Research Article

Non-communicable diseases and HIV/AIDS burden by socio-demographic characteristics in Malawi

Ansley Kasambara[1], M.S. Kamndaya[1], S.J. Masangwi[1,2], Atupele Mulaga[1]

[1] Department of Mathematical Sciences, Malawi University of Business and Applied Sciences (MUBAS) Blantyre Malawi, [2] Centre for Water, Sanitation, Health and Appropriate Technology Development (WASHTED), Malawi University of Business and Applied Sciences (MUBAS) Blantyre Malawi

Keywords: Non-communicable diseases, HIV/AIDS, NCD-HIV/AIDS, mastercard

https://doi.org/10.29392/001c.91080

Journal of Global Health Reports

Vol. 7, 2023

Background

The co-existence of non-communicable diseases (NCDs) and HIV/AIDS is a health concern that needs to be promptly addressed in Sub-Saharan Africa. However, with limited data, responding to this problem may be difficult. This paper aims to describe the burden of NCDs and HIV/AIDS within patients' socio-demographic and health facility characteristics across the cities and districts in Malawi.

Methods

We analysed health facility-based data extracted from NCD patient mastercards from 2019 to 2022 from 70 health facilities in 11 cities and districts in Malawi. Data analysis was done in R using mean, proportions, frequency distributions and charts. Hybrid k-means clustering was used to determine health facilities with similar cases.

Results

A total of 29,196 patients had at least one non-communicable disease, with 7.9% having NCDs comorbid with HIV/AIDS. The southern part of Malawi (54.2%), inland locations (69.9%) and health centres (55.3%) recorded large numbers of cases in their respective categories. The health facilities' case clustering indicated that Neno and Salima district hospitals had similar cases. About 16.1% of the young adults (19 - 39 years) had either a non-communicable disease or NCD-HIV/AIDS comorbidity. The most prominent NCD was hypertension (63.2%), followed by asthma (9.2%). The most commonly employed intervention was medication for NCD (51.6%) and NCD-HIV/AIDS comorbidity (43.4%). Only 13% of all the health facilities in the selected cities/districts used NCD mastercards from which data for this study was extracted.

Conclusions

NCDs and NCD-HIV/AIDS comorbidity among young adults pose a major concern since the ailment would lead to days off during the peak of their productivity. The NCD and NCD-HIV/AIDS comorbidity is a major public health problem that needs more attention than realised since the cases reported in this study could be under-reported.

The emergence of non-communicable diseases (NCDs) in Sub-Saharan Africa (SSA) is relatively a new burden compared to the developed world, in the rise of cases globally.[1, 2] The rise in NCDs is happening when the Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome (HIV/AIDS) epidemic is a public health concern worldwide and the majority of cases emanate from the SSA.[3-5] Low- and middle-income countries (LMICs) have seen the heaviest burden from these diseases.[3,6] NCD cases have increased in LMICs, especially in Sub-Saharan Africa, where most HIV/AIDS cases are currently reported.[3,7-9] Therefore, SSA faces the challenge of a double burden of NCDs and HIV/AIDS where comorbidity / co-existence of non-communicable diseases and Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome (NCD-HIV/AIDS) is likely to occur in an individual.[10,11]

NCDs and HIV/AIDS as separate diseases are both fatal, with high mortality rates.[12] As such, the disease severity in comorbid cases could be devastating.[13] The severity of a non-communicable disease can be aggravated if an individual has HIV/AIDS and vice-versa.[14,15] Treatment of NCD-HIV/AIDS comorbid cases may be more challenging due to drug interactions, and HIV/AIDS treatment may cause NCDs in addition to already existing NCD risk factors.[16]

NCDs have taken hold of LMICs due to the advent of rapid industrialisation, development and urbanisation that

have led to environmental risks such as air pollution and modifiable risk factors such as physical inactivity, excessive alcohol intake, poor diet and use of tobacco.[6,10,17] HIV/AIDS risk factors also border around industrialisation and urbanisation, which encourage individuals to migrate from rural to urban areas for better socio-economic status.[17,18] Migration for a better life leads to increased risk factors associated with an increased HIV infection, including poverty, unemployment, increased promiscuous behaviours, and drug abuse.[18-20] The risk factors for both diseases overlap, posing a high risk for NCD-HIV/AIDS comorbidity.[17] As such, cities and districts in SSA region that are engaged in some form of economic activity and development are likely to encourage migration from rural to urban, thereby increasing the urban poor population. Capital cities, commercial cities, lakeshore cities/districts, and border cities/districts are expected to have large numbers of NCDs, HIV/AIDS and NCD-HIV/AIDS comorbidity since they possess all the risk factors.

Furthermore, NCDs no longer affect just older adults, and since HIV/AIDS is also not age discriminatory, individuals are likely to be afflicted with the NCD-HIV/AIDS comorbidity at any age.[5,8,21,22] According to Hopkins and coauthors, relatively young adults (aged 18 to 34) are being diagnosed with NCDs (for instance, 34.6% had high blood pressure)[2] and have a higher prevalence of HIV/AIDS.[5,23]

As a country in the LMIC category and the SSA, Malawi has also experienced a fair share of disease challenges. HIV/AIDS has been a challenge which peaked in the mid-2000s and continues to be a challenge to date.[24] In recent years, we have also seen an increase in NCDs, a public health burden in Malawi, where specifically the prevalence rate of hypertension increased from 24% to 46% between 2011 and 2016 respectively.[7] These two diseases are highly likely comorbid in an individual.[3] A study by Hing discusses the growing burden of NCDs among people living with HIV (PLHIV) in LMICs and specifically Malawi,[7] attesting to the coexistence of NCD and HIV/AIDS,[25] which is increasing[26] and may even be under-diagnosed.[1]

An important consideration is that LMICs do not have robust, vital registration systems, and data is either not collected, properly documented or outright unusable.[3,11,26] This is usually the case with all health data, including data on the NCD and NCD-HIV/AIDS comorbidity, as there is either no or limited information.[1,10,13] This provides challenges in determining the extent of the NCDs and NCD-HIV/AIDS comorbidity, which likely have a high magnitude.[4,13] Hence, there is a need to describe the burden of non-communicable diseases and NCD-HIV/AIDS comorbidity cases within socio-demographic characteristics in Malawi.

The study aimed to describe the burden of NCD and NCD-HIV/AIDS comorbidity cases by socio-demographic factors. It further assesses the NCD and NCD-HIV/AIDS comorbidity health facilities from which the cases emanated.

METHODS

STUDY DESIGN

A retrospective study was conducted on non-communicable disease patients whose records were on NCD patient mastercards. Data was extracted from the NCD patient mastercards from health facilities that were using mastercards from 2019 to 2022.

STUDY POPULATION AND SAMPLE

All patients, totalling 30,686, whose NCD records were on NCD mastercards were included in the study sample. The NCD mastercard is a hard copy health card to keep records of NCD patients' diagnoses and treatment at a health facility.[27] These patients either had non-communicable disease only or NCD-HIV/AIDS comorbidity. The patients were selected from 4 cities (Blantyre, Lilongwe, Mzuzu, Zomba) and 7 districts (Karonga, Mangochi, Mchinji, Mwanza, Neno, Nkhatabay, Salima) in Malawi. The study sites were chosen due to the existence and growth of risk factors of having a non-communicable disease and HIV/AIDS due to rapid urbanisation, industrialisation and development.[6,10,17]

There were 835 health facilities from the selected cities/districts at the time of the study. These comprise government, non-government, Christian Health Association of Malawi (CHAM), mission/faith-based (other than CHAM) and privately owned facilities.[28] The facilities were categorised by type as either central hospital, district hospital, hospital, health centre, clinic or dispensary in this descending order according to the magnitude of the facility in the Master Health Facility Registry (MHFR).[28] Health facilities (n = 70) within the cities and districts were included if a facility used patient mastercards on NCDs. Thus, the health facilities were purposively sampled. Health facilities (n = 765) that were supposed to have mastercards in use but had not started or stopped using mastercards were excluded from the study.

DATA EXTRACTION

Data was extracted from the NCD patient mastercards using a data extraction tool implemented using KoboToolbox to record some pre-selected elements. Android devices were used to extract the data using forms downloaded from KoboToolBox. Trained fieldworkers extracted the data between September 2022 and February 2023. After the data extraction process was completed, a spreadsheet containing the data was generated and downloaded from KoboToolbox. Spreadsheet databases on NCDs were also obtained from the Neno district and DREAM health facility. The databases were combined to create a single database after aligning variable columns and ensuring all variable values were the same in the individual databases. Additional data on health facilities, including location and type, was extracted from the MHFR website.

DATA CLEANING

Data was cleaned using macOS Numbers spreadsheet version 13 to remove inconsistencies, errors and incomplete records from the dataset. This process also enabled easier merging of datasets since Neno District and DREAM health facility had provided digital data, which also went through the cleaning process. After the data cleaning and concatenation, the final product was an electronic database on NCDs and HIV/AIDS with their various attributes comprising 29,196 records. Data was transferred to R for analysis.

OUTCOME VARIABLES

The data extracted were for the following variables: categorical variables were patients' gender, place of residence, type of NCD, availability of NCD interventions, presence of HIV/AIDS, availability of HIV/AIDS intervention, presence of comorbidity, availability of NCD and HIV/AIDS comorbidity intervention. Date variables included: NCD diagnosis date, HIV/AIDS diagnosis date, and age was the only continuous variable. Other variables such as age group, region, designation, city/district location and health facility type were derived from the extracted data. According to the map of Malawi, the regions were north, central and south. Designation refers to whether a location is either a city or district, and city/district location refers to where the city/district is inland, border or lakeshore area. Since the data was extracted from the NCD department at every given health facility, a patient had only an NCD or a comorbidity of NCD and HIV/AIDS.

STATISTICAL ANALYSIS

Data analysis was conducted in R version 4.2.3 and RStudio version 2023.03.1+446.

Data on cases by gender, age group, city/district, region, designation, city/district location, health facility, specific NCDs, top five NCDs, interventions for non-communicable diseases, HIV/AIDS and the comorbidity were summarised using frequencies and percentage frequencies for the respective categories. Descriptive statistics of mean and standard deviation were used to summarise the age of the patients.

The cases were summarised by categories, NCD only and NCD-HIV/AIDS comorbidity, at a particular level, from national, cascading down to regional and city/district locations using frequencies and percentages. An unsupervised machine learning, a hybrid hierarchical k-means clustering, was conducted in R and RStudio using the factoextra, cluster, dendextend, ggdendro and circlize packages to group into clusters, health facilities which had similar number of cases for both non-communicable diseases and NCD-HIV/AIDS comorbidity.

Further aggregation of the cases was by gender and age group of the patients for whether the patient had an NCD only or comorbidity of NCD and HIV/AIDS and subset by region and city/district location. Cross-tabulation of gender and age groups was conducted within regions and city/district locations. Component bar charts were employed to summarise proportions of cases subset by region, city/district location and specific NCDs comorbid with HIV/AIDS within gender and age group of the patients. A Chi-Square test was also carried out to assess whether a significant association exists between a specific NCD and the presence of HIV/AIDS.

The distribution of health facilities that were using mastercards, was summarised by region, designation and geographical location. A comparative analysis to evaluate the number of health facilities using NCD mastercards per district against those without mastercards was conducted using data from the MHFR in Malawi. The purpose was to ascertain the proportion of health facilitates that were providing data using NCD mastercards, which helped determine the extent of NCDs and NCD-HIV/AIDS comorbidity.

RESULTS

The study extracted data from a total of 29,196 patients from 70 health facilities in 11 cities and districts in Malawi. All 29,196 patients had at least one non-communicable disease, and of these patients, 2,295 (7.9%) also had HIV/AIDS, which were comorbidity cases.

DEMOGRAPHICS SUMMARY OF THE PATIENTS

Table 1 presents results describing the socio-demographic characteristics of the patients with either NCD only or NCD-HIV/AIDS comorbidity. Sixty-seven percent (19,660/29,196) of the patients were females. Further statistics for age indicated that the majority (78%) of the patients were 40 years and above. Neno was the district with the highest number of cases (31%), seconded by Blantyre City (15%) (Table 1). The mean age for the patients was 53 years (SD = 19.4).

The southern part of Malawi recorded 54.2% of the non-communicable diseases and NCD-HIV/AIDS comorbidity cases, and in terms of cases by cities or districts, the districts recorded about 60.9% of the non-communicable diseases and NCD-HIV/AIDS comorbidity cases. Furthermore, the majority (69.9%) were inland city/district cases, with the least (12.8%) recorded in border districts. Health centres recorded more NCD and HIV/AIDS cases (55.3%) than other health facility types (Table 1).

Table 2 shows the distribution of the top five non-communicable diseases that afflicted the patients in this study.

There were 50 specific NCDs which had been observed among the patients. These included patients with one NCD, two NCDs and other patients with three NCDs. Hypertension emerged as the majority (63%) among the cases, with the remaining cases ranging from 9.2% to 6.3% and corresponding confidence intervals. The top five NCDs were summarised in Table 2, and the full list of non-communicable diseases is in Table S1 in the online supplementary document.

Table 3 shows the NCD and NCD-HIV/AIDS comorbidity cases were categorised by national level through region and city/district location to show the distribution of cases in order to determine the most affected areas.

Table 1. Demographics characteristics of the patients

Variable	Category	Number of Cases	Percent	Variable	Category	Number of Cases	Percent
Gender	Female	19660	67	**Age group**	0 - 18	1819	6
	Male	9536	33		19 - 39	4690	16
Region	Northern	4,955	17.0		40 or more	22687	78
	Central	8,417	28.8	**City/ District**	Neno	8985	31
	South	15,824	54.2		Blantyre	4523	15
Designation	City	11,416	39.1		Lilongwe	4009	14
	District	17,780	60.9		Salima	3134	11
City/District Location	Border	3,743	12.8		Mzuzu	2269	8
	Inland	20,401	69.9		Karonga	1672	6
	Lakeshore	5,052	17.3		Mchinji	1274	4
Health Facility Type	Central Hospitals	1855	6.4		Nkhatabay	1014	3
	District Hospitals	8684	29.7		Mangochi	904	3
	Health Centres	16143	55.3		Mwanza	797	3
	Hospitals	2514	8.6		Zomba	615	2

Table 2. Distribution of specific NCD cases

Variable	Category	Number of Cases	Percent	CI**
Specific NCD*	Hypertension	18442	63.2	[62.6, 63.7]
	Asthma	2692	9.2	[8.9, 9.6]
	Diabetes	2176	7.5	[7.2, 7.8]
	Hypertension Diabetes	2079	7.1	[6.8, 7.4]
	Epilepsy	1843	6.3	[6.0, 6.6]
	Other NCD†	1964	6.7	[6.4, 7.0]

*NCD – non-communicable disease
**CI – confidence interval
†Other NCD – See full table of NCDs in Table S1 online supplementary material

The detailed breakdown of NCD only and comorbidity cases from the national level through the regions to the location of the city/district indicated that 8% were comorbidity cases at the national level, of all cases recorded in the southern part of Malawi, 13% were also comorbidity cases, and 14% of all recorded inland cases were comorbidity cases (Table 3).

CASE CLUSTERING BY HEALTH FACILITY

Health facilities with the same magnitude are supposed to have a similar number of non-communicable diseases and NCD-HIV/AIDS comorbidity cases combined and, therefore, classified in the same group. Figure 1 shows the classification of the facilities into classes with a similar number of cases.

The hierarchical clustering of cases of NCD and HIV/AIDS within the health facilities showed that there were similarities in the number of cases for Nsambe health centre, Bangwe health centre and Kamuzu Central Hospital with an average of 537.7 cases since these facilities were grouped in the same cluster (Figure 1).

The information on health facility clustering in Figure 1 is complemented by Table 4, which details the number of clusters, the number of health facilities in the cluster and the average number of cases for the given cluster.

The highest average of 2293.5 cases was in the tenth cluster, comprised of Neno and Salima District Hospital. The lowest average of 58.1 cases was observed in the fifth cluster, comprised of Golden Outreach Clinic and 15 other health facilities (Table 4).

CASES BY GENDER AND AGE FROM REGIONS

The cases of NCD and NCD-HIV/AIDS comorbidity were grouped by gender and age groups in order to determine the

Table 3. NCD and Comorbidity cases by region and city/district location

Population	Region	City/District Location	Category	Frequency	Percent
National			NCD Only*	26,901	92
(N = 29,196)			Comorbidity**	2,295	8
	Northern Region		NCD Only	4,876	98
	(n = 4,955)		Comorbidity	79	2
		Border	NCD Only	1,637	98
			Comorbidity	35	2
		Inland	NCD Only	2,236	99
			Comorbidity	33	1
		Lakeshore	NCD Only	1,003	99
			Comorbidity	11	1
	Central Region		NCD Only	8,417	98
	(n = 8,417)		Comorbidity	200	2
		Border	NCD Only	1,250	98
			Comorbidity	24	2
		Inland	NCD Only	3,883	97
			Comorbidity	126	3
		Lakeshore	NCD Only	3,084	98
			Comorbidity	50	2
	Southern Region		NCD Only	13,808	87
	(n = 15,824)		Comorbidity	2,016	13
		Border	NCD Only	788	99
			Comorbidity	9	1
		Inland	NCD Only	12,159	86
			Comorbidity	1,964	14
		Lakeshore	NCD Only	861	95
			Comorbidity	43	5

*NCD Only represents number of cases with one or more non-communicable diseases.
**Comorbidity represents the number cases with one or more NCDs coexisting with HIV/AIDS

proportion of cases from each region with respect to these demographic characteristics (Figure 2).

The NCD and comorbidity cases summarised by region with respect to gender and age groups of the patients indicate that cases were higher within the age group 40 years and above. Female patients made up a large number of cases in the 40 years and above in all the regions for both NCD and comorbidity cases. About 16.1% of the young adults (19 - 39 years) had either a non-communicable disease or NCD-HIV/AIDS comorbidity. Specifically, 14.8% had a non-communicable disease only, while 1.3% had a NCD-HIV/AIDS comorbidity. In the young adult age group, the southern part of Malawi had 14.29% and 3.03% comorbidity cases in females and males. Generally, the cases of NCD only and the NCD-HIV/AIDS comorbidity were especially higher among women in all regions (Figure 2).

CASES BY GENDER AND AGE FROM CITY/DISTRICT LOCATION

The proportions of NCD and NCD-HIV/AIDS cases considering the city/district locations were also grouped using the demographic characteristics, gender and age groups to ascertain the locations with the proportion of cases (Figure 3).

Classifying cases from a particular city/district designation (border, inland and lakeshore) by gender and age also showed that the age group, 40 years and above, had large numbers for NCD only and comorbidity cases in all designations. The cases were lower among males for the two upper age groups compared to the lower age group, 0 to 18 years old, in city/district locations (Figure 3).

SPECIFIC NCDS AND HIV/AIDS COMORBIDITY

The top five NCDs are shown in Table 2. The specific NCDs occurrence comorbid with HIV/AIDS was particularly important in showing the proportion of comorbid cases (Table 5).

The non-communicable diseases have been shown to occur with HIV/AIDS, which was referred to as a general term comorbidity. However, given the top five NCDs, specific comorbidity between a particular NCD and HIV/AIDS indicated the majority being the comorbidity of hypertension and HIV/AIDS (4.76%). The comorbidity of diabetes and HIV/AIDS was 0.54% of the cases (Table 5). The Chi-

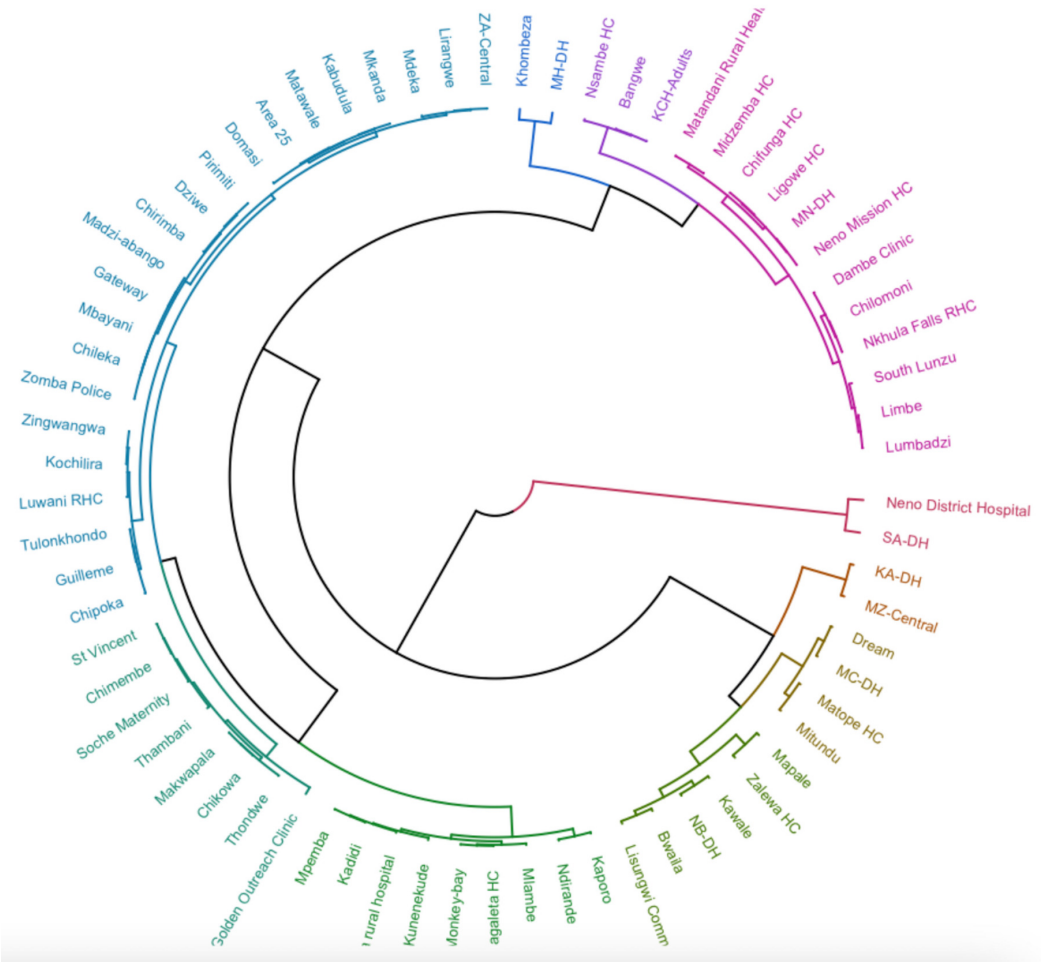

Figure 1. Dendrogram of the distribution of similar cases.

Table 4. Average number of cases per cluster

Cluster No.	Health Facility§	No. of health facilities‡	Average No. of Cases
1	ZA-Central	14	135.9
2	Nsambe HC	3	537.7
3	Mapale	6	1015.0
4	Matandani Rural Health Centre	12	385.4
5	St Vincent	16	58.1
6	Mpemba	9	243.3
7	Dream	4	874.6
8	KA-DH (Karonga Distr. Hosp.)	2	1180
9	Khombeza	2	700
10	Neno District Hospital	2	2293.5

§ lead health facility in a given cluster in the dendrogram
‡ number of health facilities in a given cluster

Square test of association indicated that there was a significant association between the specific non-communicable disease and HIV/AIDS (χ^2=812.62, P<0.0001). The Cramer's V statistics of 1.67 at 5 degrees of freedom express a moderate association between the specific non-communicable disease and HIV/AIDS.

The NCD-HIV/AIDS comorbidity cases were divided into specific NCD and HIV/AIDS comorbidity cases categorised by gender (Figure 4) and also categorised by age group (Figure 5) of the patients.

Hypertension comorbid with HIV/AIDS was high for both gender but specifically higher among women (38.8%) compared to men (21.8%). The comorbidity of diabetes and HIV/AIDS followed with 3.8% and 3.1% among women and men respectively. This trend of higher proportions among

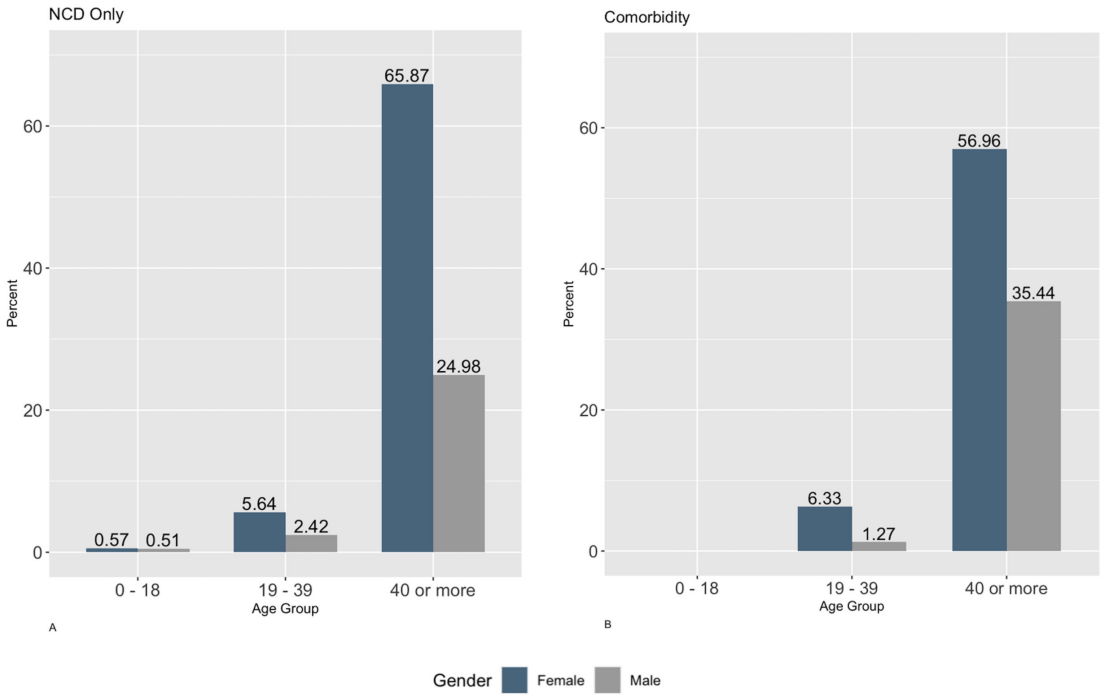

Figure 2. Panel A. Northern region cases of NCD Only by age group and gender. Panel B. Northern region comorbidity cases by age group and gender.

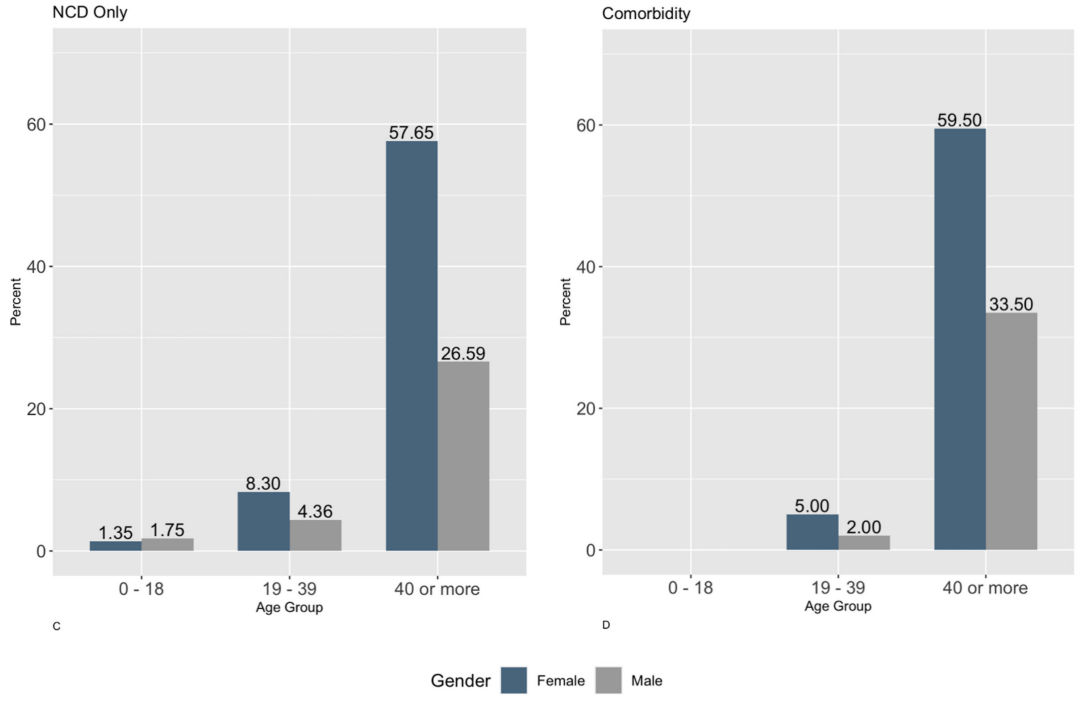

Figure 2. Panel C. Central region cases of NCD Only by age group and gender. Panel D. Central region comorbidity cases by age group and gender.

women is observed in all the specific NCDs being comorbid with HIV/AIDS (Figure 4).

The comorbidity of a specific NCD and HIV/AIDS among the different age groups are given in Figure 5. The age group 40 years or more had a large number of cases with most cases being the comorbidity of hypertension and HIV/AIDS (56.3%). There were many (7.9%) of various NCDs co-morbid with HIV/AIDS among the young adult (19 - 39) age group which implied that hypertension and HIV/AIDS co-morbidity was also prominent (4.3%) compared to the other NCDs among young adults.

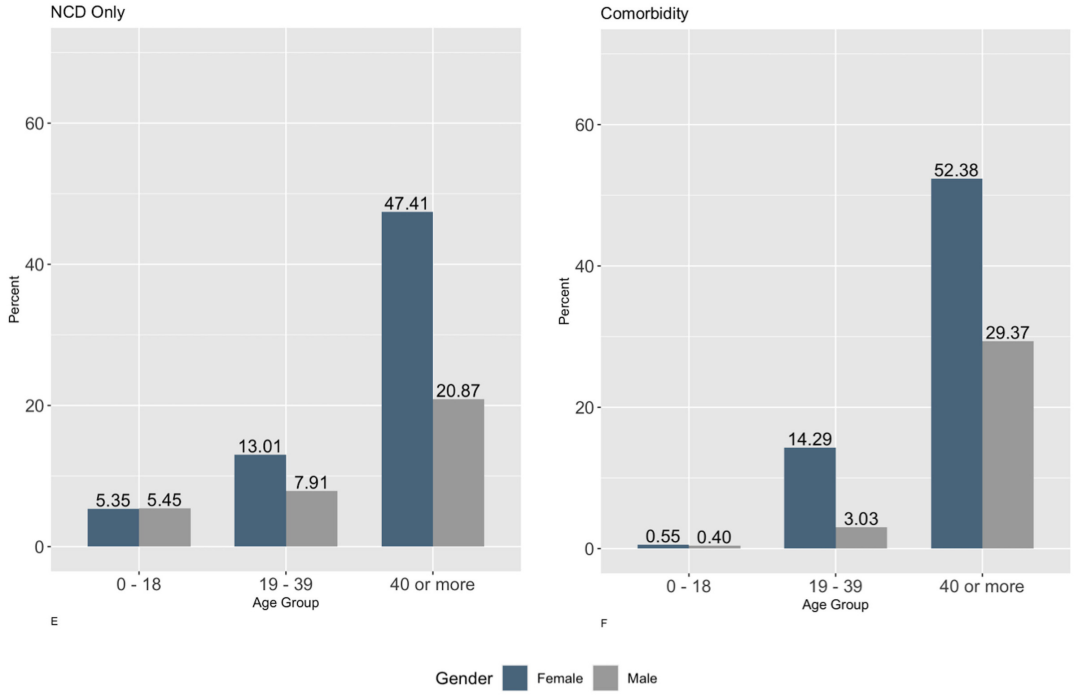

Figure 2. Panel E. Southern region cases of NCD Only by age group and gender. Panel F. Southern region comorbidity cases by age group and gender.

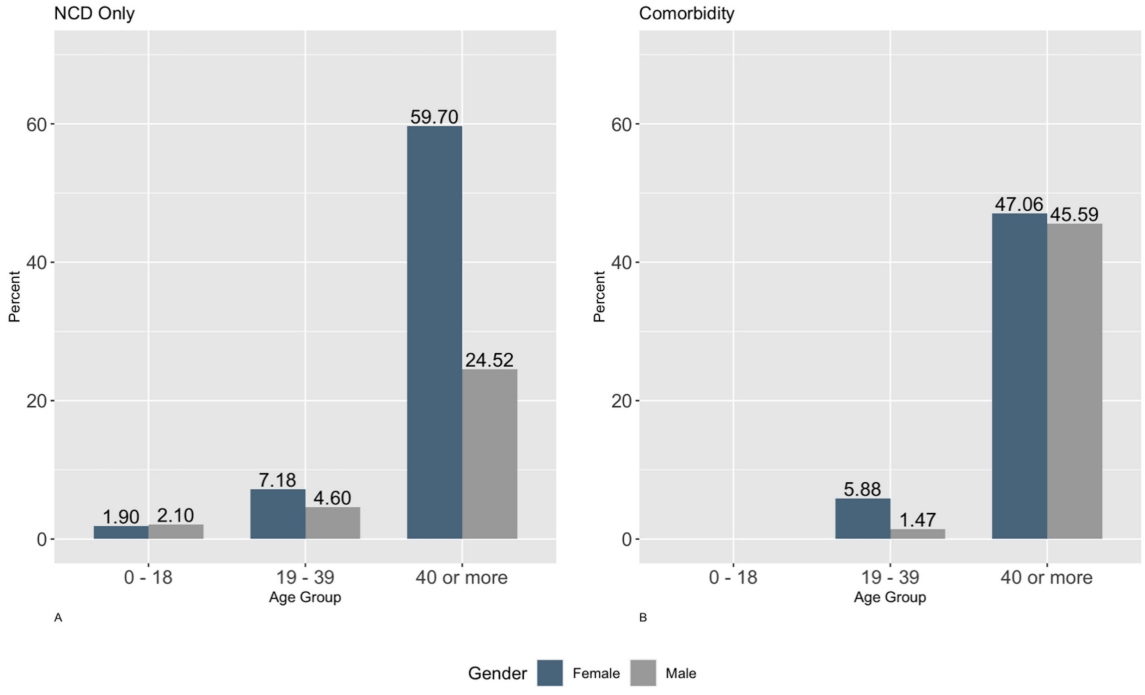

Figure 3. Panel A. Border location cases of NCD Only by age group and gender. Panel B. Border location comorbidity cases by age group and gender.

INTERVENTIONS

The study further sought to describe the proportion of the study patients who were on intervention for either NCD or NCD-HIV/AIDS comorbidity to assess the coverage extent of the interventions (Table 6).

All 29,196 patients had at least a non-communicable disease; of these, about 80% had access to some form of intervention. There were 2,295 (7.9%) patients with HIV/AIDS, and 90% of those with HIV/AIDS had access to interventions. Among the 2,295 patients who had a comorbidity of NCD and HIV/AIDS, 64% had interventions for both ailments.

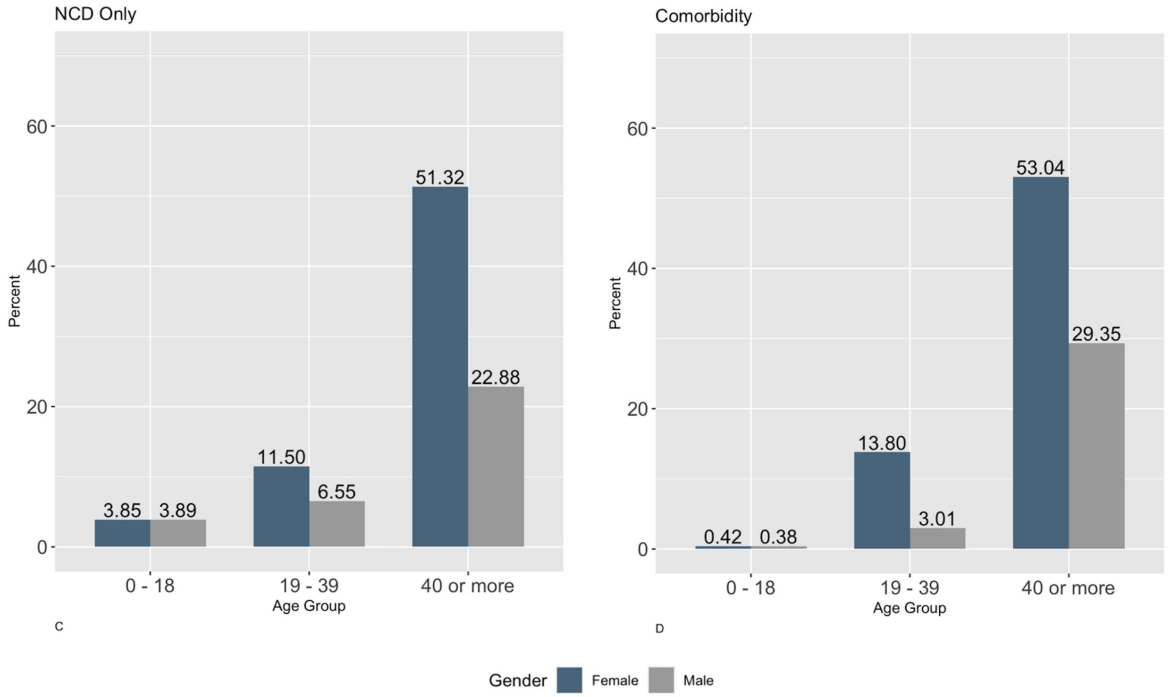

Figure 3. Panel C. Inland location cases of NCD Only by age group and gender. Panel D. Inland location comorbidity cases by age group and gender.

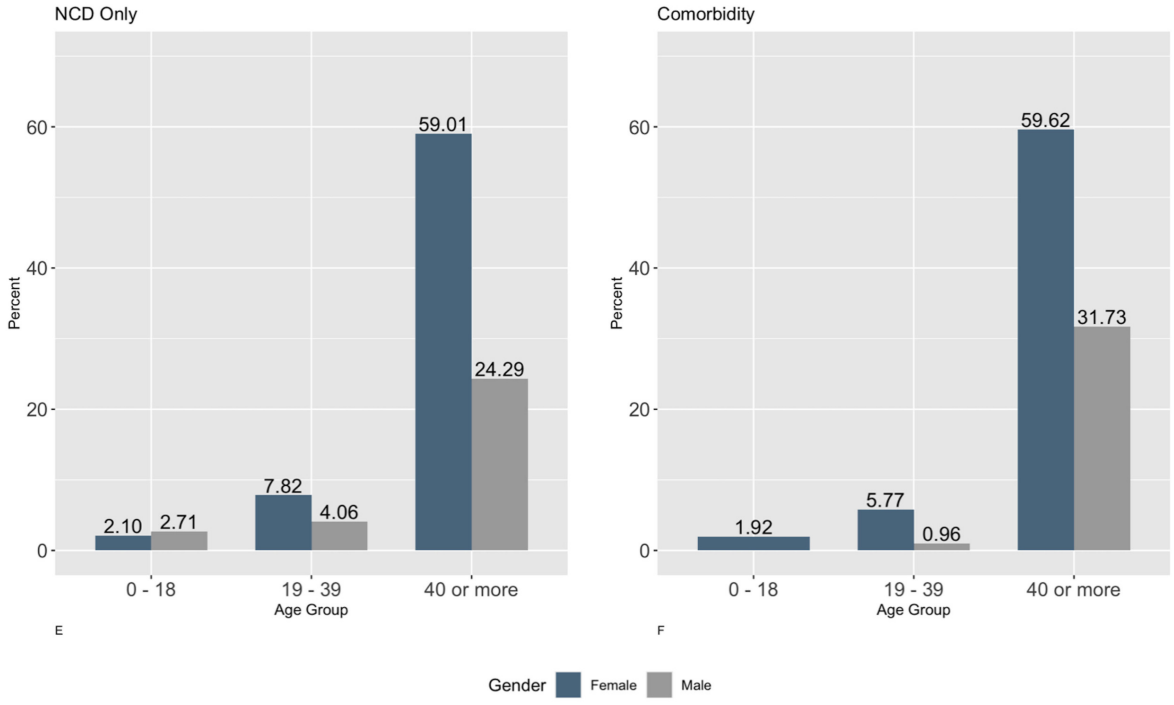

Figure 3. Panel E. Lakeshore location cases of NCD Only by age group and gender. Panel F. Lakeshore location comorbidity cases by age group and gender.

Specifically, the majority (51.6%) of the NCD patients were on medication, while some had some combinations of interventions, such as outreach/sensitisation on risk factors and physical fitness (14.0%). Antiretroviral therapy (ART) (89.8%) was the main intervention for HIV/AIDS, while 9.1% had no intervention. Comorbidity intervention had 43.4% of the patients on medication intervention for NCD and HIV/AIDS. There were also 35.8% of the patients who had no interventions for the comorbidity (Table 6).

Table 5. Specific NCD and HIV/AIDS comorbidity

Specific NCD		HIV/AIDS Present		Totals
		No	Yes	
Asthma	No. of Cases	2587	105	2692
	Percent (%)	8.86	0.36	9.22
Diabetes	No. of Cases	2018	158	2176
	Percent (%)	6.91	0.54	7.45
Epilepsy	No. of Cases	1758	85	1843
	Percent (%)	6.02	0.29	6.31
Hypertension	No. of Cases	17051	1391	18442
	Percent (%)	58.40	4.76	63.17
Hypertension Diabetes	No. of Cases	1990	89	2079
	Percent (%)	6.82	0.30	7.12
Other NCD	No. of Cases	1497	467	1964
	Percent (%)	5.13	1.60	6.73
Totals	No. of Cases	26901	2295	29196
	Percent (%)	92.14	7.86	100.00

*NCD – non-communicable disease

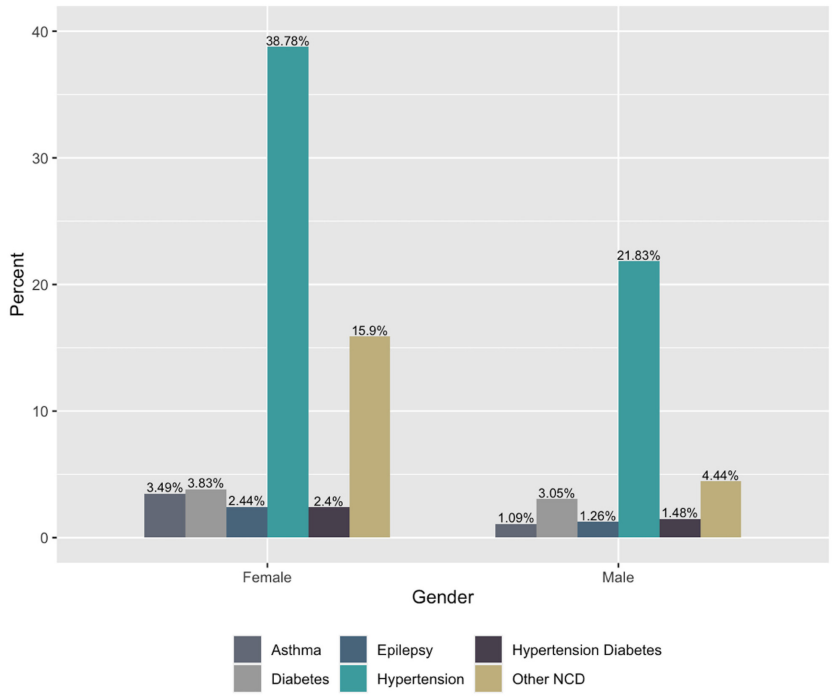

Figure 4. Specific NCD and HIV/AIDS comorbidity categorised by gender.

HEALTH FACILITIES USING NCD MASTERCARDS

The health facilities were detailed within the region, designation and geographical location to determine the distribution of the facilities using NCD mastercards.

The southern part of Malawi had the largest number of facilities (71.4%). Cities had a slightly larger number of facilities (54.3%) compared to the districts. Furthermore, 12.9% of health facilities were in the lakeshore districts (Table 7).

Table 8 presents the total number of facilities in a particular city/district and determines the proportion of facilities that were using NCD mastercards at the time of this study (excluding private facilities which did not use NCD mastercards) to indicate the extent of information available for this study with respect to health facilities.

The total number of health facilities per city or district and the percentage of facilities using NCD mastercards per district reflected the utilisation of mastercards. This ratio consists of all facilities, excluding private ones, since they

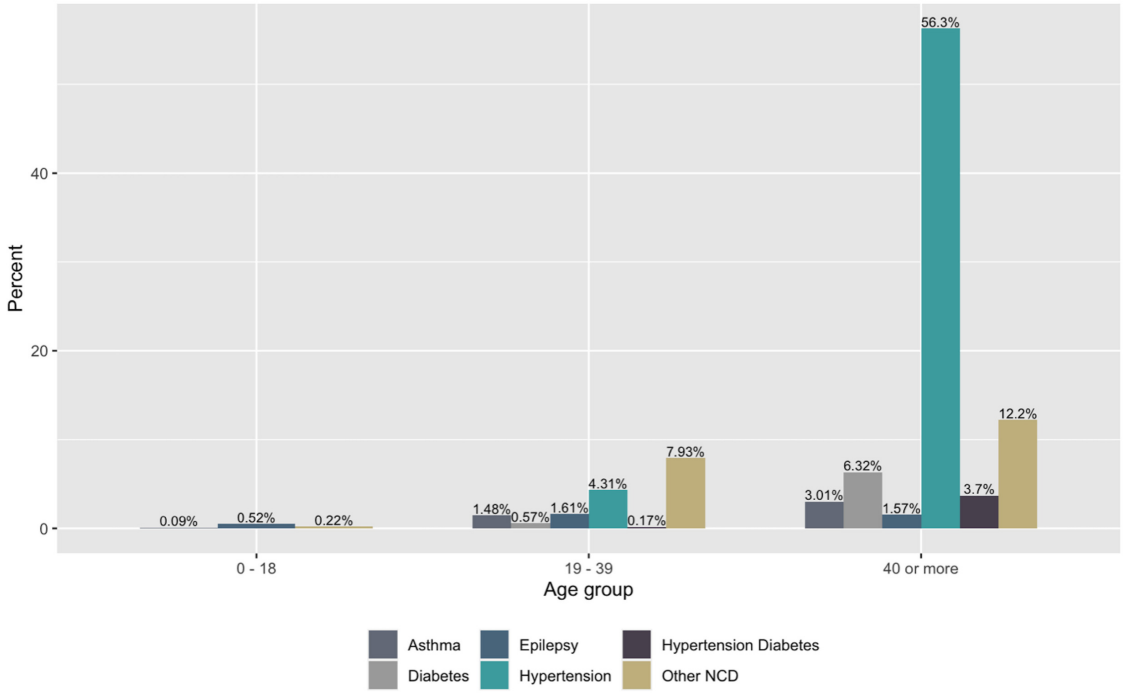

Figure 5. Specific NCD and HIV/AIDS comorbidity categorised by age group.

Table 6. Types of intervention for NCD, HIV/AIDS and the comorbidity

Disease	Type of Intervention	No. of Cases	Percent
NCD	Medication	15,059	51.58
	Medication, Outreach/Sensitisation on risk factors	3,022	10.35
	Medication, Outreach/Sensitisation on risk factors, Physical fitness	854	2.93
	Medication, Physical fitness	66	0.23
	None	5,824	19.95
	Outreach/sensitisation on risk factors	250	0.86
	Outreach/sensitisation on risk factors, Physical fitness	4,083	13.98
	Physical fitness	38	0.13
HIV/AIDS	ART*	2,061	89.80
	ART, Outreach/Sensitisation on risk factors	24	1.05
	None	209	9.11
	Outreach/ sensitisation on risk factors	1	0.04
Comorbidity†	Medication	995	43.36
	Medication, Outreach/ Sensitisation on risk factors	58	2.53
	Medication, Outreach/ Sensitisation on risk factors, Physical fitness	409	17.82
	Medication, Physical fitness	11	0.48
	None	822	35.82

*ART – Antiretroviral therapy
†Comorbidity intervention referred to a patient having interventions for both NCD and HIV/AIDS

did not use NCD mastercards. Neno district had all health facilities using mastercard, with the lowest ratio being from Mangochi (3.4%). The rest of the cities and districts also had low mastercard utilisation ratios (Table 8).

DISCUSSION

The study's main purpose was to describe NCD and NCD-HIV/AIDS comorbidity using the socio-demographic factors. Additionally, health facilities which handled and provided data on the cases were assessed considering the total number of health facilities in the sampled areas.

Table 7. Health facilities by region, designation, and city/district location

Variable	Category	No. Of Health facilities	Percentage
Region	Northern	6	8.6
	Central	14	20.0
	South	50	71.4
Designation	City	38	54.3
	District	32	45.7
City/District Location	Border	11	15.7
	Inland	50	71.4
	Lakeshore	9	12.9

Note: Karonga is both a border and lakeshore district

Table 8. Health facilities in Malawi vs facilities using NCD mastercards

City/ District	Total number of facilities	Private facilities	Non-private facilities‡	Facilities using NCD Mastercards	Percentage of non-private facilities using mastercards§
Karonga	43	11	32	3	9.4
Mzuzu	111	29	82	2	2.4
Nkhatabay	37	10	27	1	3.7
Lilongwe	197	92	105	7	6.7
Mchinji	39	9	30	4	13.3
Salima	33	12	21	3	14.3
Blantyre	195	111	84	22	26.2
Mangochi	82	23	59	2	3.4
Mwanza	8	1	7	4	57.1
Neno	19	4	15	15	100.0
Zomba	71	17	54	7	13.0
Total	835	319	516	70	13.6

‡Non-private facilities = Total number of facilities less Private facilities
§Percentage of non-private facilities using mastercards = (Facilities using NCD Mastercards/Non-private facilities) * 100

DEMOGRAPHICS SUMMARY

Women had the highest number of cases of NCD and/or HIV/AIDS. This concurs with the NCD Alliance and The George Institute for Global Health report that discusses the heavy burden of NCD falling on women.[29] Thus, women are most affected by NCDs and the NCD-HIV/AIDS comorbidity compared to men and children.[22]

Although individuals aged 40 years or older had the highest number of cases, NCDs and HIV/AIDS affect all age groups,[5,8] with higher prevalence among those aged 70 years and above.[22] Thus, the younger age groups are also affected by NCDs and HIV/AIDS.[8,23]

Cities in the southern part of Malawi had larger cases as expected since cities are where rapid urbanisation and industrialisation were at their peak.[10] This implies a high prevalence of risk factors for both NCDs and HIV/AIDS.[6] Among the districts included in the study, Neno district had large cases due to an advanced/robust data collection system implemented in all health facilities using NCD mastercards. The other districts did not have robust data collection systems, which led to a few health facilities collecting data using NCD mastercards; hence, data that could have been used in decision-making and implementation of the intervention was unavailable.[3,11,26]

CASES BY REGION, DESIGNATION, CITY/DISTRICT LOCATION AND TYPE OF HEALTH FACILITY

Southern region had many cases compared to the other region, which would be attributed to more health facilities in the region and two cities. Cities have a higher risk of both NCD and HIV/AIDS due to industrialisation, globalisation and urbanisation, hence contributing to the higher number of cases in the region.[5,8,10]

The number of cases by cities or districts revealed more cases in districts. The study comprised 7 districts, implying that more districts than cities contributed to the larger number of cases. As a larger percentage of cases were coming from Neno district, this higher number of cases could be due to the robust data collection.[11,26] Considering the number of cases recorded in Neno, an inland district, we may speculate that the other cities and districts may have underreported or under-diagnosed NCD and/or HIV/AIDS cases.[1,3] Border areas had the least number of cases of NCD

and/or HIV/AIDS, and this may be attributed to lower populations in the areas.

Similarly, central hospitals, also known as referral hospitals, do not provide basic help to patients; hence, low cases are registered. The lower number of cases may not be a true reflection of the cases, with Neno district as our case in point.[1] The number of comorbidity cases was relatively smaller compared to NCD cases. The probability of the comorbidity indicated that the likelihood of having the comorbidity was higher in the southern region. Inland areas in the southern region accounted for a higher probability of comorbidity, which can be attributed to more comorbidity risk factors for both NCD and HIV/AIDS. These probabilities could increase as many patients with NCD are potentially at risk of comorbidity.[7]

CASE CLUSTERING BY HEALTH FACILITY

According to the number of cases, health facility clusters indicated that different health facilities were grouped. The expectation was that health facilities of the same calibre would be clustered together. This implies that the average number of cases was also supposed to be similar in the type of similar health facilities. However, this was contrary to expectation since health centres, hospitals, district hospitals, and central hospitals were in the same clusters, which is not supposed to be the case due to the calibre of the health facilities according to the MHFR.[28] Despite the unanticipated similarities, the clustering will help plan intervention activities, such as integrated care, by prioritising health facilities with many cases clustered together.[3]

CASES BY GENDER AND AGE FROM REGIONS, CITY/DISTRICT LOCATION

NCDs only, as well as the comorbidity, were dominant in individuals aged 19 years and above, regardless of the region. Despite the northern region having a few cases, the relative number of NCD cases was higher for those aged 40 or more than the other regions. According to World Health Organisation (WHO), both NCDs and HIV/AIDS are not discriminatory in affecting particular age groups or regions.[5,8] This may indicate that in some clusters, the low number of cases might be due to under-diagnosed or under-reported cases.[1, 3]

Considering the gender of the patients, females reported higher numbers in both NCD only and the comorbidity from all regions. This could be attributed to the study's higher number of female patients. Compared to males, the relative number of NCD only and comorbidity cases were also higher for females aged 19 and above in all city/district locations. As reported by the NCD Alliance, NCDs in women may be under-reported in other areas, but this does not seem to be the case in Malawi.[29]

Comorbidities were higher among men aged 40 or more from all regions than other age groups. These cases were lower for those aged 19 to 39 in all regions and city/district designations. Although fewer cases were recorded in this age group, this was still a concern because these individuals are at the peak of their productivity, and these chronic ailments may lead to productivity loss.[30] The age group 18 and below had very small numbers of either NCD only or comorbidity cases from the regions and city/district designations since NCDs and/or HIV/AIDS cases are usually fewer among young people. Although these diseases affect all age groups, older groups are at higher risk, hence more cases.[8]

SPECIFIC NON-COMMUNICABLE DISEASES

The top five non-communicable diseases observed from this study were asthma, diabetes, epilepsy, hypertension and hypertension-diabetes comorbidity. Hypertension was the prominent NCD, followed by asthma. According to WHO, cardiovascular diseases, which include hypertension and are also considered risk factors for other cardiovascular diseases, are the leading cause of mortality, followed by respiratory diseases (including asthma).[8] These NCDs were also prominent in terms of comorbidity with HIV/AIDS. Hypertension specifically has been comorbid with HIV in most studies, including those on PLHIV and non-communicable diseases.[2-4,13] The prominent NCDs included a multi-morbid case of hypertension and diabetes and HIV/AIDS, as diabetes usually occurs in those taking hypertension medication and vice-versa.[31,32] Other multi-morbidity cases were reported in small numbers and were categorised under other NCD. The comorbidity cases were higher among women in the top five NCDs identified in this study with majority having the hypertension and HIV/AIDS comorbidity.[2] This iterates the high prevalence of hypertension as mentioned by WHO and others.[2,8] However, the majority of cases being women differed from the NCD Alliance report of unreported cases among women hence low prevalence among women.[29] The comorbidities among the age groups showed the older age group (40 and above), consistent with WHO non-communicable diseases report,[8] had the largest number of cases with hypertension and HIV/AIDS comorbidity accounting for majority of cases.[2,7] According to WHO, NCDs and HIV/AIDS are not age discriminatory, hence it is important to note that the young adults age group (19 – 39 years) also had the NCD-HIV/AIDS comorbidity, although NCDs are considered diseases for older people. Hypertension comorbid with HIV/AIDS was also the prominent comorbidity among the young adult age group.[5, 8]

INTERVENTIONS

A study by Akseer showed that data on effective interventions for non-communicable diseases was limited.[33] This study found that medication was the main intervention prescribed for NCD and the NCD-HIV/AIDS comorbidity, given that most were already afflicted with either a particular NCD or NCD-HIV/AIDS comorbidity. Outreach/sensitisation on risk factors and physical fitness were also among the intervention strategies for the cases observed. Furthermore, outreach/sensitisation on risk factors and physical fitness are important in managing NCD and HIV/AIDS risk factors and are more beneficial preventive measures. However, those afflicted can avoid exposure to more risk factors

and exercise to improve overall health.[34] It was instead an odd outcome that a few individuals were not on any intervention considering the severity of NCDs or HIV/AIDS or NCD-HIV/AIDS comorbidity.

HEALTH FACILITIES USING NCD MASTERCARDS

Health facilities using mastercards were very few compared to the total number of health facilities available. The southern region comprised most of the facilities included in this study but represented about 13% of all facilities in the cities and districts.[28] The same trend was observed in the other regions, city/district designation and location and within cities/districts except for Neno. Therefore, cases of NCDs and HIV/AIDS from health facilities not using NCD mastercards were/are not accounted for. This points to the fact that NCDs and NCD-HIV/AIDS comorbidity may be a bigger problem than anticipated.[3]

STRENGTHS AND LIMITATIONS

This study has several limitations. The number of health facilities using mastercards were few compared to the total number of facilities within the different locations. A few facilities using mastercards imply that there could be underreporting of cases. However, only these facilities using NCD mastercards could provide the data required for this study. Although the information on mastercards mostly aligns with health facility-based data, it is important to consider the demographic characteristics of patients with both NCDs and HIV before extrapolating findings from this study to the Malawi population. Also, although the recorders of NCD patient's mastercards were well trained, and there is no reason to believe they would withhold/make up any symptom/ medical condition, it is always possible that such paper-based recorded reports lack accuracy.

The k-means clustering is sensitive to outliers that are unusual or data points that are extreme. Furthermore, k-means clustering is sensitive to the initial random selection of cluster centres. The limitations of the k-means clustering were mitigated by the combining the hierarchical clustering and k-means method. Thus, although the study had some extreme values from Salima and Neno districts, these values did not affect that analysis since the algorithm was able to cluster them properly.

IMPLICATION FOR POLICY AND FUTURE RESEARCH

The study provides evidence of a growing number of non-communicable diseases and NCD-HIV/AIDS cases, especially in the southern region of Malawi, a LMIC in Sub-Saharan Africa. The data providing this evidence was extracted from only 13% of health facilities in the study cities and districts, which may be an indication of cases being underreported; therefore, NCDs and NCD-HIV/AIDS should be considered a major concern requiring interventions in Malawi. LMICs with similar settings as Malawi could also be guided in planning interventions. Research is needed on a prospective study on individuals' lifestyles until they have a non-communicable disease or the NCD-HIV/AIDS comorbidity to provide insight on best intervention practices. Furthermore, we highlight the lack of robust data collection, which affects data quality, thereby causing health managers to have difficulties in decision-making on non-communicable diseases and NCD-HIV/AIDS comorbidity.

CONCLUSIONS

This study on NCD and NCD-HIV/AIDS comorbidity cases indicated that inland locations and the southern region in Malawi comprised the highest number of cases. Further detailed information on cases per health facility provides insight into heavily affected areas such that they are prioritised for intervention strategies. The results indicate that the young adult age group, 19 to 39 years, are also affected by NCDs and NCD-HIV/AIDS comorbidity, considering that NCDs mainly used to affect older age groups. The young adult age group are at the peak of their productivity, and being afflicted with these diseases would imply a loss in productivity. The study provides evidence of the cases recorded through the NCD mastercards and with respect to the number of facilities using the NCD mastercards only. Therefore, the NCD and NCD-HIV/AIDS comorbidity is a huge health concern which requires attention.

The study therefore recommends outreach and sensitisation about NCDs and NCD-HIV/AIDS and their risk factors especially in areas with high number of cases as well as among the young adults. Another important recommendation to improve monitoring and follow-up of patients, and at national level, progress on NCDs and HIV/AIDS indicators, is to have electronic patient records instead of paper-based records that are prone to many disadvantages.

ACKNOWLEDGEMENTS

We sincerely thank the patients, the data clerks at the health facilities and District Health Office DHMTs for supporting this project. In particular, special thanks to the research assistants: Steven Kayipa, Madalitso Tambala, Emmanuel Guzani, Alfred Ephraim, Hanna Bello, Emily Chisale, Alick Doben, Wiseman James, Lazarus Bamusi and Mariam Muhajiri who were instrumental in data extraction.

ETHICS STATEMENT

The study obtained ethical clearance from the National Committee on Research in the Social Sciences and Humanities (NCRSH), an ethics committee under the National Commission for Science and Technology (NCST) with the protocol reference number P.01/1/22/613.

FUNDING

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Malawi University of Business and Applied Science provided funding for the study.

AUTHORSHIP CONTRIBUTIONS

AK was responsible for the data collection; MK and AK conceived, designed and planned the study; AK analysed and interpreted the data and wrote the first draft of the manuscript; SM and AM interpreted the data and wrote the final draft of the manuscript together with MK and AK. All authors have critically reviewed and approved the final version of the manuscript.

DISCLOSURE OF INTEREST

The authors completed the Unified Competing Interest form at http://www.icmje.org/disclosure-of-interest/ (available upon request from the corresponding author), and declare no conflicts of interest.

ADDITIONAL MATERIAL

The article contains additional information as an Online Supplementary Document which comprises of the 50 types of NCDs identified in this study.

CORRESPONDENCE TO:

Department of Mathematical Sciences
School of Science and Technology
Malawi University of Business and Applied Sciences
Private Bag 303
Chichiri, BT3
Blantyre, Malawi.
email: akasambara@mubas.ac.mw

Submitted: October 06, 2023 GMT, Accepted: December 03, 2023 GMT

REFERENCES

1. Achwoka D, Waruru A, Chen TH, et al. Noncommunicable disease burden among HIV patients in care: a national retrospective longitudinal analysis of HIV-treatment outcomes in Kenya, 2003-2013. *BMC Public Health*. 2019;19(1):372. doi:10.1186/s12889-019-6716-2

2. Hopkins KL, Hlongwane KE, Otwombe K, et al. The substantial burden of non-communicable diseases and HIV-comorbidity amongst adults: Screening results from an integrated HIV testing services clinic for adults in Soweto, South Africa. *EClinicalMedicine*. 2021;38:101015. doi:10.1016/j.eclinm.2021.101015

3. Adeyemi O, Lyons M, Njim T, et al. Integration of non-communicable disease and HIV/AIDS management: a review of healthcare policies and plans in East Africa. *BMJ Glob Health*. 2021;6(5):e004669. doi:10.1136/bmjgh-2020-004669

4. Kansiime S, Mwesigire D, Mugerwa H. Prevalence of non-communicable diseases among HIV positive patients on antiretroviral therapy at joint clinical research centre, Lubowa, Uganda. *PLoS ONE*. 2019;14(8):e0221022. doi:10.1371/journal.pone.0221022

5. WHO. HIV: Fact Sheet. Published 2023. Accessed June 9, 2023. https://www.who.int/news-room/fact-sheets/detail/hiv-aids

6. UNAIDS. Responding to the Challenge of Non-communicable Diseases. Joint United Nations Programme on HIV/AIDS. Published 2019. Accessed June 28, 2023. https://www.unaids.org/en/resources/documents/2019/responding-to-the-challenge-of-non-communicable-diseases

7. Hing M, Hoffman RM, Seleman J, Chibwana F, Kahn D, Moucheraud C. 'Blood pressure can kill you tomorrow, but HIV gives you time': illness perceptions and treatment experiences among Malawian individuals living with HIV and hypertension. *Health Policy and Planning*. 2019;34(Supplement_2):ii36-ii44. doi:10.1093/heapol/czz112

8. WHO. Non-communicable diseases: Fact Sheet. Published 2022. Accessed June 12, 2023. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

9. WHO. HIV: Facts in pictures. Published 2022. Accessed June 25, 2023. https://www.who.int/news-room/facts-in-pictures/detail/hiv-aids

10. Bigna JJ, Noubiap JJ. The rising burden of non-communicable diseases in Sub-Saharan Africa. *The Lancet Global Health*. 2019;7(10):e1295-e1296. doi:10.1016/s2214-109x(19)30370-5

11. Patel P, Rose CE, Collins PY, et al. Non-communicable diseases among HIV-infected persons in low- income and middle-income countries: a systematic review and meta-analysis. *AIDS*. 2018;32(Suppl 1):S5-S20. doi:10.1097/qad.0000000000001888

12. Crabtree-Ramírez B, Del Río C, Grinsztejn B, Sierra-Madero J. HIV and Noncommunicable Diseases (NCDs) in Latin America: A Call for an Integrated and Comprehensive Response. *J Acquir Immune Defic Syndr*. 2014;67:S96-S98. doi:10.1097/qai.0000000000000261

13. Getahun Z, Azage M, Abuhay T, Abebe F. Comorbidity of HIV, hypertension, and diabetes and associated factors among people receiving antiretroviral therapy in Bahir Dar city, Ethiopia. *J Comorb*. 2020;10:1-12. doi:10.1177/2235042x19899319

14. Petersen M, Yiannoutsos CT, Justice A, Egger M. Observational Research on NCDs in HIV-Positive Populations: Conceptual and Methodological Considerations. *J Acquir Immune Defic Syndr*. 2014;67(01):S8-S16. doi:10.1097/qai.0000000000000253

15. Remais JV, Zeng G, Li G, Tian L, Engelgau MM. Convergence of non-communicable and infectious diseases in low- and middle-income countries. *International Journal of Epidemiology*. 2013;42(1):221-227. doi:10.1093/ije/dys135

16. Monroe AK, Rowe TL, Moore RD, Chander G. Medication adherence in HIV-positive patients with diabetes or hypertension: a focus group study. *BMC Health Serv Res*. 2013;13(1):488. doi:10.1186/1472-6963-13-488

17. Haregu TN, Setswe G, Elliott J, Oldenburg B. National responses to HIV/AIDS and non-communicable diseases in developing countries: analysis of strategic parallels and differences. *Journal of Public Health Research*. 2014;3(1):jphr.2014.99. doi:10.4081/jphr.2014.99

18. American Psychological Association. HIV/AIDS and socio-economic status. Accessed June 28, 2023. https://www.apa.org/pi/ses/resources/publications/hiv-aids

19. McCombe G, Murtagh S, Lazarus JV, et al. Integrating diabetes, hypertension and HIV care in Sub-Saharan Africa: a Delphi consensus study on international best practice. *BMC Health Serv Res*. 2021;21(1):1235. doi:10.1186/s12913-021-07073-0

20. Rokhmah D, Khoiron. The role of sexual behavior in the transmission of HIV and AIDS in adolescent in Coastal Area. *Procedia Environmental Sciences*. 2015;23:99-104. doi:10.1016/j.proenv.2015.01.015

21. UNAIDS. Learning lessons from the AIDS response to control NCDs. Published 2018. Accessed June 28, 2023. https://www.unaids.org/en/resources/presscentre/featurestories/2018/september/learning-lessons-from-the-aids-response-to-control-ncds

22. Mini GK, Thankappan KR. Pattern, correlates and implications of non-communicable disease multimorbidity among older adults in selected Indian states: a cross-sectional study. *BMJ Open*. 2017;7(3):e013529. doi:10.1136/bmjopen-2016-013529

23. Risher KA, Cori A, Reniers G, et al. Age patterns of HIV incidence in eastern and southern Africa: a modelling analysis of observational population-based cohort studies. *Lancet HIV*. 2021;8(7):e429-e439. doi:10.1016/s2352-3018(21)00069-2

24. Zulu LC, Kalipeni E, Johannes E. Analyzing spatial clustering and the spatiotemporal nature and trends of HIV/AIDS prevalence using GIS: the case of Malawi, 1994-2010. *BMC Infect Dis*. 2014;14(1):285. doi:10.1186/1471-2334-14-285

25. Angwenyi V, Aantjes C, Kajumi M, De Man J, Criel B, Bunders-Aelen J. Patients experiences of self-management and strategies for dealing with chronic conditions in rural Malawi. *PLoS ONE*. 2018;13(7):e0199977. doi:10.1371/journal.pone.0199977

26. Gonah L, Moodley I, Hlongwana K. Capacity of antiretroviral therapy sites for managing NCDs in people living with HIV in Zimbabwe. *S Afr J HIV Med*. 2020;21(1):a1113.

27. Zimba CC, Akiba CF, Matewere M, et al. Facilitators, barriers and potential solutions to the integration of depression and non-communicable diseases (NCDs) care in Malawi: a qualitative study with service providers. *Int J Ment Health Syst*. 2021;15(59).

28. MoH. Master health facility registry. Republic of Malawi. Accessed May 5, 2023. https://zipatala.health.gov.mw/

29. The NCD Alliance. The George Institute for Global Health. Delivering healthy lives and well-being for women and girls: Non-communicable Diseases and Universal Health Coverage. NCD Alliance. Published 2019. Accessed July 2, 2023. https://ncdalliance.org/resources/delivering-healthy-lives-and-well-being-for-women-and-girls

30. Lee DW, Lee J, Kim HR, Kang MY. Health-related productivity loss according to health conditions among workers in South Korea. *Int J Environ Res PublicHealth*. 2021;18,7589.

31. Sun D, Zhou T, Heianza Y, et al. Type 2 Diabetes and Hypertension. *Circ Res*. 2019;124(6):930-937. doi:10.1161/circresaha.118.314487

32. Liu CY, Zhang W, Ji LN, Wang JG, for the ATTEND investigators. Comparison between newly diagnosed hypertension in diabetes and newly diagnosed diabetes in hypertension. *Diabetol Metab Syndr*. 2019;11(1). doi:10.1186/s13098-019-0465-3

33. Akseer N, Mehta S, Wigle J, et al. Non-communicable diseases among adolescents: current status, determinants, interventions and policies. *BMC Public Health*. 2020;20(1). doi:10.1186/s12889-020-09988-5

34. Budreviciute A, Damiati S, Sabir DK, et al. Management and Prevention Strategies for Non-communicable Diseases (NCDs) and Their Risk Factors. *Front Public Health*. 2020;8:574111.

SUPPLEMENTARY MATERIALS

Online Supplementary Document

Download: https://www.joghr.org/article/91080-non-communicable-diseases-and-hiv-aids-burden-by-socio-demographic-characteristics-in-malawi/attachment/189376.docx