

The Pattern of Underlying Causes of Death in Northern Ghana: A Review from the Medical Certificate of Cause of Death (MCCD) At the Tamale Teaching Hospital (TTH)

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Abstract

Background: Reliable mortality statistics are key for national health information systems, population health assessment, health policy and service planning; and programme evaluation. The Medical Certificates of Cause of Death (MCCDs) are major sources of this information. The aim of this study was to determine the underlying causes of deaths in Northern Ghana, by reviewing duplicate copies of MCCD, at the TTH. **Methods:** A total of 2,134 duplicate copies of the MCCD were reviewed. Data was analysed by age, gender and underlying cause of death. Associations were determined using Fisher's exact test. **Results:** The major underlying causes of deaths were: Non-Communicable Diseases (NCDs) (50.0%), Communicable Diseases (CDs), (29.3%) and injuries (20.7%). The mean age (years) for the study population was 48.2±20.8 and that, majority (78.1%) were males (P<0.0001). The top five CDs were: Viral hepatitis (39.4%), HIV/AIDS (12.4%), lobar pneumonia (11.0%), diarrhoea diseases (10.5%) and peptic ulcer disease (8.8%). The common NCDs were: Cardiovascular disorders (49.2%), cancers (20.5%), metabolic (11.2%) and renal disorders (9.4%). The common injuries related deaths were; RTA (80.7%), alcohol (9.5%) and burns and explosions (3.9%). The top 10 specific underlying causes of death were: arterial hypertension (20.1%), RTA (16.7%), Viral hepatitis (11.6%), cancers (10.4%), diabetes mellitus (5.2%), end stage kidney disease (4.5%), HIV/AIDS (3.7%), bacterial pneumonia (3.2%), diarrhoea diseases (3.1%) and peptic ulcer disease (2.7%). **Conclusion:** NCD were the commonest major underlying cause of death. All the deaths were common in males. The common specific underlying causes of death were: arterial hypertension, RTA, Viral hepatitis, cancers, DM, and ESKD.

Keywords: Underlying cause of death; Northern Ghana; Medical certificate; Cause of death

Introduction

In developing countries where functional death registration systems exist, deaths that occur in hospitals have a greater number of correct diagnoses of the underlying cause of death, than deaths that occur elsewhere in the community. ^[1,2]Vital registration data from Medical Certificates of Cause of Death (MCCD) issued by attending clinician is the optimal source of information on underlying causes of death in populations.

The MCCD is required for the registration of the death, families understanding of the potential health risks, doctors for annual health performance review, population census, health statistics and policy planning. ^[2,3]Again, the knowledge of the causes of death provides critical information on the burden of disease, and it is very important in the development of health systems worldwide. Furthermore, analysis of mortality data in health facilities give a picture of the prevailing disease patterns of death in a particular geographical location, region or country.

The need for a reliable data for the MCCD is becoming very important currently in countries where postmortem rate had diminished, and thus this form of feedback on accuracy of cause of death is now rare for hospital medical teams^[4].

Problem statement

In developing countries where functional death registration systems exist, deaths that occur in hospitals have a greater number of correct diagnoses of the underlying cause of death than deaths that occur elsewhere.

Regular estimates of cause-specific mortality are essential for

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understanding the overall epidemiological profile of disease in a population. The principal data source for these estimates is civil registration systems. Studies have shown that adequately functioning systems that produce statistics on causes of death on a regular basis exist in only about one-third of all countries of the world. In Sub-Saharan Africa, there is paucity of information on cause-specific mortality, let alone data from civil registration systems.¹⁰ In many developing countries, data is derived largely from independent disease-specific epidemiological studies and these are not examined within the context of an overall demographic context of mortality, required by WHO, to ensure that claims about causes of death are not exaggerated.

In Ghana information from the Medical Certificate of Cause Of Death (MCCD) and the birth and death register, established in 1965 by the birth and death ACT are the major sources for these estimates. This information is used for many important purposes, such as the development of public health policies, programs and interventions, and also the allocation of health care resources.

Unfortunately, these sources do not exist in many hospitals, districts and regions in Ghana, and even if they exist, these units are not managed by trained personals. Furthermore, even in the few well-established centres in Ghana, data gathering is still not encouraging because information about vital registrations systems (birth and deaths) are not widely disseminated and therefore deceased relatives do not attach much important to registering the death of a relation.

The Tamale teaching hospital is the main referral hospital serving all the regions in northern Ghana; however, the cause-specific mortality pattern has not been studies, and there is the need for this be done.

Research Questions

1. What are the major categories of underlying causes of death in Northern Ghana?
2. What are the major organ system related deaths in Northern Ghana?
3. What are the age and gender distributions and statistical significance between the two groups, if any?
4. What is the spectrum and relative proportions of the common underlying causes of death in Northern Ghana?

Objectives

General objective

To determine the underlying causes of deaths in Northern Ghana, by reviewing duplicate copies of medical certificates of death at the Tamale Teaching Hospital in Northern Ghana.

Specific objectives

1. To determine the relative proportions of the major categories of underlying causes of death: communicable disease, non-communicable disease and injuries.
2. To determine organ system/anatomic distributions of these deaths.

3. To determine age and gender characteristics of the underlying causes of death.
4. To determine the spectrum of the specific subtypes of underlying causes of death.

Materials and Methods

Study site and design

Retrospective review of the duplicate copies of all Medical Certificates of Cause of Death (MCCD) issued in TTH; department by department for the period 2012–2020. This is the only tertiary referral hospital in northern Ghana with a bed capacity of 280.

Study population

Duplicates of all MCCD in all the wards and the medical and surgical emergency room of the TTH.

Case selection:

- All deaths that occurred in the hospital and those that occurred outside the hospital but had autopsy examination conducted.
- All correctly filled duplicate copies of medical certified of cause of death with stated underlying cause of death reviewed.

Exclusion criteria

- All cases with poorly defined causes of death or unacceptable terms used; cardiopulmonary failure, brought in death.
- Incompletely filled medical certificate of cause of death.

Data collection, entry and Analysis:

We retrieved 2,662 duplicate copies of the MCCD from all the wards and the accident and emergency room from 1st January, 2012 to 31st December, 2020. A total of 2,134 (80.2%) met the selection criteria, and thus, constituted the sample size for the study.

Data were collected on the age (years) at death, gender, manner (communicable, non-communicable and injuries) organs and organ systems (cardiovascular, hepatobiliary, gastrointestinal, respiratory, metabolic, genitourinary central nervous system, etc) and finally, the specific subtypes of underlying cause of death: Hypertension, Diabetes Mellitus (DM), road traffic accident, viral hepatitis, HIV/AIDS, tuberculosis, end stage renal disease, poisons, and many others.

The data was entered into a statistical database and analysed using SPSS software version 26.0 (Chicago). Fisher's exact test was used to compare variables, where applicable. The results were presented in bar charts and frequency tables. We used a statistical significance level of $p < 0.05$.

In this study, underlying causes of death were first stratified into three broad groups of causes of death as per the Global Burden of Disease cause list:

Group I: Communicable Diseases (CDs) (tuberculosis, non-TB respiratory infections, HIV, diarrhoea, malaria, childhood cluster diseases), maternal/perinatal causes and nutritional

conditions

Group II: Non-Communicable Diseases (NCDs) (cancer, DM, cardiovascular disease)

Group III: Injuries, divided into: a) Intentional: interpersonal violence, self-harm and “collective violence and legal intervention” b) Unintentional: road injuries, falls, drowning and “other unintentional injuries”.

The underlying causes of death were further classified into subtypes, according to the World Health Organisation’s 11th International Classification for Diseases (ICD-11).

Definitions

Underlying cause of death: The underlying cause of death is defined as: “(a) the disease or injury that initiated the sequence of events leading directly to death, or (b) the circumstances of the accident or violence that produced the fatal injury” (WHO, 2016:31).

Manner of death: Classification system developed for public health statistics based on the circumstances under which death occurred. Manners of death currently includes 5 categories: accident, homicide, natural, suicide and undetermined.

Results

Major groups of underlying causes of death

A total of 2,134 medical certificates of cause of death (MCD) were reviewed during the period 2012 to 2020

The commonest major group of underlying cause of deaths was non-communicable diseases (NCDs) (50.0%), followed by communicable diseases (CD), (29.3%). All the major causes of death were significantly common in males ($P < 0.0001$) (Table 1).

Age and gender characteristics of underlying causes of death

The age (years) range for the study population was 0.08–105, with a mean of 48.2 ± 20.8 . The mean age (years) for

communicable diseases related deaths was 44.8 ± 19.3 , that for non-communicable deaths was 54.9 ± 19.2 , while it was 37.0 ± 19.5 for deaths related to injuries. Non-communicable disease related deaths were common among elderly individuals 70 – 79 years (20.3%), while that for injuries were common in very young individuals, 20–29 years (22.0%) (Table 2).

There were 1,667 (78.1%) males and 467 (21.9%) females ($P < 0.0001$). The mean age (years) for males was 47.6 ± 20.2 , compared to 49.8 ± 22.1 , for their female counterparts.

Gender characteristics of underlying causes of death based on organ systems, manner and mechanism of death

Stratifying underlying causes of death according to organ systems and mechanisms of death, many (24.6%) were due to cardiovascular disorders, followed by injuries (20.8%), hepatobiliary disorders (11.6%), cancers (10.3%) and deaths due to gastrointestinal tract pathology (8.5%), (Table 3). All the underlying causes of deaths were statistically significant among males ($P = 0.05$) (Table 3).

The spectrum of communicable disease as an underlying cause of death

The top five common CDs were: Viral hepatitis (39.4%), HIV/AIDS (12.4%), lobar pneumonia (11.0%), diarrhoea diseases (10.5%) and peptic ulcer disease (8.8%) (Table 4a). All the infections were significantly common among males. The mean ages were generally ≥ 40.0 years, except malaria (33.0 ± 21.5) and diarrhoea (38.4 ± 27.6) (Table 4b).

Injuries as underlying causes of death

The commonest underlying cause of death under in this category was road traffic accident (RTA) 356 (80.7%), followed by alcohol related conditions 33 (9.5%) (Table 5). Victims of alcohol related deaths were relatively older (mean age= 49.6 ± 16), compared to the others (Table 5). All the deaths were significantly common among males ($P < 0.0001$) (Table 5).

Table 1: Major groups of underlying causes of death, *Significant at p-value < 0.05.

Major Categories	Total (n/%)	Female (n/%)	Male (n/%)	P-values
Communicable disease (CDs)	627	125 (19.9)	502(80.1)	< 0.0001
Non-communicable disease (NCDs)	1066	263(24.7)	803 (75.3%)	< 0.0001
Injuries	441	79 (17.9)	362 (82.1%)	< 0.0001

Table 2: Age and gender characteristics of underlying causes of death.

Age group (years)	CDs (n/%)	NCDs (n/%)	Injuries (n/%)
0 – 9	14(2.3)	21(2.0)	33(7.7)
10.-19	42(6.8)	29(2.8)	38(8.8)
20 – 29	75(12.1)	65(6.2)	95(22.0)
30 - 39	136(22.0)	120(11.5)	90(20.9)
40 - 49	117(18.9)	154(14.7)	69(16.0)
50 - 59	76(12.3)	195(18.6)	40(9.3)
60 - 69	77(12.5)	169(16.2)	34(7.9)
70 - 79	55(8.9)	212(20.3)	20(4.6)
≥ 80	26(4.2)	81(7.7)	12(2.8)
Total	618(100.0)	1046(100.0)	431(100.0)
Mean age	44.8 ± 19.3	54.9 ± 19.2	37.0 ± 19.5
Missing data	9(1.4)	20(1.9)	10(2.3)

Table 3: Gender characteristics of underlying causes of death based on organ and organ systems, manner and mechanism of death, *Significant at p-value < 0.05.

Underlying causes of death (code 4)	Whole group (n/%)	Female (n/%)	Male (n/%)	P-value
Cardiovascular disorder	524(24.6)	132 (25.2)	392 (74.8)	> 0.05
Cancers	219(10.3)	43 (19.5)	179 (80.5)	> 0.05
Gastrointestinal tract Pathology	181(8.5)	46 (25.4)	135 (74.6)	> 0.05
Hepatobiliary pathology	248(11.6)	40 (16.1)	208 (83.9)	> 0.05
Respiratory tract Pathology	118(5.5)	17 (14.4)	101 (85.6)	> 0.05
Metabolic disorders	119(5.6)	25 (21.0)	94 (79.0)	> 0.05
Accidents, injuries and poisons	440(20.8)	119 (27.0)	320 (72.7)	> 0.05
Urinary tract pathology	112(5.2)	16 (14.3)	96 (85.7)	> 0.05
Immune disorders	79(3.7)	14 (17.9)	65 (82.1)	> 0.05
Haematological disorder	26(1.2)	4 (15.4)	22 (84.6)	> 0.05
Central nervous system	45(2.1)	5 (11.1)	40 (88.9)	> 0.05
Dermatological disorder	23(1.1)	6 (26.1)	17 (73.9)	> 0.05

Table 4a: Categories of communicable diseases as underlying causes of death.

Type of communicable disease	Frequency (n)	Percentage (%)
Viral hepatitis	248	39.4
HIV/AIDS	78	12.4
Lobar pneumonia	69	11
Diarrhoea diseaseS	66	10.5
Perforated peptic ulcer	55	8.8
Pulmonary tuberculosis	27	4.3
Meningitis	25	4
Soft tissue infections	20	3.2
Malaria	11	1.8
Urinary tract infection	9	1.4
Acute appendicitis	6	1
Tetanus	4	0.6
Guillain-Barre syndrome	3	0.5
Others	7	1.4
Total	627	100

Table 4b: The age and sex characteristics of the common infections among the study population, KEY: PUD = Peptic ulcer disease, SOTI = Soft tissue infections.

Type of infection	Viral hepatitis (n/%)	Lobar pneumonia (n/%)	Diarrhoea Disease (n/%)	Bacterial meningitis (n/%)	Pulmonary tuberculosis (n/%)	PUD (n/%)	SOTI (n/%)	Malaria (n/%)
≤9	0(0.0)	0(0.0)	9(13.6)	2(7.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
10 - 19	14(5.7)	1(1.5)	15(22.7)	3(11.5)	1(3.8)	1(1.8)	2(9.5)	3(27.3)
20 - 29	33(13.4)	5(7.6)	8(12.7)	1(3.8)	5(19.2)	6(10.5)	2(9.5)	3(27.3)
30 - 39	59(23.9)	9(13.6)	7(10.6)	7(26.9)	10(38.5)	11(19.3)	4(19.0)	2(18.2)
40 - 49	59(23.9)	6(9.1)	5(7.6)	5(19.2)	1(3.8)	13(22.8)	4(19.0)	0(0.0)
50 - 59	28(11.3)	15(22.7)	2(3.0)	2(7.7)	1(3.8)	11(19.3)	1(4.8)	0(0.0)
60 - 69	33(13.4)	14(21.2)	4(6.1)	5(19.2)	4(15.4)	9(15.8)	3(14.3)	3(27.3)
70 - 79	17(6.9)	10(15.2)	10(15.2)	0(0.0)	3(11.5)	4(7.0)	4(19.0)	1(0)
≥80	4(1.6)	6(8.7)	6(9.1)	1(3.8)	1(3.8)	2(3.5)	1(4.8)	0(0.0)
Total	248(100.0)	69(100.0)	66(100.0)	27(100.0)	27(100.0)	57(100.0)	21(100.0)	11(100.0)
Mean age	44.1 ± 16.6	55.8 ± 17.6	38.4 ± 27.6	40.0 ± 21	44.0 ± 18.7	48.2 ± 16.5	48.7 ± 21.6	33.0 ± 21.5
Gender								
Male	220(88.7)	57(82.6)	42(63.6)	21(77.8)	24(88.9)	44(77.2)	15(68.2)	8(72.7)
Female	28(11.3)	12(17.4)	24(36.4)	6(22.2)	3(11.1)	13(22.8)	7(31.8)	3(27.3)

Non-communicable diseases underlying cause of death (n=1,066)

The common NCDs were: Cardiovascular disorders 524 (49.2%), cancers 219 (20.5%), metabolic and 119 (11.2%) and renal disorders 100 (9.4%) (Figure 1).

Cardiovascular disorders as an underlying cause of death (n=524)

The common cardiovascular disorders were: Arterial hypertension 429 (81.9%), thromboembolic disorders 29 (5.5%), ischaemic heart disease 28 (5.3%), and cardiomyopathy (2.3%) (Figure 2). Deaths due to cardiovascular disorders were common in elderly patients, mean ages ≥ 50 years (Table 6), and were significantly common among male patients (Table 6).

Metabolic and nutritional disorders as underlying causes of death

Diabetes mellitus (DM) was the commonest 110 (92.4%),

underlying cause of death under in this category, followed by malnutrition 7 (5.9%), Thyroid thoxicosis 1 (0.8%) and haemochromatosis 1 (0.8%) (Figure 3).

The mean age (years) of patient who died of DM was 59.6 ± 16.5 , with a modal age group of 70 – 79 (29.0%). Majority (78.1%, $P < 0.0001$) of the patients were aged ≥ 40 -years. There were 69 (62.7%) males with 41 (37.3%) females (P).

Renal diseases as underlying causes of death

The renal disorders were: end stage disease 96 (85.7%), acute pyelonephritis 2 (1.8%), nephrotic syndrome 2 (1.8%).

The age (years) range of deaths due to end stage renal disease was 4–86, with a mean of 50.3 ± 21.1 . Many 61 (64.2%) of victims were aged 40-years and above (Figure 4). There were 77 (91.1%) males with 18 (18.9%) females, $P < 0.0001$.

Neoplasms as underlying causes of death (n=219)

The age range of patients who died of neoplasms was 0.25–84,

Table 5: Age and gender characteristics of accidents, injuries and poisons related deaths, *Significant at p-value <0.05

Age groups (years)	RTA (n/%)	Alcohol related (n/%)	Snake bites (n/%)	Burns&explosions (n/%)	Fall from heights (n/%)	Gun shot (n/%)
0-9	26(7.5)	0(0.0)	0(0.0)	3(16.7)	2(12.5)	1(11.1)
10.-19	30(8.6)	0(0.0)	3(23.1)	2(11.1)	2(25.0)	1(11.1)
20-29	78(22.5)	1(3.4)	4(30.8)	4(22.2)	2(12.5)	4(44.4)
30-39	74(21.5)	8(27.6)	2(15.4)	3(16.7)	2(25.0)	0(0.0)
40-49	54(15.6)	8(27.6)	1(7.7)	2(11.1)	1(12.5)	2(22.2)
50-59	35(10.1)	3(10.3)	0(0.0)	2(11.1)	0(0.0)	0(0.0)
60-69	25(7.1)	4(13.8)	3(23.1)	1(5.6)	1(12.5)	0(0.0)
70-79	16(4.6)	4(13.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
≥ 80	9(2.3)	1(3.4)	0(0.0)	1(5.6)	0(0.0)	1(11.1)
Total	347	29	13	18	8	9
Mean age	36.9 ± 19.2	49.6 ± 16	33.2 ± 20	32.9 ± 23.3	27.8 ± 18.2	30.3 ± 21.7
Gender						
Male	295(82.9)	26(88.7)	10(76.9)	13(72.2)	6(75.0)	8(88.9)
Female	61(17.1)	4(13.3)	3(23.1)	5(27.8)	2(25.0)	1(11.1)
P-Values	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

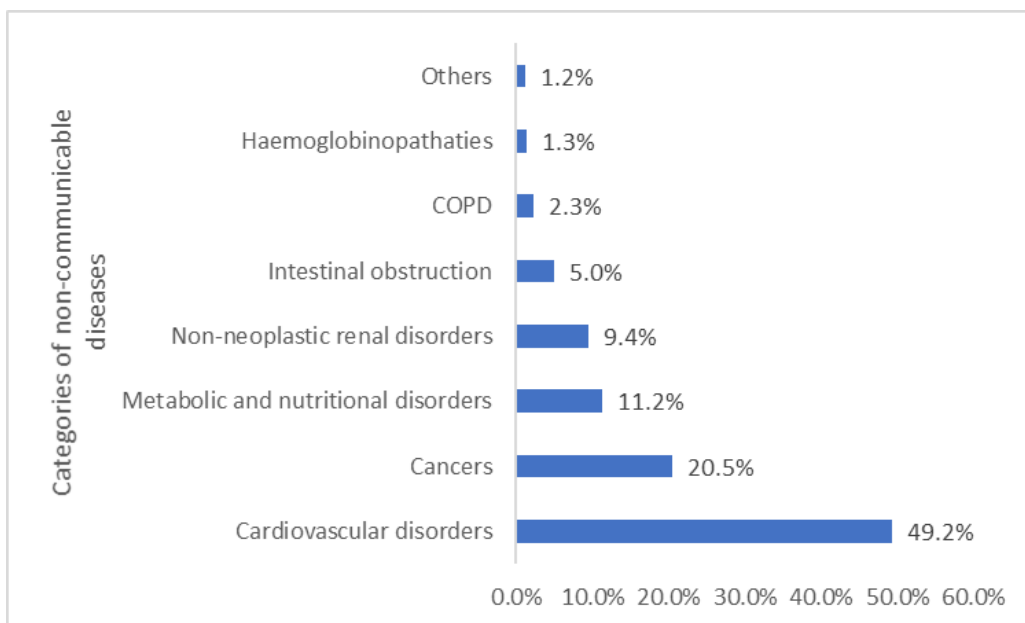


Figure 1: Categories of NCDs as underlying causes of death.

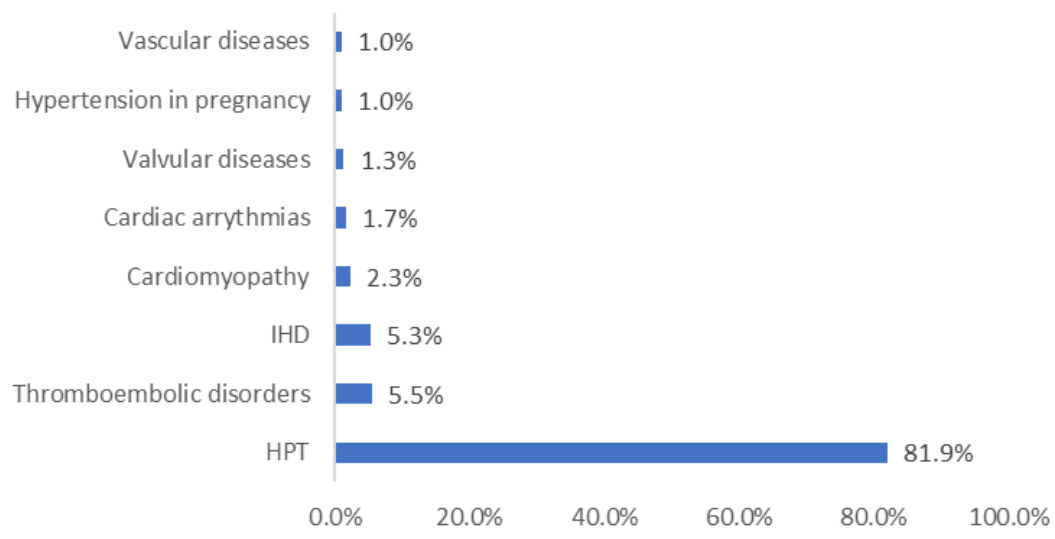


Figure 2: Cardiovascular disorders as underlying causes of death.

Table 6: Age and gender characteristics of common cardiovascular disorders as underlying causes of death, *Significant at p-value < 0.05

Age/years	HPT (n/%)	Thromboembolic disorders (n/%)	IHD (n/%)	Cardiomyopathy (n/%)
<9	0(0.0)	1(3.4)	0(0.0)	0(0.0)
10-19	3(0.7)	1(3.4)	1(3.7)	0(0.0)
20-29	11(2.6)	3(10.3)	0(0.0)	2(16.7)
30-39	33(7.9)	5(17.2)	2(7.4)	1(8.3)
40-49	54(12.9)	4(13.8)	4(14.8)	2(16.7)
50-59	109(26.0)	3(10.3)	5(18.5)	3(25.0)
60-69	80(19.1)	3(10.3)	7(25.9)	1(8.3)
70-79	90(21.5)	5(17.2)	7(25.9)	2(16.7)
≥80	39(9.3)	4(13.8)	1(3.7)	1(8.3)
Total	419(100.0)	29(100.0)	26(100.0)	12(100.0)
Mean age	59.7 ± 15.2	51.7 ± 22.3	59.1 ± 16.0	53.7 ± 19.2
	Gender			
Male	325(75.8)	18(62.1)	21(75.0)	7(58.3)
Female	104(24.2)	11(37.9)	7(25.0)	5(41.7)
P-values	0.0001	0.0001	0.0001	0.9751

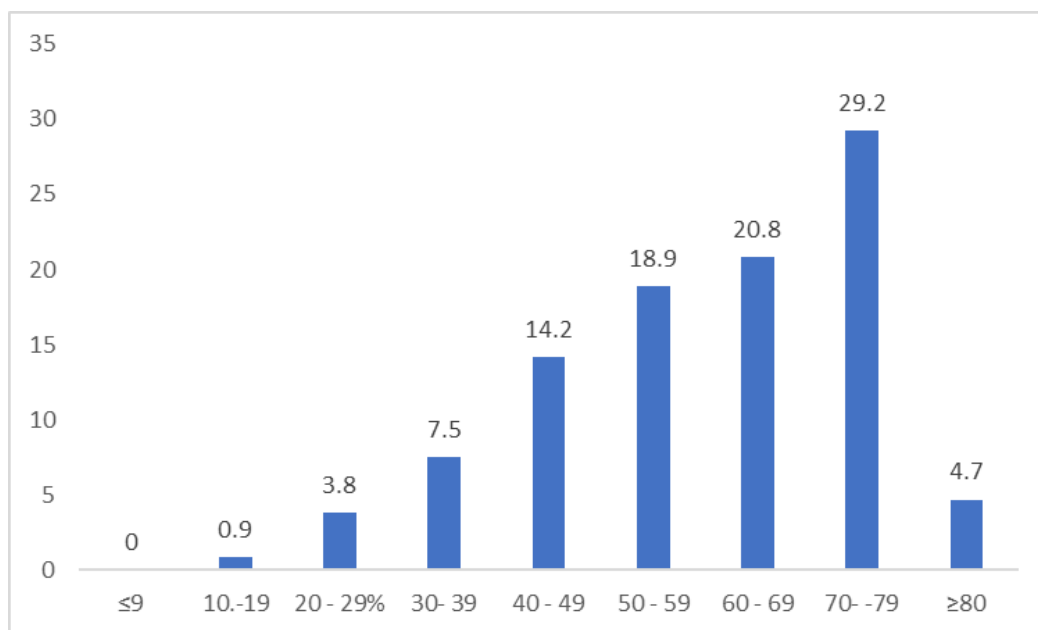


Figure 3: Age characteristics of diabetes mellitus as an underlying cause of death.

with a mean of 51.7 ± 19.1 . The great majority were aged 40 years and above (Figure 5). There were 172 (78.5%) males and 47 (21.5%), females $P < 0.0001$

The top 10 cancer related deaths in the study population were: liver 49 (22.4%), prostate 32 (14.6%), gastric 22 (10.0%), breast 15 (6.85), brain 13 (5.9%), bone 11 (5.0%), oesophagus 11 (5.0%), pancreas 9 (4.1%) and head and neck 9 (4.1%) (Table 7).

The common neoplasms in males were: Liver (26.7%), Prostate (18.6%), gastric (9.3%), brain (7.6%) and bone and soft tissues (5.8%) (Table 7).

The common neoplasms related causes of death in females were: Breast (31.9%), gastric (12.8%), cervix (8.5%), liver (6.3%) and pancreas (6.3%) (Table 8).

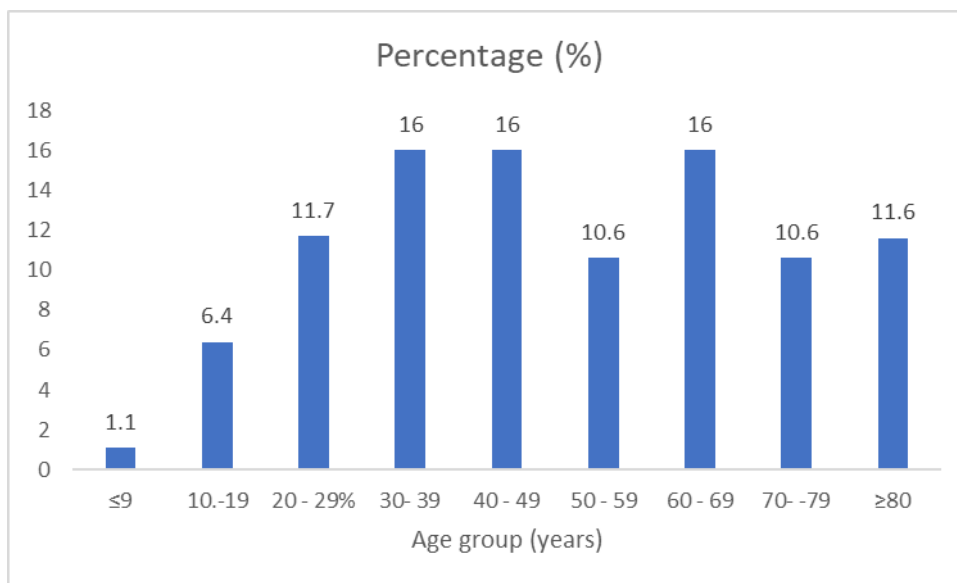


Figure 4: Age characteristics of deaths due to end stage renal disease.

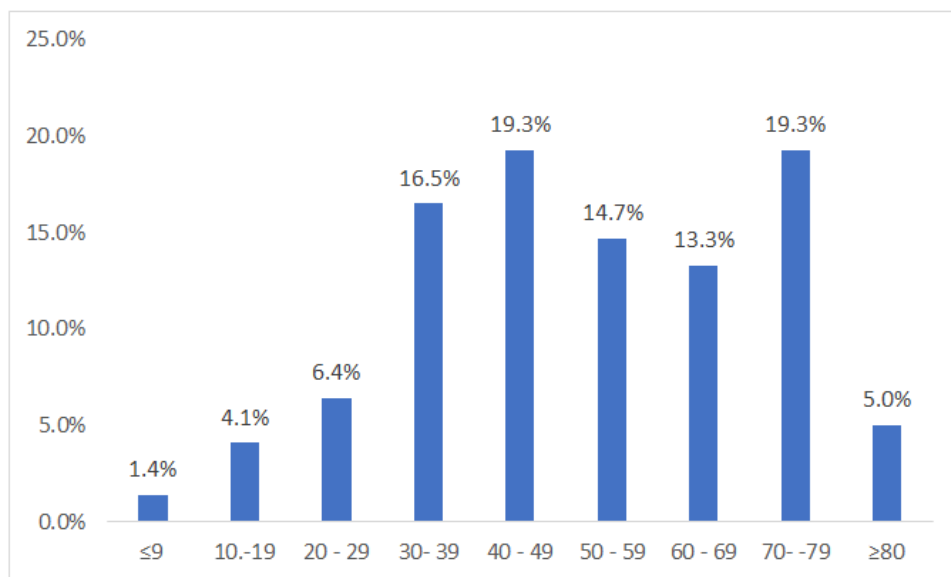


Figure 5: Age distribution of deaths related to neoplasms.

Table 7: Neoplasms as underlying causes of deaths in Male and female.

Male	Frequency(n)	Percentage (%)	Female	Frequency(n)	Percentage (%)
Liver	46	26.7	Breast	15	31.9
Prostate	32	18.6	Gastric	6	12.8
Gastric	16	9.3	Cervix	4	8.5
Brain	13	7.6	Liver	3	6.4
Bone	10	5.8	Pancreas	3	6.4
Lung	9	5.2	HNCs	3	6.4
Oesophagus	9	5.2	Oesophagus	2	4.3

Lymphoma	8	4.7	Colon	2	4.3
Pancreas	6	3.5	Ovary	2	4.3
Head & neck	6	3.5	Bladder	2	4.3
Colorectal	5	2.9	Lung	1	2.1
Renal	2	1.2	Uterus	1	2.1
Bladder	2	1.2	Bone	1	2.1
Gallbladder	2	1.2	S. bowel	1	2.1
Others	2	2.4	Skin	1	2.1
Total	172	100	Total	47	100

Table 8: The relative proportions of specific underlying causes of death in northern Ghana.

Cause of death	Frequency (n)	Percentage (%)
Arterial hypertension	429	20.1
Road traffic accident	356	16.7
Viral hepatitis (B&C)	248	11.6
All cancers	221	10.4
Diabetes mellitus	112	5.2
End stage kidney disease	96	4.5
HIV/AIDS	78	3.7
Bacterial pneumonia	69	3.2
Diarrhoea diseases	66	3.1
Peptic ulcer disease	57	2.7
Chronic alcoholism	33	1.5
Pulmonary tuberculosis	27	1.3
Snake bites	11	0.5
Intestinal obstruction	50	2.3
Meningitis	27	1.3
Urosepsis	10	0.5
Cardiomyopathies	12	0.6
Thromboembolic events	29	1.4
Haemoglobinopathies	15	0.6
Ischaemic heart disease	28	1.3
severe malaria	11	0.5
Valvular disease	7	0.3
Severe burns	18	0.8
Fall from height	14	0.7
Pregnancy related	5	0.2
COPD	24	1.1
Gun shot	9	0.4
Severe malnutrition	7	0.3
Seizure disorder	5	0.2
Soft tissue infections	22	1
Cardiac arrhythmias	9	0.4
Complicated appendicitis	6	0.3
Tetanus	4	0.2
Guillian-Barre syndrome	3	0.1
Peripheral vascular disease	5	0.2
Others	11	5.2
Total	2,134	100

Specific subtypes of underlying causes of death

The top 10 specific underlying causes of death were: arterial hypertension (20.1%), road traffic accident (16.7%), Viral hepatitis (11.6%), cancers (10.4%), diabetes mellitus (5.2%), end stage kidney disease (4.5%), HIV/AIDS (3.7%), bacterial pneumonia (3.2%), diarrhoea diseases (3.1%) and peptic ulcer disease (2.7%) (Table 8).

Discussion

Comparable information about underlying causes of death

broken down into age, sex, and geographical location provides a starting point for informed health policy debate. We describe for the first time, the underlying causes of death in the largest tertiary referral hospital in northern Ghana, based on a retrospective review of the duplicate copies of Medical Certificate of Cause of Death (MCCD) at the TTH.

The observed major groups of underlying causes of deaths per the Global Burden of Disease cause list, were: Non-Communicable Disease (NCD) (50.0%), Communicable Disease (CD), (29.3%) and injuries (20.7%). The relative proportions of major groups of

underlying causes of death in this current study with a catchment area that span the five regions of northern Ghana, differs from patterns reported in previous studies.^[5] For instance, previous studies in sub-Saharan Africa and Bangladesh, reported CD group as the common underlying cause of death and that, NCDs were said to be rare in Africa. They attributed their findings to the disproportionately high prevalence of AIDS and malaria in Africa at that time. However, the pattern observed in the Northern Ghana study, is in line with that reported globally and in some parts of West Africa,^[6,7] where studies were conducted around the period of review of the data used in this current article. In 2019, WHO reported that about 74.0% of the global deaths had NCDs as the underlying causes of death. In 2021, Owusu et al., in Ghana, reported in their study that non-communicable diseases (NCDs) were the leading cause of death in 2017 (25%) and 2018 (20%) respectively. This is so because previous studies conducted in Accra Ghana, during the period of review of the current study identified some risky life-style changes or risk factor of NCDs to be common among many Ghanaians.

The predominance of NCDs as the common underlying causes of death in this current study supports the global trend and also studies in Ghana.^[8] For instance, Agyemang et al., Awini et al., and de-Graft et al., (2007) all in Ghana in their studies reported a significant shift in the burden of patterns, in favour of NCDs. However, the difference between then and now is that deaths from both malaria and AIDS are decreasing across all the regions. To further support the findings in the northern Ghana, are reports that, sub-Saharan Africa (SSA) is experiencing an epidemic of NCD as a result of the rapid epidemiological transition with urbanization and adoption of western lifestyles,^[9,10] and due to this, the incidence of NCD in SSA has been on a rise in the recent past, and Ghana is not an exception. In 2015, about 1.2 million people died from NCD, particularly cardiovascular disorders (CVDs) in Africa, a situation described as a major public health problem in Africa and globally.

All the major groups of underlying causes of death were significantly common among males, similar to that observed in Adeolu et al., study in Nigeria.

Non-communicable diseases

In this current study, cardiovascular disorders accounted for 49.2% of all deaths due to NCDs. These deaths were significantly common among males and the elderly patients ($P < 0.0001$). This support reports of previous studies that cardiovascular related deaths were contributing significantly to the death burden from NCDs in Ghana.^[8] The pattern is again comparable with the global figures.^[11] For instance, Mensah et al., reported a value of 48% cardiovascular-related diseases in their study.

Cardiovascular disorders

The relative proportions of the subtypes of cardiovascular related deaths in this study were: arterial hypertension (81.9%), thromboembolic disorders (5.5%), ischaemic heart disease (5.3%), and cardiomyopathy (2.3%). This observed order differs from studies globally.^[11,12] For instance, Mensah et al., study in SSA, reported the common causes as stroke and ischaemic heart diseases. Yuyun et al., found the order to be hypertensive

heart disease, cardiomyopathy, and rheumatic heart disease. Oluseyi et al., reported the order as: hypertensive heart disease, cerebrovascular-accident, myocardial-infarction, heart-failure, cardiomyopathies and atherosclerosis. Furthermore, Wu et al.,^[12] in England and Wales, reported the order as stroke (35.6%), Acute Coronary Syndrome (ACS) (24.5%), heart failure (23.4%), pulmonary embolism (9.3%) and cardiac arrest (4.6%). The differences in the patterns of cardiovascular related deaths according to these studies may be reflective of the type of study conducted, the population studied and the GDP. Cardiovascular related deaths in this current study in northern Ghana were common among elderly individuals and in males, similar to reported in previous studies.^[10] This however, differs from Oluseyi et al., study in Nigeria, that found the CVS related deaths to be common among elderly women.

Hypertension, a subtype of cardiovascular disorder, was found to have contributed significantly (81.9%, $P < 0.0001$) to the burden of underlying causes of death at the TTH. In Ghana, data from the GHS and the Ghana Statistical Service (GSS) conducted in a period similar to ours, confirmed hypertension as a leading NCD in Ghana. Thus, the finding that hypertension was the leading subtype of death related to the cardiovascular system disorders is thus reflective of the morbidity pattern of diseases on admission in Ghanaian health facilities. Again, the predominance of hypertension as an underlying cause of death in this study is likely a reflection of the increasing prevalence of the risk factors of the disease among Ghanaians, the low level of awareness of individuals hypertensive status, non-compliance of medications and denial of the disease, particularly by male patients as reported in previous studies globally.^[13] Hypertensive related deaths were found to be common among elderly patients and more so, in males. Our observation of higher frequency of hypertensive deaths in male is in keeping with previous studies in Nigeria and Ghana. This however, disagrees with Nkoike et al.,^[14] study in South West region of Cameroon who found hypertensive related mortalities to be common among females.

Cancer

There are few published data directed at cancer related deaths in West Africa.^[15] Until recently, cancers and other non-communicable diseases were thought to be unimportant public health problems in developing countries, like Ghana, because of the overwhelming high prevalence of communicable diseases,^[16] while that was not the case in the developed countries.

The common cancer related deaths in males were: Liver (26.7%), prostate (18.6%), gastric (9.3%), brain (7.6%) and bone and soft tissues (5.8%). For females, these were; breast (31.9%), gastric (12.8%), cervix (8.5%), liver (6.3%) and pancreas (6.3%). Furthermore, the top 10 cancer related deaths among the study population in northern Ghana were: liver (22.4%), prostate (14.6%), gastric (10.0%), breast (6.8%), brain (5.9%), bone (5.0%), oesophagus (5.0%), pancreas (4.1%) and head and neck (4.1%). Although these patterns are closed to reports of previous studies in West Africa and Ghana, [49,50,51,52,53,54] there are some specific differences. For instance, Wiredu et al.,^[16] in their study of cancer mortality pattern in Ghana, observed the following patterns; male cancers: liver (21.15%), prostate (17.35%), haematopoietic organs (15.57%), and stomach (7.26%); and

that for females as breast (17.24%), haematopoietic organs (14.69%), liver (10.97%) and cervix (8.47%). Again, Globocan in 2002, reported cancer-related deaths in descending order for males as prostate, liver, haematopoietic organs, colorectal and urinary bladder, for females, the order was breast, liver, haematopoietic organs, stomach and colorectal. Furthermore, in the year 2020, GLOBOCAN found the common cancer related deaths in Ghana to be; liver 20.0%, breast (13.0%), cervix (10.5%), prostate (7.1%), non-Hodgkin's lymphoma (4.6%), gastric (4.3%) and ovary (4.2%).

The significant differences in the current study and those of the previous studies are the high prevalence of gastric, brain, primary bone and pancreatic cancers common cancer-related deaths among the study population. The reasons for these differences are not clear and thus calls for further investigation, although, it may be reflective of the cancer morbidity pattern in this part of the country.

Metabolic disorders as underlying causes of death

In the current study, diabetes mellitus was the commonest (92.4%), metabolic related cause of death, it also accounted for 5.2% of all deaths during the review period. There is paucity of mortality data on DM in Africa and for that matter Ghana despite the high prevalence of the disease, [17,18,19] making quantification of outcome difficult. This is however not the case in developed countries.

However, available data from similar reviewed studies using data from the MCCD in developing countries, Zargar et al., in a tertiary teaching hospital in India reported a lower rate of 4.4%. However, Ogbera et al., Chijioke et al., Roacid et al., and Zhu et al., [20] reported higher rates of mortalities due to DM in their studies. For instance, Ogbera et al., in Nigeria reported a rate of 16.0%, also Chijioke et al., in Nigeria reported a rate of 36.0%, Roacid et al., reported a rate of 12.1% in Benghai, while Zhu et al., reported a rate of 28.7% in their study in Shanghai Songjiang. The lack of published data on mortality patterns of DM in Africa and Ghana, may be attributed to the fact that researchers either concentrate on the complications of DM, [21] or the available data is not published for wider readership. For instance, available mortality from the Tamale Teaching hospital covering the period of review of the current study indicates that, in year 2019, DM was the 8th cause of death at the medical ward. Furthermore, the paucity of mortality data in developing countries may be due to under reporting as observed in previous studies [22].

The mean age (years) of patients who died of D.M, was 59.6 ± 16.5 , many (29.0%) being in the age group of 70–79 years. Also, many were males (62.7%). The age and gender characteristics in this current study support a study in neighbouring Nigeria, where Chijioke et al., in their study, reported a mean age at death of $57.07 + 14.29$ years. However, these differ from that reported in previous studies. For instance, Roacid et al., found a mean age at death of 63.8 years, with 51.1% females and 48.9% males.

End stage kidney disease

End stage kidney disease may be the end point for many disease entities and such, very difficult to be segregated as a single underlying cause of death as reported in previous studies. This

is further complicated by the fact many publications derived their data from studies such as; autopsy, clinical and the vital registration systems. However limited the data may be, it is importance to state it as an underlying cause of death according to the ICD 11 classification. In current study conducted in northern Ghana, end stage kidney disease accounted for 85.7% of death related to renal diseases, it also accounted for about 4.5% of all deaths in this study. This value (4.5%) is higher than the 2.9% reported in the Million Death Study in India by Dare et al., but within the 1.6 to 12.4% observed by Odubanjo et al., in Nigeria. Again, it is very close to the 5.9% reported in Ghana by Adjei et al., The slight difference between the current study and the previous reports is that, the later were from autopsy studies.

The mean age (years) of deaths due to end stage kidney disease was 50.3 ± 21.1 , and that the great majority were males ($P < 0.0001$). The mean age of the current study is higher than the 44.0 years reported by Sakhujia et al., in India, but lower than the 58.0 years observed in Modi et al., [23] also in India. The male predominant of end stage kidney disease is however in line with many previous studies.

Communicable diseases

The current study in northern Ghana reported communicable disease group as the second major group of underlying causes of death. This pattern differs from what was observed in previous studies by earlier researchers in sub-Saharan Africa and West Africa. For instance, in a retrospective analysis by Arodiwe et al., covering the 1995 to 2010 in the University of Nigeria Teaching Hospital, Enugu, the communicable disease group was observed to be the leading cause of death among their study population. The position of CD group in this study is however in line with the Global projections of mortality and burden of disease that in 2030 there will be a significant shift worldwide from communicable diseases to NCDs, and that, the transition is expected to affect developing countries.

The top five common communicable diseases were: Viral hepatitis (39.4%), HIV/AIDS (12.4%), lobar pneumonia (11.0%), diarrhoea diseases (10.5%) and peptic ulcer disease (8.8%). This observed pattern is a complete departure from previous studies conducted around same time period. [24] The data used for this article were gathered. For instance, Kalyesubula et al., found pneumonia and TB as the common communicable diseases in their study in Uganda. Another retrospective study at the University of Ilorin Teaching Hospital in Nigeria demonstrated a similar pattern in 1996–2005, with a sample size of 4220 deaths, infections caused 1501 deaths (35.6%), with HIV and TB constituting a major proportion.

The reasons for the high viral related mortality figures in this study is not apparent, but may be reflective of the pattern of disease admission in hospital in sub-Saharan Africa and Ghana. For instance, viral hepatitis-related deaths are recorded all over the world, more so in Sub-Saharan Africa (SSA) adult populations. Also, previous studies in Ghana have reported increased prevalence of viral hepatitis among Ghanaians. Furthermore, published data within the catchment area of this study equally documented high prevalence of viral hepatitis. [25] All the infections were significantly common among males, and

this support previous that reported male predominance in viral hepatitis.

The top specific underlying causes of death

The top 10 specific underlying causes of death were: Arterial hypertension (20.1%), RTA(16.7%), Viral hepatitis (11.6%), cancers (10.4%), DM (5.2%), ESKD (4.5%), HIV/AIDS (3.7%), bacterial pneumonia (3.2%), diarrhoea diseases (3.1%) and peptic ulcer disease (2.7%). The pattern of the top 10 causes of underlying causes of death in this current study conducted in northern Ghana differs from that observed in previous studies across the globe. For instance, Pattaraarchachai et al., in Thailand, reported the leading underlying cause of death as cerebrovascular accident, while Alipour et al. In Iran and Omar et al., in Malaysia, both reported ischaemic heart as the leading cause of death among their study populations respectively.

Conclusion

NCD were the commonest major underlying cause of death. All the deaths were common in males. The common specific underlying causes of death were: arterial hypertension, RTA, Viral hepatitis, cancers, DM, and ESKD. This study, although retrospective in nature, provides useful information on the epidemiology of underlying causes of death in this part of Ghana, in an era of epidemiological transition.

Limitations

This study may underestimate the occurrence of underlying causes of death within the catchment areas due to religious and cultural beliefs and practices.

- Many patients with severe disease including road traffic accidents, might have died at home or before reaching the hospital and would not be reported in the hospitalization registries, thus were not captured in this study.

Recommendations

- The birth and death departments in all districts, regions and teaching hospital in Ghana, must be resourced adequately by the government for accurate and reliable registration of vital events.
- More trained staff, particularly, those with information technology background should be employed by the government to manage information on vital events.
- The Ministry of health, Ghana health service, Ghana police, opinion leaders and non-governmental agencies should be encouraged to help to disseminate information on vital registration systems and the useful of such data to the development of the country.

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