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ORIGINAL ARTICLE

Worsening of the disability grade during leprosy treatment: prevalence and its determinants in Southern Nigeria

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Background: In Nigeria, little is known about the development of new or additional physical disability during leprosy treatment. The objective of this study was to determine the prevalence and evaluate factors associated with worsening of physical disability during leprosy treatment in Nigeria.

Methods: This was a retrospective cohort study conducted among leprosy patients treated in six referral facilities in six States in Nigeria between January 2011 and December 2015. Multivariable logistic regression analysis was used to identify predictors of worsening disability after treatment.

Results: Of 984 leprosy patients who completed treatment, the mean age of the patients was 39.8±17.6 years and 57.4% (565/984) of them were male. Also, 51.6% (508/984) of the patients had either grade 1 or 2 disability at diagnosis, but this declined to 30.8% (303/984) following treatment (p<0.001). Overall, 4.7% (46/984) of the cases developed new or additional disability (or worsening disability) during treatment. The cases with the greatest odds for developing worsening physical disability were patients from the southwest (adjusted odds ratio [aOR] 15.9; 95% CI 3.8–67.4) and southeast zones (aOR 4.7; 95% CI 1.1–19.2), and patients who had a leprosy reaction requiring additional corticosteroid therapy (aOR 11.7; 95% CI 4.4–31.2).

Conclusion: Sustained capacity building for health professionals on better monitoring and management of leprosy and its complications is strongly recommended in Nigeria.

Keywords: clinical evolution, leprosy complications, leprosy treatment, risk factors, sequelae and disability

Introduction

Leprosy is a neglected tropical disease caused by *Mycobacterium leprae*, which mainly affects the skin, the peripheral nerves and the eyes. Although, in 2000, the elimination of leprosy as a public health problem was attained worldwide, it remains a major global health challenge.[1] According to the WHO, the global registered prevalence of leprosy at the end of 2015 was 176 176 cases (0.18 cases per 10 000 people). The number of new cases reported globally in 2015 was 211 973 (0.21 new cases per 10 000 people).[2] Also, 94% (201 065/213 899) of these leprosy cases notified came from 13 countries in Asia and Africa. This large number of cases suggests an ongoing transmission within countries.[2]

In the last decade, there has been a substantial decline in the burden of leprosy in Africa.[3] In 2015, 20 004 new leprosy cases were detected in the African region; of these, 10.2% (2038/20 004) were children, 79.3% (15 859/20 004) multibacillary (MB), 38.5% (7698/20 004) female and 14.4% (2887/20 004) had grade 2 disability (G2D).[3] The high prevalence of new child leprosy cases suggest continued transmission within the community, while the new high G2D case rate may be the result of better assessment and reporting, but may also indicate delays in detection from poor awareness and inappropriate care-seeking. Moreover, the high proportion of MB cases observed in the African region indicates the presence of advanced cases of leprosy and, indirectly, the magnitude of infection in the region.[3] Early detection of all leprosy cases before they develop disability, prompt treatment with multidrug therapy regimens, and the inclusion of persons affected by leprosy, still remains key tenets of the 2016–2020 Global Leprosy Strategy.[4] Nigeria is one of the top 17 countries reporting cases. Although Nigeria achieved the global leprosy elimination target of having less than 1 case per 10 000 population at national level in 2000, there is still significant clustering of all new and childhood

leprosy cases in the country.[1,5,6] This may indicate regional differences in risk factors for leprosy and high transmission rate in hotspots in Nigeria.

Stigma and discrimination against persons affected by leprosy continue to challenge early detection and successful completion of treatment. Although the Global Strategy aims to achieve marked reduction in leprosy cases with disability before diagnosis and particularly at release from treatment, little is known about the effect of treatment on the disability status of leprosy patients.[4,7–10] The strategy recommends, as a key performance indicator, the assessment of leprosy patients for disabilities at the end of treatment by leprosy control programmes.[4] In addition, the Nigeria TB, Leprosy and Buruli Ulcer Control Programme targets quality leprosy care, such that the proportion of patients who develop new or additional disabilities at the end of treatment is not more than 5% annually.[11] However, not much is known about the proportion of leprosy patients who develop new/additional disabilities on release from treatment in Nigeria or their determinants.[12,13] This evidence is needed to inform health policy initiatives for improved leprosy control. Therefore, the aim of this study was to evaluate the disability of leprosy patients following release from treatment in Nigeria. The specific objectives were to evaluate the disability status of leprosy patients at the end of treatment compared with at diagnosis, to assess the proportion of leprosy patients who developed new or additional disability at the end of treatment, and to identify its predictors.

Materials and methods

Study design

This was a retrospective cohort study of leprosy patients who were diagnosed and registered for treatment between 2011 and 2015 in selected referral centres in Southern Nigeria.

Study area and sampling

The study was carried out in the southern region of Nigeria. The region consists of three geo-political zones, with six or five states each. The study subjects were selected through a multistage sampling method. In the first stage, two States were selected from each of the geopolitical zones using simple random sampling. The study states include Delta and Edo (south-south zone), Abia and Ebonyi (southeast zone), and Ogun and Ondo (southwest zone). In each of the selected states, the top leprosy referral and treatment centre (where 45–80% of cases were managed in the state) was identified and selected. In the six selected facilities, leprosy patients registered for treatment constituted the final sample.

Leprosy diagnosis and management in Nigeria

In Nigeria, leprosy is diagnosed by finding at least one of the following cardinal signs:

- definite loss of sensation in a pale (hypo-pigmented) or reddish skin patch;
- a thickened or enlarged peripheral nerve, with loss of sensation and/or weakness of muscles supplied by that nerve;
- the presence of acid-fast bacilli in a slit skin smear.[11]

All diagnosed cases undergo dermatoneurological examinations, slit skin smear and bacilloscopies to assess bacillary index, and physical examinations to determine disability grade at diagnosis and at the end of treatment.[11] All patients classified as having paucibacillary (PB) or MB leprosy were treated for at least 6 or 12 months, respectively, with supervised doses of the standard WHO multidrug therapy.

The status of leprosy patients impairment was determined using both the WHO disability grade (DG) and the Eye, Hand & Foot (EHF) sum score.[14,15] The DG categories were as follows:

- *grade 0*: no eye, hand or foot problems;
- *grade 1*: decrease or loss of sensitivity in the eyes, hand and/or feet;
- *grade 2*: visible deformity or damage in the eyes, hands and/or feet.[14]

The EHF score uses the sum instead of the maximum of the individual grades for eyes, hands and feet.[15]

Patients

All leprosy patients who registered for and completed their treatment between 1 January 2011 and 31 December 2015 in the study facilities were included in the study.

Data sources and variables

The sources of data were the leprosy registers and quarterly reports obtained from the study facilities. A standardized proforma was used for data collection. Data variables collected included information on WHO classification of leprosy type, age, gender, occupation, residence, patient classification, slit skin smear for acid-fast bacilli, initial bacillary index, corticosteroid use for leprosy reaction, and disability status at diagnosis and at release from treatment. The main outcome variable was the change in the physical disability grade (no worse or worsening) between the evaluation at diagnosis and that at treatment completion.

Data analysis

The data were entered, cleaned and analysed using Epi Info 3.4.1 (CDC, Atlanta, GA). A descriptive analysis of the data was carried out to estimate absolute frequencies and percentages for categorical variables. The normality of the distribution of the EHF sum scores physical disability data was evaluated using a visual inspection of their graphs. The scores were not normally distributed and were therefore summarized using the median± interquartile range (IQR). χ^2 tests were used to compare the proportion of categorical groups. A stratified analysis was carried out to assess for confounding and interaction between the outcome variable (worsening WHO physical disability) and explanatory variables. Odds ratios (ORs) and their 95% CIs were

estimated using multivariable logistic regression analysis with worsening WHO physical disability (yes/no) as an outcome variable. The likelihood ratio test was used to assess the model fit. A p-value of less than 0.05 was considered to be significant.

Ethical approval

The Ethics and Research Advisory Board of German Leprosy and TB Relief Association, Nigeria approved the study. Approval was also obtained from the State TB and Leprosy Control Programme in six states selected for the project.

Results

Sociodemographic and clinical characteristics

The total number of leprosy cases treated during the study period in the six health facilities was 1192, of whom 82.5% (984/1192) completed their multidrug therapy and were released from treatment. All 984 (100%) patients were assessed for disability at diagnosis and also at discharge. The demographic and clinical characteristics of the patients are shown in Table 1. The mean age of the patients was 39.8±17.6 (median [IQR]; 38 [6–54]) years; 7.3% (72/984) were children (<15 years) and 12.7% (125/984) were elderly (>60 years old). Also, 57.4% (565/984) were male, 79.4% (781/984) resided in a rural area and the predominant occupations were farming, 46.7% (460/984); trading, 16.3% (160/984); and artisans, 13.3% (131/984). Most of the leprosy cases (65.2%; 642/984) were from the southeastern geopolitical zone of the country. Furthermore, 89.3% (879/984) of the patients were registered for multidrug therapy as new cases, 96.1% (946/984) had multibacillary leprosy, and 23.3% (229/984) had a positive skin slit smear, 95.6% (219/229) of which had an initial bacillary index of 1–3. During treatment, 6.9% (68/984) of the patients had leprosy reactions requiring corticosteroid use (Table 1).

Disability status at diagnosis and treatment

The disability grades at diagnosis and after treatment of the patients are as shown in Table 2. Using the WHO disability grading, 51.6% (508/984) of them had either grade 1 or 2 disability at diagnosis; following treatment this declined to 30.8% (303/984; p<0.001). Also, using the EHF sum score grading, 53.2% (523/984) of the patients had some disability at diagnosis, this decreased to 32.7% (322/984) at discharge (p<0.001). The WHO disability status at diagnosis and at the end of treatment stratified by demographic and clinical characteristics of the patients are shown in Table 3. Across patients' age, gender, residence, geographical zone and treatment category (Table 3), the rates of disability were significantly lower after treatment compared with at diagnosis; this decreased by an additional proportion of 15–51% (p<0.001). In patients with multibacillary leprosy, 52.2% (494/984) had disability at diagnosis and 31.3% (296/984) had disability after treatment (p<0.001); however, no significant difference in rates of disability existed with treatment among paucibacillary leprosy patients (p=0.07). In patients who received corticosteroids for leprosy reaction, rates of disability after treatment were lower compared with those at diagnosis, but the difference was not statistically significant (73.5% vs 58.8%; p=0.07), while among those who had neither leprosy reaction nor additional corticosteroid, rates of disability were lower after treatment (50.0% vs 28.7%; p<0.001; Table 3).

Worsening disability after treatment

Overall, 4.7% (46/984) of the cases developed new or additional disability (worsening disability) using the WHO disability grading system and 4.6% (45/984) developed worsening disability using the EHF sum score system. The agreement between the two grading systems was 93.5% (43/46) using a denominator of the WHO system. The proportions of patients who developed new or worsening WHO disability after treatment stratified by their demographic and clinical characteristics are as shown in Table 4. There were no differences in the proportion of patients who developed worsening disability according to patient category, age group, gender, residence, disease classification and slit skin smear status (p>0.05). Also, none of the patients with paucibacillary leprosy developed worsening disability compared with 4.9% among those with multibacillary leprosy (p=0.156). However, only 1.8% of patients from the south-south zone developed worsening disability compared with 3.7% and 10.6% in the southeast and southwest zones, respectively. Also, 16.2% of patients who had leprosy reaction requiring corticosteroid therapy had worsening disability compared with 3.8% among those who did not have it (p<0.001). In addition, the rates of worsening disability after treatment varied substantially with occupation; the highest rates of new or additional disability occurred among civil servants (13.8%), while the lowest rate (0%) occurred among teachers (p=0.03).

Table 5 presents the results of the multivariable logistic regression analysis to identify predictors of worsening disability among the patients. After adjusting for confounders, only geopolitical zone and leprosy reaction requiring corticosteroid use were independent predictors of worsening disability. Patients from the southwest (adjusted OR [aOR] 15.9; 95% CI 3.8–67.4) and southeast (aOR 4.7; 95% CI 1.1–19.2) zones, respectively, had a higher odds of developing worsening physical disability compared with patients from the south-south zone. Also, patients who had leprosy reaction requiring corticosteroid therapy were 12 times more likely to develop worsening disability compared with patients who did not have it (aOR 11.7; 95% CI 4.4–31.2).

Discussion

This study demonstrates that there was a high proportion of multibacillary leprosy in the setting with over a fifth of cases having G2D at diagnosis. Secondly, it reaffirms the effectiveness of multidrug therapy in lowering the rates of physical disability among those who completed their treatment. Thirdly, it shows that the incidence of disability during treatment was 4.7%. In addition, it demonstrates that worsening disability was more likely in patients from the southeast and southwest zones of

Table 1. Demographic and clinical characteristics of leprosy cases in Southern Nigeria 2011–2015

Variables	Total (n)	n (%)
Age group (years)	984	
<15		72 (7.3)
15–60		787 (80.0)
>60		125 (12.7)
Sex	984	
Female		419 (42.6)
Male		565 (57.4)
Residence	984	
Rural		781 (79.4)
Urban		203 (20.6)
Occupation	984	
Artisan		131 (13.3)
Business		160 (16.3)
Civil servant		29 (2.9)
Farmer		460 (46.7)
Student/pupil		176 (17.9)
Teacher		7 (0.7)
Others		21 (2.1)
Geographic zone	984	
Southeast		642 (65.2)
South-south		163 (16.6)
Southwest		179 (18.2)
WHO classification	984	
Paucibacillary		38 (3.9)
Multibacillary		946 (96.1)
Patient registration	984	
New		879 (89.3)
Previously-treated		105 (10.7)
Slit skin smear	984	
Positive		229 (23.3)
Negative/not available		755 (76.7)
Initial bacillary index	229	
1–3		219 (95.6)
>3		10 (4.4)
Leprosy reaction	984	
Yes		68 (6.9)
No		916 (93.1)

Table 2. WHO AND EHF disability grade at diagnosis and after treatment of leprosy patients in Southern Nigeria, 2011–2015

	Initial disability n (%)	Disability after treatment n (%)	Statistic (p-value)
WHO grading			χ^2 399.85 (<0.001)
Grade 0	476 (48.4)	681 (69.2)	
Grade 1	227 (23.0)	150 (15.2)	
Grade 2	281 (28.6)	153 (15.6)	
EHF sum score			χ^2 110.16 (<0.001)
0	461 (46.8)	662 (67.3)	
1	67 (6.8)	72 (7.3)	
2	155 (15.8)	118 (12.0)	
3	50 (5.1)	26 (2.6)	
4	115 (11.7)	55 (5.6)	
5	39 (4.0)	15 (1.5)	
6	54 (5.5)	18 (1.8)	
7	10 (1.0)	5 (0.5)	
8	22 (2.2)	11 (1.1)	
≥9	11 (1.1)	2 (0.2)	
Median (IQR)	1.0 (0.0, 4.0)	0.0 (0.0, 2.0)	F 1.7861 (<0.001)

WHO, World Health Organization; EHF, Eyes Hands and Feet; IQR, interquartile range.

Nigeria and among patients who developed leprosy reactions requiring additional corticosteroid therapy.

Despite progress in the elimination of leprosy and the declining trend of the disease in Nigeria,[16,17] this study found that a substantial proportion of new patients still present with multibacillary leprosy and over a fifth of all cases had G2D at diagnosis. These findings have been demonstrated elsewhere in the country,[12,17] and this suggests that there might be places in southern Nigeria where there is high transmission of the disease. A recent study suggests that hotspots of leprosy transmission in Nigeria predominate in the northern part of the country.[6] This study points to the need for closer evaluation of possible areas of high transmission in southern Nigeria. In addition, the high proportion of individuals presenting with G2D at diagnosis suggests possible delays in the diagnosis of the disease.[12,17] This indicates the need to improve expertise in the diagnosis of leprosy, strengthen active case-finding strategies, and reinforce community-based initiatives to reduce stigmatization and discrimination of individuals with the disease.

Irrespective of the patients' demographic or clinical characteristics, this study demonstrates marked reduction in physical disability following multidrug therapy—with WHO G2D declining from 28.6% to 15.6%. This reaffirms the effectiveness of programmatic management using multidrug therapy in reducing disability among leprosy patients. These findings are consistent with earlier studies in Nigeria.[12,13,17] The marked reduction in disability observed suggests that the cases were probably treated in the early periods of the disability when they are yet to develop irreversible deformities and/or nerve damage. Unlike these findings, the experience from Brazil shows a marked variation in the rates of physical disability following treatment with most patients having worsening of G2D.[18–21] The difference between these finding and the reports from Brazil may be due to longer delays to diagnosis in the two countries. This late diagnosis can be reduced by improving coverage and access in endemic areas.[18–21] The reduction in the prevalence of physical disability observed in this study is probably an indication that a good number of the cases were either detected early, and had

Table 3. Disability status* at diagnosis and at end of treatment stratified by demographic and clinical characteristics of leprosy patients in Southern Nigeria, 2011–2015

Variables	Disability at diagnosis		Disability after treatment		χ^2 statistic
	No n (%)	Yes n (%)	No n (%)	Yes n (%)	(p-value)
Age group (years)					
<15	43 (59.7)	29 (40.3)	56 (77.8)	16 (22.2)	5.43 (0.02)
15–60	390 (49.6)	397 (50.4)	549 (69.8)	238 (30.2)	66.74 (<0.001)
>60	43 (34.4)	82 (65.6)	76 (60.8)	49 (39.2)	17.40 (<0.001)
Sex					
Female	215 (51.3)	204 (48.7)	309 (73.7)	110 (26.3)	44.95 (<0.001)
Male	261 (46.2)	304 (53.8)	372 (65.8)	193 (34.2)	44.2 (<0.001)
Residence					
Rural	386 (49.4)	395 (50.6)	539 (69.0)	242 (31.0)	62.02 (<0.001)
Urban	90 (44.3)	113 (55.7)	142 (70.0)	61 (30.0)	27.13 (<0.001)
Occupation					
Artisan	57 (43.5)	74 (56.5)	76 (58.0)	55 (42.0)	5.49 (0.019)
Business	81 (50.6)	79 (49.4)	114 (71.3)	46 (28.7)	14.25 (<0.001)
Civil servant	6 (20.7)	23 (79.3)	14 (71.3)	15 (28.8)	4.80 (0.028)
Farmer	225 (48.9)	235 (51.1)	327 (71.1)	133 (28.9)	47.07 (<0.001)
Student/pupil	97 (55.1)	79 (44.9)	133 (75.6)	43 (24.4)	16.21 (<0.001)
Teacher	4 (57.1)	3 (42.9)	5 (71.4)	2 (28.6)	0.31 (0.577)
Others	6 (28.6)	15 (71.4)	12 (57.1)	9 (42.9)	3.50 (0.061)
Zone					
Southeast	355 (55.3)	287 (44.7)	466 (72.6)	176 (27.4)	46.62 (<0.001)
South-south	57 (35.0)	106 (65.0)	91 (55.8)	72 (44.2)	14.26 (<0.001)
Southwest	64 (35.8)	115 (64.2)	124 (69.3)	55 (30.7)	40.32 (<0.001)
WHO classification					
Paucibacillary	24 (63.2)	14 (36.8)	31 (81.6)	7 (18.3)	3.22 (0.07)
Multibacillary	452 (47.8)	494 (52.2)	650 (68.7)	296 (31.3)	85.16 (<0.001)
Patient registration					
New	435 (49.5)	444 (50.5)	611 (69.5)	268 (30.5)	73.12 (<0.001)
Previously-treated	41 (39.0)	64 (61.0)	70 (66.7)	35 (33.3)	16.07 (<0.001)
Slit skin smear					
Positive	98 (42.8)	131 (57.2)	147 (64.2)	82 (35.8)	21.07 (<0.001)
Negative/not available	378 (50.1)	377 (49.9)	534 (70.7)	221 (29.3)	67.38 (<0.001)
Initial bacillary index					
1–3	94 (42.9)	125 (57.1)	141 (64.4)	78 (35.6)	20.23 (<0.001)
>3	4 (40.0)	6 (60.0)	6 (60.0)	4 (40.0)	0.80 (0.371)
Corticosteroid use					
Yes	18 (26.5)	50 (73.5)	28 (41.2)	40 (58.8)	3.29 (0.07)
No	458 (50.0)	458 (50.0)	653 (71.3)	263 (28.7)	86.97 (<0.001)

*Disability status is defined by a WHO grade of 1 or 2.

not developed irreversible deformities or damage. It may also indicate higher knowledge and adequate engagement of the patients in their care as poor knowledge has been shown to contribute to higher rates of physical disability from inadequate treatment.[22]

Furthermore, this study has shown that 4.7% (46/984) of leprosy cases developed worsening disability during treatment in southern Nigeria. This indicates that the region had met the national target of <5% of cases developing worsening disability following treatment.[11] In addition, it is reassuring that this target was met irrespective of the patients' disease classification, residence, age or gender categories. This indicates the effectiveness of disability prevention and care offered to leprosy cases in the region. Other factors that might be contributory include health education about self-care, prescription of adapted footwear, regular dermatoneurological assessment and monitoring offered to the patients during treatment.[11] This is unlike the findings in Brazil where 18.2%–20.8% of leprosy patients developed worsening disability following treatment.[20,21] Also, an Indonesian study found little differences in

Table 4. Proportion of leprosy cases that developed worsening disability after treatment in Southern Nigeria, 2011–2015 stratified by their demographic and clinical characteristics

Variables	Worsening disability after treatment		χ^2	(p-value)
	Yes n (%)	No n (%)		
Total	46 (4.7)	938 (95.3)		
Age group (years)				0.714*
<15	2 (2.8)	70 (97.2)		
15–60	37 (4.7)	750 (95.3)		
>60	7 (5.6)	118 (94.4)		
Sex			0.235	0.628
Female	18 (4.3)	401 (95.7)		
Male	28 (5.0)	537 (95.0)		
Residence			0.863	0.353
Rural	39 (5.0)	742 (95.0)		
Urban	7 (3.4)	196 (96.6)		
Occupation			13.6	0.03*
Artisan	8 (6.1)	123 (93.9)		
Business	2 (1.3)	158 (98.8)		
Civil servant	4 (13.8)	25 (86.2)		
Farmer	25 (5.4)	435 (94.6)		
Student/pupil	5 (2.8)	171 (97.2)		
Teacher	0 (0.0)	7 (100.0)		
Others	2 (9.5)	19 (90.5)		
Zone			18.37	<0.001
Southeast	24 (3.7)	618 (96.3)		
South-south	3 (1.8)	160 (98.2)		
Southwest	19 (10.6)	160 (89.4)		
WHO classification				0.156*
Paucibacillary	0 (0)	38 (100.0)		
Multibacillary	46 (4.9)	900 (95.1)		
Patient registration				0.211*
New	39 (4.4)	840 (95.6)		
Previously-treated	7 (6.7)	98 (93.3)		
Slit skin smear			2.36	0.125
Positive	15 (6.6)	214 (93.4)		
Negative/not available	31 (4.1)	724 (95.9)		
Initial bacillary index (n=229)				0.499*
1–3	14 (6.4)	205 (93.6)		
>3	1 (10.0)	9 (90.0)		
Corticosteroid use			21.685	<0.001
Yes	11 (16.2)	57 (83.8)		
No	35 (3.8)	881 (96.2)		

Disability is defined by WHO grade of 1 or 2 disability.
*Indicates Fisher's exact p-value.

the disability status of leprosy patients between diagnosis and release from treatment (62% vs 59%, respectively). However, within 5 years of being released from treatment, 39% of the patients developed worsening disability.[23] This suggests that leprosy-related sequelae may still occur after patients have been released from treatment and, therefore, are not being monitored by the health services. In addition, none of the patients in this study with paucibacillary, and only 4.9% (46/946) with multibacillary leprosy had worsening disability. This contrasted with the findings from Brazil where up to 9% and 30% of paucibacillary and multibacillary leprosy cases, respectively, had worsening disability at discharge.[19,20]

Geographical zone of the patients was an independent predictor for developing worsening disability. Patients in the southwest zone of Nigeria were 16 times more likely to develop worsening disability compared with the south-south zone. The reasons for these differences are not clear. Consistent with a previous study in Brazil, it may be because the southwest zone is currently the zone with lowest leprosy endemicity in Nigeria.[6] Thus, with declining prevalence, there is a reduction in professionals with clinical expertise for the diagnosis of leprosy and monitoring for the occurrence of physical disabilities.[24] Moreover, the available health workers in the zone might be losing the essential skills for the management of leprosy complications due to the limited cases they have encountered over time. Thus, there is a need to sustain capacity building initiatives, particularly in the southwest and southeast zone towards improving leprosy management and sustaining its elimination in the country.

Leprosy reactions are immunologically-mediated episodes of acute or sub-acute inflammation that interrupt the relatively usual chronic course of the disease affecting the skin, nerves, mucous membrane and/or other sites.[11,25] Such reactions may rapidly cause severe and irreversible nerve damage, and must always be treated promptly. The cornerstone of the treatment of leprosy reaction is corticosteroids and analgesics.[11,25] In patients with severe leprosy reactions who do not respond to corticosteroids or in whom corticosteroids are contraindicated, clofazimine at high doses or thalidomide may be used under close medical supervision.[25] In this study, patients who had leprosy reaction and received additional corticosteroid therapy were 12 times more likely to develop worsening disability. Several studies have shown that the occurrence of leprosy reaction is associated with the development of physical disability.[4,20,26] This is because individuals who exhibit reactive outbreaks of leprosy are more susceptible to neural damage and possible sequelae.[4,20,26] Thus, prompt detection combined with appropriate treatment of leprosy reaction using steroid combined with multidrug therapy can be an effective strategy to prevent disability in leprosy.[11,26]

This study has some limitations. The data used was collected from routine records; therefore, the authors are unable to report on duration of illness or the timing of care. There is a need to explore delays in the diagnosis and treatment of leprosy in Nigeria. In addition, the authors are unable to explore other potential risk factors of worsening disability. Previous studies have indicated that multibacillary disease, treatment delay, educational status and irregular treatment were predictors of worsening disability;[7,19,21,27,28] these factors should be considered in further studies. Although the data used were from major leprosy referral hospitals in Southern Nigeria, it is not generalizable to the whole country. However, it has provided evidence that could inform the modification of leprosy care in Nigeria.

Table 5. Multivariable logistic regression analysis of predictors of worsening disability after treatment among leprosy patients in Southern Nigeria, 2011–2015

	Patients n (%)	Disability n (%)	Crude OR (95% CI)	Adjusted OR (95% CI)	Adjusted p-value
Age group (years)					
<15	72 (7.3)	2 (2.8)	1	1	
15–60	787 (80.0)	37 (4.7)	1.7 (0.4–7.3)	1.3 (0.2–7.9)	0.811
>60	125 (12.7)	7 (5.6)	2.1 (0.4–10.3)	1.6 (0.2–12.6)	0.648
Sex					
Female	419 (42.6)	18 (4.3)	1	1	
Male	565 (57.4)	28 (5.0)	1.2 (0.6–2.1)	1.1 (0.6–2.1)	0.841
Residence					
Urban	203 (20.6)	7 (3.4)	1	1	
Rural	781 (79.4)	39 (5.0)	1.5 (0.6–3.3)	1.5 (0.6–4.0)	0.415
Occupation					
Artisan	131 (13.3)	8 (6.1)	1	1	
Business	160 (16.3)	2 (1.3)	0.2 (0.04–0.9)	0.2 (0.1–1.0)	0.052
Civil servant	29 (2.9)	4 (13.8)	2.5 (0.7–8.8)	2.5 (0.6–10.3)	0.200
Farmer	460 (46.7)	25 (5.4)	0.9 (0.4–2.0)	0.7 (0.3–1.8)	0.483
Student/pupil	176 (17.9)	5 (2.8)	0.4 (0.1–1.4)	0.4 (0.1–1.7)	0.236
Teacher	7 (0.7)	0 (0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.988
Others	21 (2.1)	2 (9.5)	1.6 (0.3–8.2)	1.5 (0.3–8.5)	0.629
Zone					
South-south	163 (16.6)	3 (1.8)	1	1	
Southeast	642 (65.2)	24 (3.7)	2.1 (0.6–7.0)	4.7 (1.1–19.2)	0.03
Southwest	179 (18.2)	19 (10.6)	6.3 (1.8–21.8)	15.9 (3.8–67.4)	<0.001
WHO classification					
Paucibacillary	38 (3.9)	0 (0)	1	1	
Multibacillary	946 (96.1)	46 (4.9)	4.0 (0.2–60.2)	0.0 (0.0–0.0)	0.977
Patient registration					
New	879 (89.3)	39 (4.4)	1	1	
Previously-treated	105 (10.7)	7 (6.7)	1.5 (0.7–3.5)	2.5 (0.8–7.4)	0.103
Slit skin smear					
Negative	755 (76.7)	31 (4.1)	1	1	
Positive	229 (23.3)	15 (6.6)	1.6 (0.9–3.1)	1.3 (0.6–2.8)	0.435
Corticosteroid use					
Yes	68 (6.9)	11 (16.2)	4.9 (2.3–10.1)	11.7 (4.4–31.2)	<0.001
No	916 (93.1)	35 (3.8)	1	1	

OR, odds ratio.

In conclusion, this study showed that southern Nigeria has met the national target of the proportion of leprosy cases with worsening disability following treatment; and geographical zone and leprosy reaction requiring corticosteroid therapy use were its predictors. The authors recommend sustained capacity building for health professionals on better monitoring, and prompt management of leprosy and its complications.

Authors' contributions: JNC and NE conceived the study; KNU, NE, JNC, CCN, CA, CCE and OKM designed the study protocol. All authors collected data, performed data entry, and carried out the data analysis and interpretation. KNU, NE and JNC, drafted the manuscript. All authors critically revised the manuscript for intellectual content. All authors read and approved the final manuscript. JNC and KNU are guarantors of the paper.

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