

Causes and predictors of mortality among Ghanaians hospitalised with endocrine disorders

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Background: Endocrine disorders have been noted to be on the increase in the developing world, but little is known about their outcomes on the African continent.

Methods: We conducted a retrospective longitudinal study to evaluate the demographic characteristics and determinants of endocrine-related mortality among adult patients over 9 y in a leading tertiary hospital in Ghana. We determined the predictors of inpatient mortality using Kaplan–Meier survival curves and Cox proportional hazard regression analysis.

Results: Overall, 6265 patients (9.7% of all medical admissions) were admitted with various endocrine disorders during the period. The most common endocrine cause of hospitalisation was diabetes mellitus (86.0%), followed in order of decreasing frequency by thyroid disorders (7.7%) and miscellaneous disorders (1.4%). The overall crude mortality rate of endocrine admissions was 16.7%. Death was predicted by increasing age with an adjusted hazard ratio of 1.25 (95% confidence interval 1.15 to 1.65) for every 10-y increase in age.

Conclusions: Almost one in six adults admitted with an endocrine disorder to a tertiary care centre in Ghana died in hospital, and many of the deaths were due to non-communicable disease complications. Enhanced public health disease prevention strategies and endocrine inpatient care processes are warranted.

Keywords: endocrine admissions, Ghana, outcomes, West Africa

Introduction

For several decades, communicable diseases have dominated as the leading cause of morbidity and mortality in low- and middle-income countries (LMICs), especially those in sub-Saharan Africa (SSA).^{1–4} Although infectious diseases account for approximately 69% of deaths in SSA, non-communicable diseases (NCDs) have emerged as a significant cause of death.^{5–7}

Endocrine disorders contribute significantly to the NCD burden worldwide, with diabetes leading the way in severity and prevalence. Diabetes accounts for >8% of the global disease burden and 60–70% of the mortality burden.⁸ In Ghana, where middle-income status was recently achieved, the menace posed by various endocrine diseases and other NCDs looms large.^{9–11} Recently a review of diabetes cases in the middle belt of Ghana showed a 633% increase in admissions over 31 years.¹² Significant increases in thyroid and other endocrine disorders have been reported in the two main urban areas in Ghana.^{13,14}

Despite projected increases in admissions and death rates from NCDs, little attention is paid to them in terms of resource and infrastructure allocation, with most of the weak and limited health care budget in resource-limited countries like Ghana still prioritised towards the treatment of infections and nutritional disorders. The care of NCDs is suboptimal and fractured, leaving the population at significant risk of morbidity and mortality.

Enumerated data on the burden, spectrum and determinants of outcomes of endocrine admissions in less developed countries like Ghana are needed to shed light on the problem and enable policy directives to be initiated to combat NCDs. This study aims to present the spectrum, demography, crude mortality rates and determinants of outcomes of adult endocrine disorders in a tertiary referral hospital in the middle belt of Ghana.

Methods and materials

This retrospective study was carried out at the adult medical unit of Komfo Anokye Teaching Hospital (KATH), a leading tertiary hospital

situated in Kumasi, in the middle belt of Ghana. The hospital is a 1200-bed hospital accessible to >10 million people, including those from neighbouring countries. The medical unit has 200 hospital beds and offers emergency services, inpatient services and outpatient specialists, as well as general care. The medical records of patients with endocrine disorders admitted to the medical wards over a 9-y period (1 January 2007–31 December 2015) were retrieved from the hospital admissions and discharge registers. Data collected for the analyses included age, gender, endocrine diagnosis based on International Classification of Disease revision 10 (ICD-10) codes, documented comorbidities, duration of admission and vital status at discharge. The time to discharge or death was calculated by subtracting the date of admission from the date of discharge or death. Endocrine diagnoses were made clinically with the aid of laboratory investigations and in some cases radiological confirmation. For the period under study, five general medical teams admitted all emergency cases. These patients were managed until the general team found the need for subspecialist consultation, in which case the patients were referred to one of the three endocrinologists for further care. Laboratory tests available on site to facilitate clinical diagnosis included full blood count, serum biochemistry for lipid profile, fasting blood sugar, liver and renal function tests, cortisol levels, thyroid function tests, serum calcium, parathyroid hormone and serological tests for human immunodeficiency virus (HIV) and tuberculosis (TB). Radiological investigations available included X-rays, ultrasonography, computed tomography and magnetic resonance imaging. Endocrine disorders were categorised under these main headings: thyroid gland disorders, diabetes mellitus and related disorders, parathyroid gland and related disorders, disorders of the pituitary gland, disorders of the adrenal gland and miscellaneous endocrine diseases. The ICD-10 was used to classify the diseases. Records with incomplete data were excluded from the study. Data were entered into Excel (Microsoft, Redmond, WA, USA) spreadsheets by data entry clerks.

Data analysis

Means and medians were compared using the Student t-test or Mann-Whitney U-test for paired comparisons and analysis of

variance or Kruskal-Wallis test for more than two group comparisons, depending on whether continuous variables were parametric or non-parametric. Crude case fatality rates of specific endocrine disorders were calculated by dividing the number of deaths by the number of admissions of the specific endocrine disorders. Predictors of inpatient endocrine mortality were evaluated using Kaplan-Meier survival curves and multivariate Cox proportional hazard regression models. Variables included in the model were the age of admission in years, gender, year of admission and type of endocrine disorder. In bivariate analyses, a p-value of 0.10 was set for selection of variables into the final multivariable model, with visual inspection for compliance with the collinearity assumption. A two-sided p-value <0.05 was considered significant in all statistical analysis, with no adjustments made for multiple comparisons.

Results

Demographic characteristics of endocrine admissions

There were 6265 endocrine admissions between 2007 and 2015. This represented 9.7% of all adult medical admissions (year-to-year range 8.5–11.6%) (Table 1). There was a preponderance of female admissions, with a female:male ratio of 2:1. The median age of admission was 61 y (interquartile range [IQR] 49–72). The median age of admission for males was 61 y (IQR 49–72) and for females was 60 y (IQR 49–71); the difference was not statistically significant ($p < 0.16$). The overall mean age at admission was 52.0 ± 16.1 y.

Spectrum of endocrine disorders

Table 2 shows the spectrum of endocrine disorders and their case fatality rates. The leading endocrine causes of admission were diabetes and its related disorders (86.0%), thyroid disorders (7.7%), miscellaneous disorders of the endocrine glands (1.4%), adrenal disorders (1.3%) and metabolic syndrome (1.1%).

Table 1. Endocrine admissions and fatalities at the KATH, Kumasi, 2007–2015

Year	Adult medical admissions, n	Endocrine admissions, n	Admissions due to endocrine disorders, %	Mortality of adult medical admissions, %	Endocrine deaths, n	Mortality in adult endocrine admissions, %
2007	7128	734	10.3	29	111	15.1
2008	7286	634	8.7	28	125	19.7
2009	7102	604	8.5	27.7	71	11.8
2010	7306	759	10.4	25.4	108	14.2
2011	7266	745	10.3	25.2	95	12.8
2012	7279	750	10.3	23.1	110	14.7
2013	6947	809	11.6	26.4	107	13.2
2014	7123	714	10.0	28.9	98	13.7
2015	6946	692	10.0	25.5	85	12.3
Total	64 383	6265	9.7	26.6	910	14.5

Table 2. Frequencies of endocrine disorders at the KATH, Kumasi, 2007–2015

Endocrine disorders	Number	Percentage	Male:female ratio	Age (years), mean (SD)
Diabetes mellitus	5628	86.9	1:2.6	61.0 (18.3)
Adrenal disorders	84	1.3	1.6:1	46.7 (17.0)
Thyroid disorders	482	7.7	1:5.6	45.9 (18.5)
Pituitary disorders	48	0.8	1:1	38.6 (14.6)
Metabolic syndrome	72	1.1	1:1.8	49.0 (15.0)
Parathyroid disorders	52	0.8	1:1.4	37.2 (18.0)
Others	79	1.4	2:1	66.3 (9.2)
Total	6265	100	1:1.8	50.7 (16.1)

SD: standard deviation.

Diabetes-related admissions and mortality

Glycaemic complications

Table 3 shows the various diabetes mellitus-related medical admissions. Almost a third of the patients were newly diagnosed with diabetes mellitus. Nine in ten of the admissions were type 2 diabetes. There was a significant difference in the age at presentation of the various types of diabetes, with those with type 2 relatively older compared with type 1 and the other causes of diabetes. The overall crude mortality rate for glycaemic admissions was highest among those with hyperosmolar hyperglycaemic state, hypoglycaemia and diabetic ketoacidosis (DKA), in that order.

Microvascular complications

A total of 1927 (35.4%) of the all diabetes-related admissions were associated with microvascular complications and 988 (18.1%) had nephropathy. The median age of admission of patients with nephropathy was 60 y (IQR 50–71), the male:female ratio was 1.3:1.0 and the mortality associated with nephropathy was 27.6%.

Macrovascular complications

A total of 1035 (22.1%) patients with diabetes admissions presented with a macrovascular complication of diabetes: 492 (9.0 %) had cerebrovascular accidents (CVAs), 261 (5.6%) had coronary artery disease (CAD) and 282 (5.7%) had peripheral artery disease (PAD)/gangrene. The median number of the various macrovascular admissions were CVA 67 (IQR 58–75), CAD 59 (IQR 55–71) and PVD 62 (IQR 52–72) ($p < 0.001$ by Kruskal-Wallis). The male:female ratios were 2:1, 1.3:1 and 1:1, respectively. The overall mortality associated with macrovascular complications was 58.5%: 43.0% for CVAs, 79.8% for CAD and 53.6% for PVD.

Infections

Infections complicated 984 (18.1%) of the admissions. Of these, 157 (2.9 %) had cellulitis/foot infections, 278 (5.1%) had pneumonia or respiratory tract infections, 78 (1.4%) had TB, 49

(0.9%) had HIV, 379 (8.9%) had urinary tract infections and 43 (0.9%) had central nervous system (CNS) infections. The median number of the various infections was foot 56 (IQR 47–68), pneumonia 70 (IQR 54–75), TB 57 (IQR 47.5–68), HIV 55 (IQR 36–63), urosepsis 65 (IQR 50–75) and CNS 48 (IQR 39–55). The overall mortality associated with infections was 42.2%. Foot infections and cellulitis were associated with a mortality of 47.4%, pneumonia 40.6%, TB 20%, HIV 33.3%, urinary tract infection 30.6% and CNS 82.1%.

Miscellaneous

Congestive heart failure complicated 214 (3.9%) of the diabetes-related admissions, 324 (5.9%) were accompanied by uncontrolled hypertension, 15 (0.3%) by venous thromboembolic disease, 23 (0.4%) with cholecystitis and 53 (0.7%) with malignancies. The most common malignancy associated with diabetes was hepatocellular carcinoma (64%). The median age of admission for diabetes-related disorders was 65 y (IQR 59–74), uncontrolled hypertension 49 y (IQR 40–55), venous thromboembolic disease 50 y (IQR 39–63), cholecystitis 54 y (IQR 41–62) and malignancies 58 y (IQR 50–74). The male:female ratios of the various disorders were 1.0:5.2 (diabetes-related disorders), 1:1.8 (uncontrolled hypertension), 1.0:1.3 (venous thromboembolic disease) and 1.0:3.0 (cholecystitis). Crude case fatality rate associated with these disorders was 21.6%. Congestive heart failure was associated with a 13% mortality rate and hypertensive crises with 22.0% mortality rate. Venous thromboembolic disease was associated with 20% case fatality rate, cholecystitis 20% and malignancy 33%.

Thyroid disorders

Disorders of the thyroid gland represented the second most frequent cause of endocrine admissions, representing 7.7% of endocrine entries. The mean age at entry of patients with thyroid disorders was 45.9 ± 18.5 y, with a male:female ratio of 1.0:5.6. The most common thyroid disorder was hyperthyroidism, accounting for 412 (85.5%) thyroid admissions. Hypothyroidism constituted 52 (10.8%) thyroid admissions and 18 (3.7%) had other causes of thyroid disease. The median number of patients

Table 3. Frequencies, demographics and crude mortality rates of various diabetes complications at the KATH, Kumasi, 2007–2015

Diabetes disorders/complication	Number (%)	Age at presentation (years), median (IQR)	Crude mortality rate, %	Male:female ratio
Glycaemic complications				
DKA	784 (14.3)	28 (19–38)	14.0	1:1
HHS	1137 (20.7)	68 (60–76.5)	30.4	1:3
Hyperglycaemia	2760 (50.3)	60 (47–71)	6.7	1:4.5
Hypoglycaemia	767 (14.0)	64 (52–74)	16.0	1:1.6
Microvascular complications				
Nephropathy	988 (21.1)	60 (50–71)	27.6	1:2.3
Macrovascular complications				
Cerebrovascular accident	492 (10.5)	67 (58–75)	43.0	2:1
Myocardial infarction/CAD	261 (5.6)	58.5 (55–71)	78.9	1.3:1
PVD (gangrene)	282 (6.1)	62 (52–72)	53.6	1:1
Infections				
Foot infections/cellulitis	157 (3.4)	56 (47–68)	47.4	2.7:1
Pneumonia	278 (5.9)	69.5 (53.5–75.3)	40.0	2.3:1
TB	78 (1.7)	57 (47.5–68.3)	20.0	1:1.5
HIV	49 (1.0)	55 (36–63)	33.3	1:1
Urinary tract	379 (8.1)	65 (50–75)	30.6	1:8
CNS	43 (0.9)	48 (39–55)	82.1	2:1
Other complications				
Biventricular failure	114 (2.4)	65 (59–74)	13.0	1:5.2
Hypertension crises	224 (4.8)	49 (40–55)	22.0	1:1.8
Deep vein thrombosis/pulmonary embolus	15 (0.3)	50 (39–63)	20	2:1
Cholecystitis	13 (0.2)	54 (41–62)	20.0	1:1.3
Malignancies	33 (0.7)	58 (60–70)	33.0	1:3

with hyperthyroidism was 44 (IQR 32–54), hypothyroidism 78 (IQR 27–90) and other thyroid disorders 40 (IQR 24–55) ($p < 0.001$). The male:female ratios were hyperthyroidism 1:1, hypothyroidism 1:1.5 and other thyroid disorders 1:8. In patients with hyperthyroidism, Graves disease was the cause in 185 (44.9%) patients, toxic multinodular goitre in 191 (46.3%) and toxic nodule in 15 (3.1%). Hyperthyroidism in 21 (5.1%) patients had an unspecified cause. The median age of admission for the various causes of hyperthyroidism was 51 y (IQR 37–64) for Graves disease, 43 y (IQR 26–49) for toxic nodule, 46 y (IQR 38–53) for toxic multinodular goitre and 42 y (IQR 27–56) for other thyroid disorders. The male:female ratio for thyroid disorders was 1.0:8.0 for Graves disease, 1.0:2.0 for toxic adenoma and 1.0:7.0 for toxic multinodular goitre. The most frequent complications associated with hyperthyroidism were diastolic dysfunction with high output failure (54%), atrial fibrillation (23%), systolic hypertension (10%) and CVAs (3%). In patients with hypothyroidism, the most common accompaniments were heart failure (55%), hypoglycaemia (44%) and hypothermia (21%). The case fatality for rate patients with hypothyroid disorders was 33.0%, while for those with hyperthyroidism it was 13.0%.

Adrenal disorders

Adrenal disorders constituted 84 (1.5%) endocrine admissions, with a male:female ratio of 1.6:1 and a mean age at entry of

46.7±17.0 y. Hyperfunction was the cause in 39 cases of adrenal gland disorders. In patients with hyperfunction of the adrenal gland, adrenal Cushing's constituted 24 (62.0%) cases, with median age of admission of 38 y (IQR 32–45) and male:female ratio of 1:3. In those with congenital adrenal hyperplasia, it constituted 5 (13.0%) cases, with a male:female ratio of 1:2 and a median age of admission of 15 y (IQR 12–34). Pheochromocytomas represented 26 (31.0%) cases, with a male:female ratio of 1:1.5 and a median age of admission of 45 y (IQR 32–55). Adrenal insufficiency occurred in 45 (53.6%) cases of adrenal disorders. The most common causes of adrenal dysfunction included Waterhouse-Friderichsen syndrome ($n=2$) and HIV and TB co-infection ($n=36$); 7 patients had only HIV infection and were diagnosed with HIV adrenalitis. The overall case fatality rate for adrenal disorders was 38.0%.

Pituitary disorders

A total of 48 (0.8%) patients were admitted because of pituitary disease. Of these, 29 had hyperfunction disorders with an overall median of 35 (IQR 21–45). Among these, 15 had acromegaly with a median of 41 (IQR 25–35), 13 had Cushing's disease with a median of 36 (IQR 24–55) and 1 was admitted with prolactinoma. Regarding hypofunction, pituitary apoplexy represented the most frequent cause, with a median of 55 (IQR 28–82) patients. The overall case fatality rate associated with pituitary

disorders was 16.7% and the case fatality rate associated with pituitary apoplexy was 87%.

Metabolic syndrome

Metabolic syndrome constituted 72 (1.3%) of all cases of endocrine disease admitted, with a mean age of 49.0±15.0 y. Hypertensive heart disease and arrhythmias were the most frequent accompaniments. The overall case fatality rate was 6.7%.

Disorders of calcium and bone metabolism

Disorders of calcium and bone metabolism represented 52 (1.0%) of the endocrine admissions over the period under study. The mean age of admission was 37.2±18.0 y with a male:female ratio of 1:1.4. Hypercalcaemia represented 81% (n=42) of the cases with a median of 33 (IQR 24–56) and hypocalcaemia (n=10) representing 48% with median age of admission of 32 y (IQR 20–33) and male:female ratio of 1:1. The causes of hypercalcaemia included chronic kidney disease and primary hyperparathyroidism. In the case of hypoparathyroidism, the most common causes were parathyroid and thyroid surgeries. The overall case fatality rate was 20%.

Miscellaneous disorders

Miscellaneous disorders constituted 34 (0.9%) of the endocrine disorders, with the mean age of 66.3±9.2 y and a male:female ratio of 2:1. The overall case fatality rate was 12.8%. Some of these disorders included thyroid abscesses (n=3), various

disorders causing a syndrome of inappropriate antidiuretic hormone secretion (n=18), autoimmune polyglandular syndromes (n=8) and multiple endocrine neoplasias (n=5).

Duration of admission

The overall median duration of admission of patients with endocrine disorders was 5 d (IQR 3–8), with disorders of the pituitary gland requiring the longest duration of 8 d (IQR 2–9) and hyperthyroidism requiring 3 d (IQR 5–8). With almost all endocrine conditions, those who were discharged spent a relatively longer duration compared with those who died (Table 4).

Predictors of mortality

Increasing age at admission was associated with an increased risk of death, with each 10-y increase in age associated with an adjusted hazard ratio (aHR) of 1.23 (95% confidence interval [CI] 1.12 to 1.53; p<0.001), as shown in Table 5 and illustrated in Fig. 1. The probability of death was greatest with adrenal disorders, followed by metabolic syndrome, pituitary disorders, parathyroid and calcium homeostasis, diabetes and thyroid disorders, as depicted in Fig. 2. Among people with diabetes, the probability of death was predicted by age (aHR 1.12 [95% CI 1.04 to 1.17]) for each 10-y increase in age. The probability of death was highest in those with type 2 diabetes (aHR 2.23 [95% CI 1.95 to 2.50], p<0.0001) and specific causes of diabetes (aHR 1.12 [95% CI 1.02 to 1.63], p<0.0002) compared with type 1 diabetes (Fig. 3). Cardiovascular, neurological, infections, renal and glycaemic complications were associated with a significant

Table 4. Duration of admission per endocrine disorder and vital status at discharge

Endocrine disorder	Admissions, n	Duration of admission (days), median (IQR)	Deaths (crude mortality rate), n	Patients who died, median (IQR)	Patients who survived, median (IQR)	p-Value
Diabetes						
HHS	1137	5 (3–8)	70 (30.4)	4 (2–7)	6 (4–9)	<0.0001
DKA	784	7 (4–10)	41 (40)	3 (1.5–6)	7 (5–11)	<0.0001
Hyperglycaemia	2760	5 (3–8)	120 (6.7)	4 (2–8)	5 (3–8)	0.06
Hypoglycaemia	767	4 (3–8)	104 (16)	3 (2–7)	5 (3–8)	0.002
Infections	100	4 (2–8)	68 (36.6)	2.5 (1–7)	4 (3–8)	0.0001
Foot ulcers	57	5.5 (4–10)	22 (38.6)	4 (2–10)	7 (5–10.5)	0.04
PVD	282	6 (3–13.6)	42 (84)	4 (1.6–8)	10 (5.75–3.8)	<0.0001
CAD	261	5 (2.3–10)	24 (92.3)	5 (2–10)	7 (5–11)	<0.0001
Cerebrovascular accident	492	5 (3–8)	49 (41.5)	4 (2–7)	5 (3–8.3)	<0.0001
Nephropathy	988	6 (3–10)	86 (17.9)	5 (2–8)	6 (4–10)	0.002
Neuropathy	861	5 (2.5–10)	18 (29.5)	3 (1–9.8)	7 (5–11.3)	<0.0001
Thyroid disorder						
Hypothyroidism	52	7 (4–9)	13 (11.2)	3 (1.5–8)	7 (4–9)	0.02
Hyperthyroidism	412	3 (5–8)	23 (5.6)	2 (1–3)	6 (5–9)	<0.0001
Other						
Adrenal disorder	79	6 (3–10)	30 (38)	4 (1–6)	8 (6–14)	<0.0001
Pituitary disorder	12	8 (2–9)	2 (16.7)	8 (2–9)	8 (3–9)	0.03
Parathyroid disorder	20	5 (3–7)	5 (20)	2 (0.5–4)	6 (3–8)	0.01
Metabolic syndrome	15	4 (2–8)	1 (6.7)	2.5 (1–7)	5 (3–8)	<0.0001

Table 5. Predictors of inpatient diabetes mortality

Predictor	Unadjusted HR (95% CI)	p-Value	Adjusted HR (95% CI)	p-Value
Gender				
Male	1			
Female	0.67 (0.31-1.2)	0.12	-	
10-y age increase	1.25 (1.15-1.65)	<0.0001	1.23 (1.12-1.53)	<0.0001
Type of diabetes mellitus				
Type 1	1		1	
Type 2	3.45 (3.13-3.89)	<0.0001	3.21 (2.58-3.67)	<0.0001
Specific type	2.39 (2.25-2.90)	<0.0001	2.21 (1.59-2.50)	<0.002
Complications				
Pneumonia	2.79 (1.98-2.93)	<0.0001	2.28 (1.91-2.54)	<0.0001
Cerebral infection	8.66 (5.52-12.38)	<0.0001	7.51 (2.62-9.32)	<0.0001
Foot infection	5.31 (2.81-7.67)	<0.001	4.31 (3.92-5.21)	<0.0001
Hypertension	1.51 (1.02-1.71)	<0.001	1.14 (3.21-3.21)	<0.0001
CAD	11.4 (3.01-15.7)	<0.0001	9.2 (8.32-15.3)	<0.00001
PAD	6.32 (3.35-9.2)	<0.001	5.8 (5-7.21)	<0.00001
Nephropathy	2.0 (1.5-2.3)	<0.0001	1.89 (1.22-2.12)	<0.00001
DKA	1.9 (1.5-3.2)	<0.0001	1.5 (1.30-2.50)	<0.0001
HHS	4.2 (3.5-5.2)	<0.001	3.5 (2.9-3.9)	<0.0001
Hypoglycaemia	2.8 (2.23-3.2)	<0.0001	1.9 (1.3-2.8)	<0.0001
Hyperglycaemia	1.0		1	

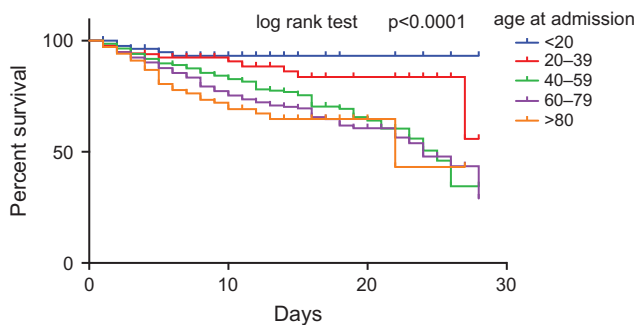


Figure 1. Kaplan-Meier curves of probability of death per age of admission with an endocrine disorder.

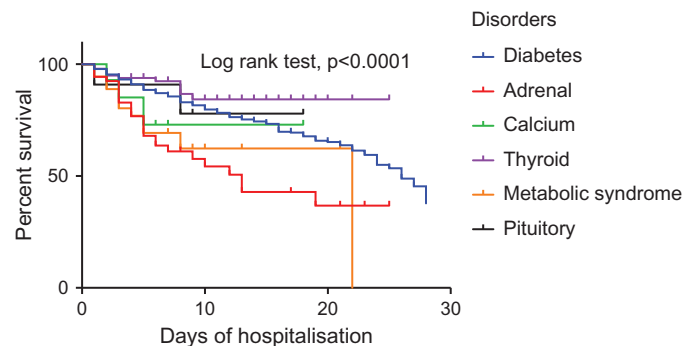


Figure 2. Kaplan-Meier curves of probability of death per endocrine disorder.

probability of death, as shown in Fig. 4. The presence of a chest infection (aHR 2.28 [95% CI 1.91 to 2.54], $p < 0.001$), foot infection (aHR 4.31 [95% CI 3.92 to 5.21], $p < 0.0001$) or CNS infection (aHR 7.51 [95% CI 2.62 to 9.32], $p < 0.001$) was associated with significant probabilities of death, as were nephropathy (aHR 1.89 [95% CI 1.22 to 2.12], $p < 0.001$), CAD (aHR 9.2 [95% CI 8.32 to 15.3], $p < 0.001$), PVD (aHR 5.8 [95% CI 5 to 7.2], $p < 0.001$), DKA (aHR 1.14 [95% CI 3.21 to 3.21]), HHS (aHR 3.5 [95% CI 2.9 to 3.9], $p < 0.001$) and hypoglycaemia (aHR 1.9 [95% CI 1.3 to 2.8], $p < 0.001$).

Discussion

Endocrine disorders represented almost 10% of medical admissions to the KATH over the study period, with an average

admission of 600 patients per year. Patients presented with a broad spectrum of endocrine disorders, with diabetes and thyroid disorders representing the two most frequent causes of endocrine admissions. In patients presenting with both diabetes and other endocrine disorders, cardiovascular complications predominated. This observation highlights the well-described growing menace of NCDs and uncontrolled vascular risk factors such as diabetes, hypertension, dyslipidaemia, obesity and physical inactivity that has emerged in populations of SSA over the past few decades.¹⁵⁻¹⁸ This has resulted from the adoption of westernised lifestyles leading to an epidemiological transition in SSA, of which Ghana has not been spared.^{4,5} An overall endocrine case fatality rate of 17% obtained in this population is significantly high compared with the mortality rates obtained in other areas of the world.^{19,20}

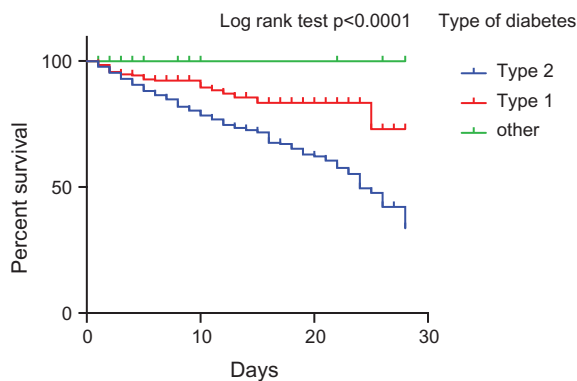


Figure 3. Kaplan–Meier curves of probability of death per type of diabetes.

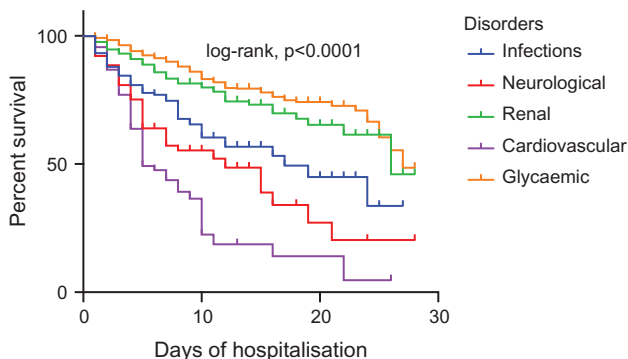


Figure 4. Kaplan–Meier curves of probability of death per diabetes complication.

The poor outcomes of endocrine disorders in Ghana can be attributed to a combination of factors, including late presentation of patients, patients presenting with multiple and severe pathologies, fragmented institutional care of endocrine patients and a severe lack of endocrinologists in the country, as well as the lack of lifesaving emergency medications, insufficient equipment and infrastructure required for acute management of patients with endocrine emergencies. Deaths from hypoglycaemia, which seems to be almost unheard of in the developed world, was found to be relatively high in this study (16%). This is largely attributed to the low rate of education among diabetes patients, especially those on insulin and other hypoglycaemic agents. In addition, the high burden of diabetes complications, including nephropathy, shown in this study may serve as a contributing factor to the worse outcomes associated with hypoglycaemia. Other reasons include late presentation among patients and the absence of glucagon to provide immediate relief for these patients at the time of need.

A similar situation is seen in the high risk of death among patients with hypothyroidism. Most of these patients present late, with significant cardiac complications, thus exposing them to greater risk of death. Additionally, in the past, endocrine emergencies constituted only a small percentage of emergencies and the inpatient workload (<2%) seen by general doctors, with most of these patients presenting with diabetes-related complications.²¹ This resulted in a situation where most general

practitioners had insufficient exposure to other endocrine disorders and diabetes complications, causing them to be less confident in the management of these disorders. This resulted in increased mortality when confronted with such cases.

Endocrine disorders, like most other NCDs, are common in the elderly, causing a significant association with increased mortality. It should be noted that most elderly patients usually present with additional comorbidities, mostly cardiovascular disorders, thereby increasing their risk of death. The observed age distributions also lend credence to the hypothesis that adult populations in developing countries may have an increased susceptibility to diabetes and other endocrine illnesses due to the socio-economic deprivation that was present during their infancy and childhood, possibly leading to the earlier manifestations of these disorders.^{21–23}

Although a broad spectrum of endocrine-related illness was observed in this study, highlighting the epidemiology of diseases in middle-income countries where a transition from infections to NCDs has occurred, diabetes remains the leading cause of endocrine admission in consonance with various other diseases.^{24–26} Recently a study in our hospital reported a 633% increase in admission rates over a 31-y period. Importantly, no significant improvements in mortality rates have been achieved over this 31-y period.¹¹ A significant proportion of diabetes admissions were complicated by CVDs.²⁷ This often reflects the severity of the underlying disease or delayed hospitalisation, although indicators of severity and the duration of symptoms before presentation were not assessed in this study.

Thyroid disorders represented the second most prevalent cause of endocrine admission in our study. More than 80% of patients presented with hyperfunction of the thyroid gland, in line with findings from other African countries and other areas of initial hypothyroidism, where the transition from iodine deficiency to iodine sufficiency achieved through iodisation of salt has resulted in an increasing prevalence of hyperthyroidism.^{28–32} The relatively high number of patients with Graves' disease or toxic multinodular goitres seen in our study may have resulted from >20 y of unregulated iodination in Ghana.³³

The relatively low levels of endocrine disorders apart from diabetes and thyroid disorders can potentially be explained by patients being missed at the emergency room, as most of these disorders require a high index of suspicion and can easily be mistaken for other common diseases, especially in settings where there is no constant availability of radiological services and other critical investigative tools.

The main limitation of this study is its retrospective nature with the inherent absence of data completeness. Additionally, the study was not accompanied by biochemical and radiological results, which would have served as useful tools for comparison and confirmation of the various diagnosis. The main strengths of the study are its longitudinal design over a 9-y period and it being the first of its kind in the subregion to report on endocrine disorders.

The practice of endocrinology in resource-limited settings like Ghana is thus constrained by inadequate diagnostic support and a substantial disease burden. A clearer picture of the endocrine burden will continue to emerge in the coming years as more endocrinologists are trained and determinants of outcomes of endocrine disorders become clearer. Such data will be

invaluable for policy formulation and health improvements at both the individual and population levels.

Conclusions

The leading causes of endocrine admissions are very preventable, but this will require multidimensional and multilevel efforts toward reversing the current trajectory of admissions, disability and mortality from endocrine disorders.

Authors' contributions: OSK, EOA, IK and NAB conceived the study and designed the study protocol. OSK, NAB and IK performed the data extraction. OSK, EOA and IK performed the data analysis and interpretation. OSK, IK, NAB and EOA drafted the manuscript and critically revised the manuscript for intellectual content. OSK is the guarantor of the paper. All authors read and approved the final version of the manuscript.

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