighboring Michika LGA experienced a decline from 228 in 2013 to 119 and 87 in 2014 and 2015. Among LGAs with moderate conflict, Mubi North experienced a progressive decline from 228 in 2013 to 166 and 124 in 2014 and 2015, while notifications in Mubi South declined from 375 in 2013 to 255, 256 and 214 in the same years and in Gombi, cases dropped from 155 in 2013 to 71 in 2015. In Hong, the cases dropped from 193 in 2013 to 71 in 2015, while Maiha LGA had a small decrease from 70 in 2013 to 59 in 2014.

During post conflict years, from 2015 to 2016, there was an increase in case notifications in the high conflict areas (χ2 for trend, p = 0.0001) and low conflict areas (p = 0.03), but no significant changes in observed in areas with moderate conflict (p = 0.1) (Figure 2).

**Trend of case notifications by sex and LGAs**

Overall, more males than females were notified (1.6 times). Before the conflict, from 2010 to 2013, there were no significant changes in the trends of notified cases by gender (males: p = 0.4; females: p = 0.6 ) in the areas with high, moderate and low conflict areas (p > 0.7 for all areas) (Figure 3). However, more female cases were notified in 2014 in areas with high (Michika) and moderate conflict (Mubi North and to some extent, Mubi South). Overall, the sex ratio (male to female) increased in low conflict areas, while the opposite occurred for moderate and very high conflict areas (Figure 3).

**Trends of case notifications by age group and period of conflict**

There was a significant increase in case notifications among adults ≥ 65 years between 2010 and 2016 (χ2for trend, p ≤ 0.0001); while case notifications among 15-64 years old remained stable (p > 0.2) (Figure 4). Moreover, from 2010 to 2013, there was a significant increase in case notifications among 0-14 (p < 0.01) and ≥ 65-year-old cases (p = 0.0001), but no significant change occurred among 15-64 years old cases (p = 0.5). Although there were no significant changes from 2010 to 2016 for the age group 0-14 and 15-64 in high conflict areas (p > 0.2 for both age groups), there were significantly increased notifications of TB patients ≥ 65 years old between 2010 and 2013 (χ2 for trend, p < 0.001) (Figure 4a). Among areas with moderate conflict, there was no significant change in the trend of notifications among 15-64 year-old cases between 2010 and 2016 (p > 0.4), while there was significant decrease among 0-14 year-old cases (χ2 for trend, p = 0.0139) and increase among ≥ 65 cases (χ2 for trend, p < 0.0001) from 2010 to 2013 (p = 0.0004) and 2015 to 2016 (p = 0.0501) (Figure 4b). In contrast, low conflict areas had a significant increase of 0-14 and ≥ 65-year-old cases from 2010 to 2016 (p = 0.0367 and p = 0.0053, respectively), but no significant changes among 15-64-year-old cases (p = 0.7) (Figure 4c).

**DISCUSSION**

In this report, we demonstrate that political conflict impacts TB case notifications. There was gross heterogeneity and many intricate factors during the complex humanitarian emergency that affected North East Nigeria. This heterogeneity led to some locations having lower TB notification for a few years, while others did not. Generally, years and places of higher conflict were associated with lower TB notifications. All LGAs experiencing conflict reported lower numbers of cases from 2013 onwards and the decline was more severe in the most affected areas, with corresponding increases in case notifications in low conflict areas. The decline in case notification coincided with the progressive capture of LGAs by Boko Haram, the displacement of population and disruption of health services.[4-8](#_ENREF_4),[10-12](#_ENREF_10) The lower numbers of cases notified in the places and times most likely reflected displacement of the populations to other locations that were considered safer, less access and disruption of TB services, decrease access due to transport, destruction of health facilities, and desertion of health staff. As a result of these major challenges, Madagali recorded no cases in 2015, which was attributed to the severity of the conflict in this LGA. Madagali was the first LGA to be invaded and the last to be recaptured by the army. In 2015, all TB services in Madagali came to a standstill, all health staff and patients left the area and transport was unavailable. Other studies have shown similar low case notifications from areas of conflict in Sudan.[24](#_ENREF_24) In Adamawa State, areas of low conflict reported more case notifications than in previous years, while areas of very high conflict reported low number of cases. This is attributable to several factors, including population displacement from high conflict to relatively safe areas, displaced persons in the host communities of low conflict areas accessing the TB services, displaced populations living in poor conditions and malnutrition, with overcrowding, which facilitates transmission and disease progression and the coincidental introduction of four GeneXpert machines, which have higher sensitivity than smear-microscopy, in the low conflict areas.

Most LGAs had increased notifications from 2012 to 2013. This period coincided with a TB Reach-funded project in all LGAs during which TB risk messages were broadcasted through jingles in the local radios, with the intention to increase case finding among nomadic pastoralists. At that time, health workers were re-trained on TB identification, diagnosis, treatment and follow-up and 402 community volunteers were engaged to boost awareness and reporting of cases. This intervention coupled with the introduction of GeneXpert testing increased awareness on TB and provided additional resources, possibly resulting in improved health care seeking behavior, better case notification and reporting. Some LGAS also appeared to have a rebound of cases to pre-conflict notification levels (e.g Michika) due to a massive return of displaced populations after the recapture of the areas by the military. In those situations, health services resumed with varying intensity across the areas and service availability was not evenly distributed across the LGAs.

Overall, a higher number of males than females were notified. However, in areas of high and moderate conflict the sex ratio changed, with more female cases being notified. This was likely due to males avoiding contact with health services, as Boko Haram targeted males for killings and abductions. In contrast, in low conflict areas, the sex ratio increased, suggesting that males may have travelled to these relatively safe areas for health seeking.

The overall number of cases reported was lower among areas with moderate and severe conflict. Similar findings have been reported from other areas of conflict , as conflict interfere with identification and treatment TB patients.[14](#_ENREF_14) A low number of children and elderly cases were also reported in all areas, which reflects the increased difficulty in reaching a diagnosis in those age groups and the lower accessibility of services for individuals with young and advanced age. These pre-established barriers seemed to worsen within conflict areas. The low proportion of cases diagnosed in elderly groups may reflect societal and economic barriers to access the services and a cohort effect where vulnerable individuals died at early age, with the selection of the fittest. Children in turn often have low bacilli numbers, are unable to produce sputum and are more difficult to diagnose at any time, requiring skills to obtain alternative clinical samples for diagnosis (e.g. gastric lavage). Added to this their dependence on parents separated by conflict and in poverty, it is not surprising the number of cases dwindled sharply during conflict years.[25](#_ENREF_25) [26](#_ENREF_26) Surprisingly, the trend analysis showed increasing numbers of cases in children and the elderly in pre-conflict and post-conflict periods. This may have been due to the TB Reach intervention described above during the pre-conflict period and then, the return of the population to their own areas. Other studies have attributed the increasing trends in under five notifications to a higher susceptibility to TB among displaced populations and better access to diagnostics and treatment services due to humanitarian organizations providing emergency services. [27](#_ENREF_27)

The analysis presented here needs to consider the limitations of the data. Being aggregated data, it lacks socio-demographic granularity and individual patient information to warrant detailed exploration into associations and confounders. The data was also collected from services using passive TB case finding, which is likely to underestimate the real burden of TB. Areas in conflict are also more likely to have missing cases and minimal reporting than areas that can run normal services. Population sizes are also likely to have changed substantially with the internal and international displacement of the population. A systematic review has shown instances in which forced population displacement caused by conflict in areas with a substantial TB burden is associated with decreases in the TB notification rates with increase mortality and morbidity from other infectious diseases.[28](#_ENREF_28)

**CONCLUSIONS**

Despite these limitations, we have shown that case notifications in LGAs in conflict areas decreased during the period of insurgency. However, notifications changes were not homogeneous and affected differently males and females and age groups. We believe this analysis is useful to plan TB services for areas in conflict and their neighboring areas receiving internally displaced populations{https://www.vanguardngr.com/2013/05/breaking-news-jonathan-declares-state-of-emergency-in-borno-yobe-adamawa/, #2258}.

**References**

1. Ukwaja K, Alobu I, Ifebunandu N, Osakwe C, Igwenyi C. From DOTS to the Stop TB Strategy: DOTS coverage and trend of tuberculosis notification in Ebonyi, southeastern Nigeria, 1998-2009. The Pan African medical journal 2011;9:12.

2. Rodger AJ, Toole M, Lalnuntluangi B, Muana V, Deutschmann P. DOTS-based tuberculosis treatment and control during civil conflict and an HIV epidemic, Churachandpur District, India. Bulletin of the World Health Organization 2002;80:451-6.

3. Dangisso MH, Datiko DG, Lindtjorn B. Trends of tuberculosis case notification and treatment outcomes in the Sidama Zone, southern Ethiopia: ten-year retrospective trend analysis in urban-rural settings. PloS one 2014;9:e114225.

4. UNDP. Livelihood and economic recovery assessment. 2016.

5. Omole O, Welye H, Abimbola S. Boko Haram insurgency: implications for public health. Lancet (London, England) 2015;385:941.

6. UNICEF. Annual Report. Nigeria. 2015. 2015.

7. Boko Haram Fast Facts. 2018. at <https://edition.cnn.com/2014/06/09/world/boko-haram-fast-facts/index.html>.)

8. Dunn G. The impact of the Boko Haram insurgency in Northeast Nigeria on childhood wasting: a double-difference study. Conflict and health 2018;12:6.

9.<https://www.vanguardngr.com/2013/05/breaking-news-jonathan-declares-state-of-emergency-in-borno-yobe-adamawa/>.

10. Boko Haram Has So Far Captured 16 Local Government Areas, Group Says. 2014. at <http://www.greenbreporters.com/news/crime/boko-haram-far-captured-16-local-government-areas-group-says.html>.)

11. 5,247 killed in Boko Haram militancy in Nigeria's Adamawa since 2013: Report. 2018. at <http://www.presstv.com/DetailFr/2017/12/31/547397/Nigeria-Adamawa-Boko-Haram>.)

12. UNHCR. Nigeria Situation. 2017.

13. IOM. Displacement Tracking Matrix 2014 : Round 02 Dashboard of Baseline Assessment Nigeria. . 2014.

14. Gele AA, Bjune GA. Armed conflicts have an impact on the spread of tuberculosis: the case of the Somali Regional State of Ethiopia. Conflict and health 2010;4:1.

15. <https://dtm.iom.int/nigeria>.

16.<https://www.vanguardngr.com/2015/03/military-recaptures-madagali-last-area-held-by-boko-haram-in-adamawa/>.

17.<https://allafrica.com/stories/201503130289.html>.

18.<https://www.premiumtimesng.com/regional/nnorth-east/175958-military-recaptures-michika-town-boko-haram-says-jonathan.html>.

19.<https://www.bellanaija.com/2015/01/military-has-recaptured-michika-town-from-boko-haram-pres-jonathan/>.

20.<https://www.vanguardngr.com/2014/12/boko-haram-army-recaptures-mubi-gombi-maiha-hong-council-areas/>.

21.<https://www.vanguardngr.com/2014/11/military-recaptures-gombi-hong-pella-boko-haram/>.

22.<https://punchng.com/boko-haram-horror-in-adamawa/>.

23.Statistics NBo. Annual abstract of Statisitics. National bureau of stattistics, Nigeria. 2012. 2012.

24.Hassanain SA, Edwards JK, Venables E, et al. Conflict and tuberculosis in Sudan: a 10-year review of the National Tuberculosis Programme, 2004-2014. Conflict and health 2018;12:18.

25.Seddon JA, Jenkins HE, Liu L, et al. Counting children with tuberculosis: why numbers matter. The international journal of tuberculosis and lung disease : the official journal of the International Union against Tuberculosis and Lung Disease 2015;19 Suppl 1:9-16.

26.Oshi DC, Chukwu JN, Nwafor CC, et al. Does intensified case finding increase tuberculosis case notification among children in resource-poor settings? A report from Nigeria. International journal of mycobacteriology 2016;5:44-50.

27.van Rie A, Beyers N, Gie RP, Kunneke M, Zietsman L, Donald PR. Childhood tuberculosis in an urban population in South Africa: burden and risk factor. Archives of disease in childhood 1999;80:433-7.

28.Kimbrough W, Saliba V, Dahab M, Haskew C, Checchi F. The burden of tuberculosis in crisis-affected populations: a systematic review. The Lancet Infectious diseases 2012;12:950-65.

**Figures**

Figure 1. A map of Nigeria showing the three North-eastern states affected by insurgency (A) and local government areas (LGAs) affected by insurgency in Adamawa State, Nigeria (B)

Figure 2. Number of TB case notifications by level of conflict (high, moderate and low) in Adamawa State, Nigeria

Figure 3. TB case notifications and gender ratio (male:female) by level of conflict (high, moderate and low) in Adamawa State, Nigeria

Figure 4. Number of TB case notification by age group and level of conflict in Adamawa State, Nigeria. Left, middle and right figures represent data from low, moderate and high conflict areas, respectively

Table 1 Characteristics of TB patients in Adamawa State, Nigeria, 2010–2016

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Characteristics** | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| **All** | 2,900 | 2,644 | 3,382 | 3,460 | 2,821 | 2,794 | 3,075 |
| Female | 1,080 (37.2) | 974 (36.8) | 1,326 (39.2) | 1,359 (39.3) | 1,061 (37.6) | 1,016 (36.4) | 1,146 (37.3) |
| Male | 1,820 (62.8) | 1,670 (63.2) | 2,016 (59.6) | 2,101 (60.7) | 1,760 (62.4) | 1,778 (63.6) | 1,929 (62.7) |
| **Age group** |  |  |  |  |  |  |  |
| 0-4 | 61 (2.1) | 66 (2.5) | 62 (1.8) | 77 (2.2) | 72 (2.6) | 80 (2.9) | 80 (2.6) |
| 5-I4 | 145 (5.0) | 107 (4.0) | 128 (3.8) | 117 (3.4) | 115 (4.1) | 89 (3.2) | 123 (4.0) |
| 15-24 | 442 (15.2) | 382 (14.4) | 478 (14.1) | 462 (13.4) | 373 (13.2) | 367 (13.1) | 418 (13.6) |
| 25-34 | 825 (28.4) | 750 (28.4) | 929 (27.5) | 849 (24.5) | 690 (24.5) | 692 (24.8) | 740 (24.1) |
| 35-44 | 622 (21.4) | 570 (21.6) | 731 (21.6) | 752 (21.7) | 669 (23.7) | 643 (23.0) | 620 (20.2) |
| 45-54 | 402 (13.9) | 334 (12.6) | 511 (15.1) | 549 (15.9) | 449 (15.9) | 434 (15.5) | 474 (15.4) |
| 55-64 | 233 (8.0) | 251 (9.5) | 293 (8.7) | 324 (9.4) | 248 (8.8) | 255 (9.1) | 298 (9.7) |
| ≥ 65 | 170 (5.9) | 184 (7.0) | 250 (7.4) | 330 (9.5) | 205 (7.3) | 234 (8.4) | 322 (10.5) |
| **TB Category** |  |  |  |  |  |  |  |
| Extra pulmonary | 92 (3.2) | 156 (5.9) | 193 (5.7) | 321 (9.3) | 244 (8.6) | 238 (8.5) | 230 (7.5) |
| Smear +ve PTB | 1,506 (51.9) | 1,299 (49.1) | 1,977 (58.5) | 1,839 (53.2) | 1,594 (56.5) | 1,727 (61.8) | 1,917 (62.3) |
| Smear - ve PTB | 1,302 (44.9) | 1,189 (45.0) | 1,212 (35.8) | 1,300 (37.6) | 983 (34.8) | 829 (29.7) | 928 (30.2) |
| **Patient Category** |  |  |  |  |  |  |  |
| New | 2,651 (91.4) | 2,357 (89.1) | 3,147 (93.1) | 3,195 (92.3) | 2,631 (93.3) | 2,682 (96.0) | 2,941 (95.6) |
| Relapse | 122 (4.2) | 106 (4.0) | 105 (3.1) | 119 (3.4) | 100 (3.5) | 47 (1.7) | 72 (2.3) |
| Treatment failure | 18 (0.6) | 27 (1.0) | 17 (0.5) | 22 (0.6) | 15 (0.5) | 10 (0.4) | 15 (0.5) |
| Loss to follow-up | 50 (1.7) | 36 (1.4) | 36 (1.1) | 26 (0.8) | 17 (0.6) | 22 (0.8) | 13 (0.4) |
| Other | 59 (2.0) | 118 (4.5) | 77 (2.3) | 98 (2.8) | 58 (2.1) | 33 (1.2) | 34 (1.1) |

Table 2. TB case notification by Local Government Areas stratified by degree of conflict, Adamawa state, 2010-2016

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Cases (%)** | | | | | | | |
| **Conflict** | **LGA** | **2010**  **(baseline)** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **All** |
| High | Madagali | 95 (100) | 63 (66) | 97 (102) | 103 (108) | 50 (53) | 0 (0) | 28 (29) | 436 |
|  | Michika | 154 (100) | 143 (93) | 162 (105) | 218 (152) | 119 (77) | 87 (61) | 181 (126) | 1064 |
| Moderate | Gombi | 199 (100) | 168 (84) | 204 (102) | 155 (78) | 131 (66) | 71 (36) | 129 (77) | 1057 |
|  | Hong | 132 (100) | 146 (111) | 164 (124) | 193 (146) | 146 (111) | 139 (105) | 200 (152) | 1120 |
|  | Maiha | 52 (100) | 50 (96) | 79 (152) | 70 (135) | 59 (113) | 75 (105) | 74 (142) | 459 |
|  | Mobi-North | 173 (100) | 148 (86) | 186 (108) | 228 (132) | 166 (96) | 124 (144) | 188 (109) | 1213 |
|  | Mobi-South | 300 (100) | 300 (100) | 309 (103) | 375 (125) | 255 (85) | 256 (72) | 214 (71) | 2009 |
| Low | Demsa | 68 (100) | 44 (65) | 90 (132) | 45 (66) | 41 (60) | 58 (85) | 84 (124) | 430 |
|  | Fufure | 124 (100) | 107 (86) | 134 (108) | 197 (159) | 218 (176) | 168 (85) | 188 (152) | 1136 |
|  | Ganye | 161 (100) | 132 (82) | 137 (85) | 122 (76) | 127 (79) | 146 (135) | 150 (93) | 975 |
|  | Gayuk | 60 (100) | 41 (68) | 82 (137) | 111 (185) | 77 (128) | 54 (91) | 56 (93) | 481 |
|  | Gerei | 113 (100) | 72 (64) | 129 (114) | 92 (81) | 99 (88) | 134 (90) | 145 (128) | 784 |
|  | Jada | 57 (100) | 85 (149) | 196 (344) | 117 (205) | 110 (193) | 102 (119) | 102 (179) | 769 |
|  | Larmurde | 80 (100) | 69 (86) | 96 (120) | 106 (133) | 83 (104) | 59 (179) | 61 (76) | 554 |
|  | Mayo-Belwa | 68 (100) | 86 (126) | 113 (166) | 120 (176) | 87 (128) | 94 (74) | 119 (175) | 687 |
|  | Numan | 136 (100) | 97 (71) | 215 (158) | 178 (131) | 184 (135) | 183 (138) | 130 (96) | 1123 |
|  | Shelleng | 51 (100) | 36 (71) | 58 (114) | 79 (155) | 75 (147) | 67 (135) | 67 (131) | 433 |
|  | Song | 99 (100) | 81 (82) | 155 (157) | 120 (121) | 100 (101) | 111 (131) | 108 (109) | 774 |
|  | Tongo | 20 (100) | 19 (95) | 66 (330) | 75 (375) | 76 (380) | 42 (112) | 27 (135) | 325 |
|  | Yola-North | 404 (100) | 420 (104) | 402 (100) | 368 (91) | 303 (75) | 349 (210) | 376 (93) | 2622 |
|  | Yola-South | 354 (100) | 337 (95) | 308 (87) | 388 (110) | 315 (89) | 475 (86) | 448 (127) | 2625 |
| **All** |  | **2900**(100) | **2644** | **3382** | **3460** | **2821** | **2794** | **3075** | **21076** |

Figure 1A close up of a map

Description automatically generated

Figure 2A screenshot of a computer

Description automatically generated

Figure 3A close up of a map

Description automatically generated

Figure 4A close up of a map

Description automatically generated