Transportation: Barrier to Maternal and Child Health Services in Rural sub-Saharan Africa

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Maternal and infant mortality has been a great challenge to the global health system. 1 Globally, 830 women die every day from preventable causes related to child birth and pregnancy. On the other hand, an estimate of 5.9 million of children under age five died in 2015 according to the World Health Organization 2016 report 2. The 2014 report by the World Health Organization estimated that 56 million people die globally with almost 99% of these deaths occurring in middle and lower income countries. 3 More than half of these deaths happened in sub-Saharan African countries 4 such as Ghana, Ethiopia, Sierra Leone, Tanzania, Malawi, Nigeria, among others.

Many lives especially that of pregnant women and children have been endangered in sub-Saharan Africa especially in the rural communities due to the challenges of patient referral 1. Patient referral refers to the request of a health professional at a lower health facility for a patient to receive healthcare services at a higher level health facility 6. Key among the other challenges in referring a patient to a higher health facility from rural communities in sub-Saharan is the means of transport.

Transport is very critical to healthcare delivery especially in areas where people have to travel for several kilometers before accessing a health facility 7. People have to travel that long because health facilities are sited within urban and peri-urban communities. This significantly and negatively affects the achievement of Maternal and Child health outcome in spite of the efforts ongoing in sub-Saharan Africa.

Maternal Mortality Ratio and under 5 (children below age 5) mortality is higher in rural communities and among the poor 4. In sub-Saharan Africa, poor road network, lack of ambulance for referral services, non-existence of regular means of suitable transport, long distance from homes to facilities among others makes it difficult for people in rural communities to access specialized healthcare available in urban areas 7,8. Some sections of rural communities in sub-Saharan Africa do not have access to primary healthcare and this has led to a situation where indigenes of these communities have no choice but to resort to alternate forms of healthcare such as spiritual healers and herbal medicine other than the modern scientific method of healthcare. 9. The above challenges hampered the achievement of the goal 4 and 5 of the Millennium Development Goal (MDG) of Reduction in Child Mortality and Improvement in Maternal Health 7 respectively in sub-Saharan Africa.

Although sub-Saharan African countries have experienced a considerable decline in Maternal Mortality Ratio between the periods of 1990 and 2015, it remains the highest in the world which is approximately 66% (201,000) 10. Also, infant mortality in sub-Saharan Africa is the highest globally 2. Between these periods (1990 to 2015), sub-Saharan African countries have witnessed 45% decrease in Infant Mortality 2,11. The percentage of reduction in Maternal Mortality between these periods are Ghana 49.7%, Ethiopia 71.8%, Tanzania 60.1%, Malawi 33.8%, Nigeria 39.7% and Sierra Leone representing 48.3% 12.

The 2012 report by the World Health Organization on maternal deaths in sub-Saharan Africa was so alarming. Most of the countries with high maternal and infant mortality were located in sub-Saharan Africa. Women in this part of the world were 15 times more prone to the dangers of childbirth and pregnancy situations as compared to those in the developed countries 13. In sub-Saharan Africa, children on the other hand were more than 14 times more likely to die before attaining age 5 than children in the developed world 11. For example, Maternal Mortality Ratio in Ghana as presented by the World Health Organization reduced by 2.6 percent between 1990 to 2000. Beyond the year 2000, Maternal Mortality Ratio further declined by 4.5 percent, this represents a Maternal Mortality Ratio of 350 per 100,000 births 14. On the other hand, Netherlands (a developed country) Maternal Mortality Ratio as presented by the United Nations Development Programme (UNDP) was 10 per 100,000 births in 1990, this figure witnessed a slight increase to 13 per 100,000 births in the year 2000 and reduced to 8 per 100,000 births in 2005 15.

It is considered that, more than half of deaths caused by pregnancy in developing countries could have been prevented if the right emergency referral facilities were readily available, accessible and affordable especially in the rural communities 7. Therefore, for countries in sub-Saharan Africa to achieve the targets of the goal 3 of the Sustainable Development Goal (SDG) which is to “ensure healthy lives and wellbeing for all at all ages”, the issue of geographic and physical barriers to healthcare should be well looked into. Communities should be able to easily access healthcare. Government and non-governmental organizations should help in the building of health facilities in rural and deprived communities, provide ambulance services, adequate health officers and drugs. All these coupled with good road network would help people in these communities. Also, primary healthcare should be placed within the cultural settings of these people, so that they can embrace and easily access it to save mothers and children from preventable deaths. Again, the scaling up of the Community-based Health Planning and Services (CHPS) compound pilot project carried out by the Navrongo Health Research Center (NHRC) in Ghana, which aims at bringing healthcare services to the doorsteps of rural indigenes, should be intensified to reach all rural communities in the various regions in Ghana. Finally, other sub-Saharan African countries should adopt the Community-based Health Planning and Services (CHPS) compound system of primary healthcare provision to help reduce the maternal and infant mortality rate drastically by 2030.
REFERENCES


Retrospective review of renal cases in a tertiary hospital in West Africa

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ABSTRACT

Introduction
Kidney diseases commonly present to the Komfo Anokye Teaching Hospital (KATH). There has not been a comprehensive analysis of the number of renal cases managed. We set out to analyze comprehensively the renal cases seen at KATH to describe the trends for the past decade.

Methods
A retrospective study was conducted from January 2006 to December 2016. We collected secondary data from the records on the wards, outpatient clinics and Haemodialysis unit from the KATH annual reports. We then plotted the trends in kidney diseases seen and managed in KATH and the corresponding mortalities over the decade.

Results
Renal outpatient clinics started in 2007. There were an average of 65,273 medical outpatients seen yearly with kidney diseases accounting for 5,397 (8.3%). Renal clinic patients increased by 271% from 710 in 2007 to 1927 in 2016.

The average yearly medical admission was 6,880 patients of which kidney disease admissions accounted for 276 (4.0%). The average position of renal admissions was 6th (range 2nd-10th) of total medical admissions. The average annual mortality rate of renal admissions was 32.7% as compared to the average general medical cases mortality of 23.8% annually.

Haemodialysis services commenced in 2006. Patients on haemodialysis have increased by 50 times from 8 in 2006 to 407 in 2016. Haemodialysis session also increased by 38.8 times from 59 in 2006 to 2350 in 2016. The average number of patients on Haemodialysis per year was 211.5.

Conclusion
Renal diseases are common and associated with significant morbidity and mortality. A concerted effort is needed to enhance the diagnosis and management of kidney diseases in Ghana.

INTRODUCTION

The prevalence of kidney diseases is increasing worldwide. Kidney diseases are commonly classified as acute kidney disease or chronic kidney diseases. Chronic kidney disease (CKD) is a recognised worldwide heath problem with increasing incidence and prevalence worldwide. The prevalence in Africa is estimated to be 13.9% in a meta-analysis and believed to be increasing. The prevalence of CKD in Ghana is currently unknown but the causes of chronic kidney disease such as hypertension and diabetes are increasing in prevalence.

Prevalence of hypertension ranges from 4.5%–54.6% with the highest among urban dwellers. The prevalence of hypertension is increasing with urbanisation and westernization. Almost half of hypertensive patients in Ghana have CKD.

Diabetes mellitus is also increasing in prevalence and noted to be the commonest cause of CKD worldwide. The total number of people with diabetes worldwide is projected to rise from 171 million in 2000 to 366 million in 2030 with an estimated prevalence of 4.4% from 2.8% in 2000. In Ghana, the age adjusted prevalence of diabetes was 6.4% in a community based study in 2002 which is higher than the estimated global prevalence for 2030.

The high prevalence of infectious diseases coupled with the increase in non-communicable diseases due to lifestyle changes in developing countries make the disease burden greater than in developed countries. Developing countries including Ghana are saddled with rampant use of herbal medication for the treatment of medical and spiritual conditions. This is because they are readily available without prescription and are believed to be “natural” and therefore safer though the safety profile of such medications are unknown. The use of herbs is associated with acute kidney injury, tubular dysfunctions, hypertension, chronic kidney disease, chronic interstitial nephritis, renal papillary necrosis and even

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urothelial carcinomas\(^{16}\). This is believed to worsen an already precarious prevalence of kidney disease in developing countries. Kidney diseases have been managed in KATH since the hospital’s inception. Management of kidney diseases in KATH is somewhat sub-optimum. The low nephrologist numbers in Ghana\(^ {11}\), inadequate renal replacement services\(^ {12}\) and the absence of renal transplant services makes the management of ESRD a daunting task for physicians and nephrologists in developing countries such as Ghana. The renal services provided in KATH include in-patient and out-patient care and until 2006 the provision of Haemodialysis services in adults and acute peritoneal dialysis for children with acute kidney injury (AKI). Renal transplantation services is currently unavailable in KATH. Korle Bu Teaching hospital, a tertiary institution provided limited renal transplantation services in 2008\(^ {12}\) but not anymore currently.

To our knowledge, annual reviews of kidney diseases have not been done in any institution in Ghana to describe trends in renal cases seen. We therefore set out to report the trends of kidney diseases seen at the Komfo Anokye Teaching hospital over a decade and the mortality rate of kidney disease admissions. This will serve as baseline data for subsequent studies into renal disease for appropriate management in Ghana and the West Africa.

**METHODOLOGY**

We conducted a retrospective review of the annual reports of KATH from 2006 to 2016. Documentation of the annual outpatient cases for general medicine, hypertension and renal cases seen were done. The inpatient medical and renal out-patient cases were also documented. Renal cases included chronic and acute kidney injury and excludes cases of pyelonephritis, urinary tract infections, renal stones and other infections of the urinary tract. The number of patients on haemodialysis and number of haemodialysis sessions done during the study period were also recorded. The medical and renal mortality rates over the period were also documented.

**Study setting**

Komfo Anokye Teaching Hospital (KATH) is a 1,300 bed capacity tertiary facility established in 1955 in Kumasi in the Ashanti region. It’s been a teaching Hospital since 1975. The hospital provides services to the Ashanti Region, Brong Ahafo, and the three Northern Regions and to some parts of the Western and Central Regions.

The Internal Medicine Directorate is one of the twelve (12) clinical directorates in KATH. Among the specialized clinics run by the internal medicine directorate are: hypertension, asthma, diabetes, human immunodeficiency virus (HIV), chest, psychiatry, dermatology, haematology, neurology, cardiology, and the renal. The directorate also runs a daily physician specialist general out-patient clinic in specialist consulting room one (CR1). The Directorate of medicine operates seven (7) wards with an average of 205 beds. The turnover per bed for the year was 31 with bed occupancy of 86.4\%. The average length of stay on the medical ward was 9 days.

The renal clinic operates twice a week and the hypertension clinic operates once a week. The Haemodialysis unit offers chronic and acute dialysis to patients with kidney disease requiring renal replacement therapy. The renal unit is run by physician specialist, principal medical officers, rotating medical officers and until recently trained nephrologists.

The Haemodialysis unit currently has eight functioning machines but is plagued with frequent shortage of dialysate fluids, power outages and water interruptions which affects service delivery.

**RESULTS**

A total of 713,194 outpatient medical cases were seen over the study period with an average of 64,835.8 per year. Renal outpatient cases were 13,719 over the period with an average of 1,371.9 patients per year. Renal outpatients are 2.1\% of outpatient medical cases seen. Renal and hypertension outpatient cases make up 8.0\% of all outpatient medical cases seen at the Komfo Anokye teaching Hospital.

There were a total of 69,603 medical admissions over the study period with an average admission of 6,898 patients per year. Total recorded renal admission was 2,206 patients which excluded the years 2006, 2007 and 2009 as there was no available data as shown in table 1. The average renal admission per year was 275.8. Renal admissions were 4.0\% of all medical admissions.

**Table 1: number of medical, renal and hypertension cases from 2006-2016**

<table>
<thead>
<tr>
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<td>No of Medical OPD patients</td>
<td>75877</td>
<td>78934</td>
<td>72971</td>
<td>67014</td>
<td>68694</td>
<td>68335</td>
<td>65620</td>
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<td>1355</td>
<td>1214</td>
<td>1710</td>
<td>1326</td>
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<td>4908</td>
<td>4088</td>
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<td>4880</td>
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<td>718</td>
<td>954</td>
<td>477</td>
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<td>1397</td>
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<tr>
<td>No of patients on Haemodialysis</td>
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<td>125</td>
<td>150</td>
<td>106</td>
<td>73</td>
<td>235</td>
<td>243</td>
<td>338</td>
<td>278</td>
<td>163</td>
<td>407</td>
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<td>7124</td>
<td>7286</td>
<td>7102</td>
<td>7306</td>
<td>7266</td>
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<td>6094</td>
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<td>No of Renal admissions</td>
<td>-</td>
<td>-</td>
<td>103</td>
<td>-</td>
<td>159</td>
<td>301</td>
<td>317</td>
<td>212</td>
<td>408</td>
<td>275</td>
<td>431</td>
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Year


| Renal position on Top 10 mortality on medical ward | - | - | 10th | - | 10th | 2nd | 4th | 7th | 8th | 6th | 3rd |
| Renal mortality rate (%) | - | - | - | - | 32.1 | 38.2 | 32.2 | 29.7 | 25.98 | 46.9 | 23.7 |

No, number; OPD, outpatients department

Table 2 showing the total number of patients seen per year and the average per year

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total number of patients over a decade</th>
<th>Average no of patients seen per year</th>
<th>Percentage of medical cases</th>
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<td>Medical OPD clinics</td>
<td>713194</td>
<td>64835.82</td>
<td>-</td>
</tr>
<tr>
<td>Renal OPD clinic</td>
<td>13719</td>
<td>1371.9</td>
<td>2.12%</td>
</tr>
<tr>
<td>No of dialysis sessions</td>
<td>11143</td>
<td>1018.36</td>
<td>-</td>
</tr>
<tr>
<td>No of Patients on Haemodialysis</td>
<td>2318</td>
<td>211.45</td>
<td>4.82</td>
</tr>
<tr>
<td>Renal admissions</td>
<td>2206</td>
<td>275.75</td>
<td>4.0</td>
</tr>
<tr>
<td>Renal position on Top 10 Mortality</td>
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<td>6.25</td>
<td>-</td>
</tr>
<tr>
<td>Renal mortality rate (%)</td>
<td>-</td>
<td>32.68</td>
<td>-</td>
</tr>
</tbody>
</table>

OPD; Outpatient department: No; Number

The yearly total outpatient medical clinic cases for all specialties showed a decreasing trend over the study period as shown in the Figure 1. Medical outpatient cases decreased from 75877 in 2006 to 59796 in 2016 representing a decrease of 21.2%.

Figure 1 showing the trends in general medical outpatient cases seen in KATH since 2006.

Hypertension clinic in KATH started in 2003. There has been a decreasing trend to a low of 3120 patients in 2010. Patient numbers then increased to a peak of 4908 in 2012 followed by a decrease to 314 in 2015 and then rose to 4880 in 2016 as shown in figure 2. The hypertension clinic has generally increased by 27.5% in 2016 from 2006.

Figure 2 showing the trend in the number of patients seen at the hypertension clinic at KATH

The renal specialist clinic commenced in 2007 and has steadily risen from 710 patients seen in 2007 to 1927 cases in 2016 representing an increase of 171.4% as shown in Figure 3.

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Figure 3 showing the trend in OPD cases seen in the renal outpatient clinic since 2007.

Haemodialysis is the only form of renal replacement therapy currently available for the management of adults with renal cases at KATH. There is no renal transplantation services or continuous ambulatory peritoneal dialysis (CAPD). Haemodialysis patients and sessions have risen steadily since its inception in 2006. The number of ESRD patients on dialysis has increased by 49.9 times from 8 in 2006 to 407 in 2016. The number of Haemodialysis sessions has also increased by 39.8 times from 59 in 2006 to 2350 in 2016 as shown in figure 4 below. This includes sessions done for both acute and chronic kidney diseases requiring renal replacement therapy.

Figure 4 showing the number of patients on Haemodialysis in KATH

Total hospital medical cases admissions increased from 6275 in 2006 to a peak of 7306 in 2010 and is been on a decline since then to 6094 in 2016 as shown in Figure 5 below. Medical admission decreased by 2.9% in 2016 as compared to 2006.

Figure 5 showing the total medical admission over the years since 2006 at KATH

Admission of renal cases increased by 318.4% since 2008 from 103 to 431 in 2016 as shown in the Figure 6 below.

Figure 6 The number of yearly renal admissions on the medical ward

The average annual renal mortality rate ranged from 23.7 to 46.9% of all renal admissions. The highest mortality rate was recorded in 2015 as shown in Figure 7 below.

Figure 7 showing the mortality rate of renal admissions from 2010 to 2016

The position of mortality from renal cases on the top ten causes of death on the medical ward ranged from the second position to the tenth position. In 2011, renal cases was second position in
the top ten causes of mortality on the medical ward from the 10th position the previous year. The mean position of renal deaths was sixth over the study period [Table 1].

**DISCUSSION**

To our knowledge, this is the first ever review of renal cases seen over a ten year period in KATH and the country as a whole. This review highlights the increasing number of kidney diseases seen in out-patient clinics and those admitted at KATH. It also highlights the significant mortality rates of renal admissions probably due to the unavailability of adequate Haemodialysis machines or the inability of patients to afford renal replacement therapy.

Over the ten-year retrospective review, there has been a decrease in the medical outpatient cases seen. This could be attributable to the capacity of the peripheral hospitals to manage severe medical cases as a result of the training of more specialist in these referral sites. It may also be as a result of increase in peripheral private hospitals with specialist who are able to manage adequately medical cases and therefore refer less to the teaching hospital for specialist management.

There have been a constant increase in the number of hypertension and kidney disease cases seen. This may be due to the increasing prevalence of hypertension and kidney diseases as suggested by some studies13,14. The number of hypertensive patients seen might be an underrepresentation of all the cases seen here in KATH as the family medicine directorate also have a chronic care clinic and have also been seeing hypertensive and diabetic patients since 2013 and was not captured in the review. Hypertension has been shown to be a cause of kidney disease and also a sign of kidney disease. In a study by Osafo et al, CKD was found to be present in 46.9% of hypertensive patients15. The continual increase in the number of renal cases may also be due to the increasing prevalence of diabetes in Ghana which has been shown to be 6.0% in a community based study16.

There was a continual decrease in medical admission from 2012. This may be due to the change in the triaging system at the Komfo Anokye teaching hospital after the establishment of the accident and emergency Centre17. Some patients are seen and discharged by emergency medicine physicians if found to be stable. Some also die at the emergency unit and may not end up on the medical ward. This may have led to the decrease in medical ward admissions by about 3% over the study period. The decrease in medical admissions could also be due to the training of physician specialist who are now at the peripheral hospitals and able to manage medical cases adequately.

Though there was a decrease in medical admissions, renal admissions have continually increased over the review period by over 300%. This may be as a result of the increasing prevalence of kidney diseases in the Ashanti region and the fact that though there are physician specialists available in the peripheral hospitals to manage these cases, patients with end stage renal disease are referred to the teaching hospitals to access renal replacement therapy. These peripheral hospitals have no renal replacement therapy or nephrologists to manage these ESRD patients. It was shown by Antwi S that there are very few Haemodialysis centres in Ghana, mainly in the teaching hospitals18. There have been some improvement in Haemodialysis machines and centres even in private centres in Ghana.

Our review shows an increase in the accessibility of Haemodialysis since its inception in 2006. The number of patients have increased by about 50 folds. There has been a consequential increase in the number of Haemodialysis sessions by about 40 folds. This may be due to the rise in the prevalence of the disease and the fact that more patients with ESRD can now afford renal replacement therapy or are getting support from family and friends for their treatment. The disparity between the increase in patients on dialysis and the number of Haemodialysis sessions is due to the fact that most of the patients on dialysis could not afford the three times a week sessions as suggested by the Haemodialysis (HEMO) study19. There are some patients on once a week dialysis session which is very inadequate to improve the quality of life and mortality of patients on Haemodialysis. The mortality of renal replacement therapy in KATH is high. It was shown by Eghan et al,20 that 90-day mortality on Haemodialysis was 32.4%. Mortality on Haemodialysis was attributed to cardiovascular disease, sepsis and anaemia in a retrospective study conducted in KATH in 2007. Most patients due to increased cost also discontinue treatment and die as shown in a recent systematic review21. The mortality rate of renal admissions was higher than the average mortality of all medical admissions. End stage renal disease patients have poor prognosis. This may be due to the inability to Haemodialysis by most patients seen on the medical ward as most die from ureamic complications, sepsis and cardiovascular diseases. Accessibility to renal replacement therapy has been shown by Antwi S22 to be very poor due to increased cost and the fact that the national health insurance scheme does not cater for chronic dialysis patients. In the absence of renal replacement therapy, death is inevitable23. It has been shown that mortality on Haemodialysis is equally high and therefore there might be the need for governmental support for renal transplantation which has been shown in several studies to be cost effective and associated with improved survival and better quality of life as compared to Haemodialysis and peritoneal dialysis24-26.

Mortality with or without renal replacement therapy is high in end stage renal disease patients25. This may be due to the late presentation of cases for which very little can be done due to the advanced nature of the disease. Late presentation for dialysis has also been associated with poor outcomes due to use of temporary catheters which are associated with access infections. These affect the quality of life in these patients26,27.

**CONCLUSION**

There is an increase in the number of kidney diseases seen at KATH. Though there have been a modest increase in the accessibility of renal replacement therapy, there is still an increase
in renal mortality. There is the need to aim for prevention of kidney disease in Ghana and governmental support in the management of kidney disease as the cost of treatment is enormous.

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I will like to acknowledge the staff members of the planning and monitoring unit of the Komfo Anokye teaching hospital who provided the series of annual report that was used for this review.

REFERENCES
Prevalence and characteristics of congenital talipes equinovarus (clubfoot) in Northern Ghana: a two year retrospective descriptive study

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Clubfoot; congenital talipes equinovarus; phenotype; characteristics; prevalence; Northern Ghana

Abstract

Background
Clubfoot is considered the most common birth defect of the musculoskeletal system with a reported general prevalence of 1 in 1000 live births. Literature documents that a higher prevalence exists in developing countries.

Purpose
This study aimed to determine the prevalence and phenotypic characteristics of clubfoot in the Northern Region of Ghana which is the largest and one of the most deprived regions in the country.

Methods
The researchers collected clubfoot data of children visiting the only clubfoot clinic in the region from January 2015 to December 2016. Parameters of interest included sex distribution, laterality, types of clubfoot, annual trends and overall prevalence rate of clubfoot for the region. A descriptive statistical analysis of the data using SPSS version 16 was made and the outcome represented was on tables and figures.

Results
A total of 112 clubfoot cases were recorded within the review period resulting in a prevalence rate of 0.9 per 1000 live births. The month of January recorded the highest numbers of cases for both years. In addition, twice the number of males were affected as females and bilateral clubfoot formed 65.5% of case presentation. Almost same numbers of left (n=19) feet were affected as right (n=20) in unilateral presentation of cases. Idiopathic clubfoot was the most common type of clubfoot and made up 67.9% recorded of cases.

Conclusion
The outcome suggests that the phenotypic trends of clubfoot in the Northern Region of Ghana is similar to findings in other parts of Ghana, Africa and the world. However, the prevalence rate may be an underestimation of the actual situation owing to poor birth defect surveillance and awareness education of clubfoot in the northern region and Ghana in general. Further studies are needed to investigate risk factors for clubfoot and to explain the phenotypic and annual trends in this part of the world. Management efforts also need to anticipate using greater numbers of casts per child due to the majority of bilateral clubfoot case presentations.

Introduction
Congenital talipes equinovarus (CTEV) commonly known as clubfoot 1, is reported to be the most common musculoskeletal birth defect thought to occur in early weeks of gestation 2, 3. Clubfoot is characterised by equinus of the ankle, varus of the hindfoot, as well as cavus and adductus of the forefoot with an associated atrophy of the calf muscles 4, 5. The most common form of presentation is idiopathic or primary clubfoot 5. According to the Ponseti classification 6, when clubfoot is associated with wider neuromuscular anomalies such as spina bifida or arthrogryposis, it may be classified as secondary clubfoot.

The exact cause of clubfoot is uncertain although several genetic and environmental factors have been implicated 2, 3, 5 but perhaps the strongest risk factor equivocally documented in literature is the male sex 2-5, 7. Research also reports that first born babies are more likely to develop clubfoot 2, 3, 5 and bilateral presentation occurs in 50% of cases 4.
Research consensus suggests that clubfoot occurs in every 1 per 1000 live births 3, 5 although, variations have been found between racial ethnic groups 4, 7. For instance in the United States of America (USA) Parker, Mai 7 found an overall prevalence of 1.29 per 1000 live births out of which the white population recorded 1.38 per 1000 live births whereas Hispanics and non-Hispanic blacks recorded prevalence of 1.30 and 1.14 per 1000 live births respectively. Worldwide, over 150,000 babies are affected with more than 80% clubfoot cases reported to occur in developing countries and especially in low-resource regions 5.

Clubfoot has been inadequately researched in Ghana, a World Health Organisation recognised Low Middle Income Country (LMIC) 8 and thus the prevalence rates and trends across the country are uncertain varying from region to region. This research aims to address this knowledge gap by being the first to investigate the prevalence of clubfoot as well as the associated phenotypic trends in the Northern region, which is the largest yet third poorest region in Ghana 9. The outcome of the study apart from adding to existing knowledge about clubfoot and providing data for future research, can also help inform policies and plans regarding the treatment of Clubfoot in Ghana.

Methodology

This research set out to determine the prevalence of clubfoot per 1000 live births in the Northern region. It also sought to investigate and describe the trends of clubfoot with respect to phenotype, age group distribution as well as types of clubfoot recorded in the region using a retrospective descriptive cross sectional study design. The research used data (in retrospect) of clubfoot cases recorded from January 2015 to December 2016 in the Tamale Teaching Hospital (TTH) clubfoot clinic in Tamale, the Northern region’s capital. The TTH affords tertiary healthcare to persons living in Tamale, the capital of the region, as well as the neighbouring communities and regions and it is also the only facility which runs a clubfoot clinic in the Northern region.

The TTH clubfoot clinic since establishment in 2013, runs once a week and includes a team of clinical (nurses, physiotherapists and orthopaedic surgeons) and non-clinical (administrative and supportive staff). The clinic is also supported by the Ghana Clubfoot programme, which advocates the Ponseti method of treatment and supports the clinic with treatment materials such that clubfoot management is free.

Babies who are brought to TTH (or referred to TTH from other hospitals in the region) suspected to have clubfoot or other physical birth defects are referred to the clubfoot clinic after orthopaedic consultation for further management. Once at the clinic, a more detailed assessment is conducted using the Ponseti screening and classification method to confirm clubfoot and to categorise them into primary and secondary subgroups as well as determine the severity of the deformity. Laterality, sex of the babies and ages are captured in addition and babies are eventually managed with the Ponseti method which has been accepted as the gold standard for clubfoot treatment 10-13.

Operational definitions

For the purposes of this research, the following terms are defined according to the classification system for clubfoot used at the TTH clubfoot clinic:

**Primary/idiopathic clubfoot**

All babies who were found to have clubfoot without any other neuromusculoskeletal anomaly were classified as having idiopathic clubfoot.

**Secondary clubfoot**

During assessment, babies with clubfoot who also presented with other anomalies were classified as having secondary clubfoot. This group was further classified as neuropathic or syndromic clubfoot.

**Neuropathic clubfoot.**

Associated with a neurological disorder such as meningomyelocele, meningocele.

** Syndromic clubfoot.**

Clubfoot presenting with other orthopaedic defects such as congenital arthrogryposis multiplex, amniotic band syndrome, Down syndrome etc.

**Postural clubfoot.**

The deformity is very flexible and is thought to be due to intrauterine crowding.

**Neglected clubfoot.**

Clubfoot that has never been treated in a child two years and over.

**Recurrent clubfoot.**

Clubfoot that relapses after or during treatment with the Ponseti method.

**Treated clubfoot.**

Clubfoot treated with the Ponseti method.

**Data collection**

The researchers sought permission from the Tamale Teaching Hospital’s Department of Research and Development to allow the use of patients’ data for the research. Caregivers of children with clubfoot on the first day of assessment, are also informed that their children’s data may be used for research to better understand the condition as part of clubfoot clinic routine.

The investigators collected and examined all folders of patients who reported to the clubfoot clinic from January 2015 to December 2016. These patients included those who had existing clubfoot but lived in their communities not seeking appropriate treatment, as well as new born babies suspected to have clubfoot and were referred to the clubfoot clinic. Once their diagnosis was confirmed, their information was included in the study. Patient folders which recorded diagnoses other than clubfoot or CTEV were excluded from the study. The parameters of research interest included details of the children such as the age of first visit, sex, unilateral or bilateral presentation of the clubfoot (laterality), foot affected (if unilateral) and the type of clubfoot were documented both in hard copy and on a Microsoft excel spreadsheet. The parameters were then analysed descriptively with the Statistical Package for the Social Sciences (SPSS) version 16 software to determine the frequencies of clubfoot cases with respect to each of the parameters during the period under review. The results of the analysis were represented in tables and figures.

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Results
There was a total of 112 children diagnosed with clubfoot for the two years (see Figure 1) with a 2:1 male versus female representation (Figure 2). The children were all Ghanaian born Africans with the majority being babies of seven months and below whereas children 29 months and over formed the least frequent age group (see Table 1). The month of January recorded the most numbers of new cases at the clubfoot clinic for both 2015 and 2016, with a sharp decline in numbers especially during the middle to ends of both years (Figure 3).

Bilateral clubfoot was 65.1% (n =73) of the total and 34.9% (n =39) unilateral clubfoot cases, left and right presentations were 17% (n=19) and 17.9% (n=20) respectively of the total number of cases.

Table 1 Age distribution of participants in months. The table shows number of cases recorded for the two years under the various age brackets.

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Number of children</th>
<th>Percentage distribution/%</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 months or less</td>
<td>76</td>
<td>67.9</td>
</tr>
<tr>
<td>8 – 14 months</td>
<td>17</td>
<td>15.2</td>
</tr>
<tr>
<td>15 – 21 months</td>
<td>8</td>
<td>7.1</td>
</tr>
<tr>
<td>22 – 28 months</td>
<td>7</td>
<td>6.3</td>
</tr>
<tr>
<td>29 months and above</td>
<td>4</td>
<td>3.6</td>
</tr>
<tr>
<td>Total</td>
<td>112</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Figure 1 Annual distribution of clubfoot cases. The bar charts display the total numbers of clubfoot cases recorded for the years 2015 and 2016, in the Northern region of Ghana, at the clubfoot clinic.

Figure 2 Sex distribution of Participants. The pie chart shows the total number of male and female babies and children with clubfoot, recorded for the years 2015 and 2016 at the clubfoot clinic in the Northern region of Ghana.

Figure 3 Clubfoot Cases by Monthly Attendance. The figure below represents the number of clubfoot cases recorded for each month of years 2015 and 2016 at the clubfoot clinic of the Northern region of Ghana.
The largest classification subgroup was idiopathic clubfoot whereas postural and neuropathic clubfoot presented least frequently. Details of subgroup results are captured in Table 2.

Prevalence rate
A total of 127,910 live births were recorded in the Northern region of Ghana within the two year period thus the prevalence for the region was 0.9 per 1000 live births.

Table 2 Classification of Clubfoot cases. The table displays the number of clubfoot cases recorded for each type of clubfoot and the associated sex distribution.

<table>
<thead>
<tr>
<th>Type of clubfoot</th>
<th>Males</th>
<th>Females</th>
<th>children</th>
<th>Number of Percentage of distribution/%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idiopathic clubfoot</td>
<td>54</td>
<td>22</td>
<td>76</td>
<td>76.9</td>
</tr>
<tr>
<td>Syndromic clubfoot</td>
<td>14</td>
<td>11</td>
<td>25</td>
<td>22.3</td>
</tr>
<tr>
<td>Neuropathic</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>9.0</td>
</tr>
<tr>
<td>Clubfoot</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postural clubfoot</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>9.0</td>
</tr>
<tr>
<td>Neglected Clubfoot</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>3.6</td>
</tr>
<tr>
<td>Treated clubfoot</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.7</td>
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<tr>
<td>Recurrent clubfoot</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td>112</td>
<td>0</td>
<td>0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Discussion
Clubfoot is the most common birth defect of the musculoskeletal system 2. However, there is a dearth of research investigating clubfoot in Ghana. To the best of our knowledge, this is the first clinic-based study in Ghana to determine the prevalence of clubfoot and specifically for the northern region. Generally, findings of this study with regard to phenotypic trend of clubfoot were similar to existing evidence. The results will be discussed under subheadings to cover the prevalence rate, seasonal variation and phenotypic characteristics of clubfoot in the Northern region as follows:

Prevalence of clubfoot in the Northern region
The 1.2 per 1000 live births prevalence reported by previous Ghana based studies 13, 14 was a figure obtained from the global clubfoot initiative 8 which in turn used the widely accepted 1.2/1000 to estimate prevalence for low and middle income countries (LMICs) including Ghana. The current study found that clubfoot occurred in every 0.9 per 1000 live births for the 2015 to 2016 period which is lower than the reported prevalence for Ghana 8 as well as the frequently reported 1 per 1000 global prevalence 3.5. Research has found no association of African (black) ethnicity as a risk factor for developing clubfoot and indeed, prevalence among babies of African descent was consistently lower than that of Caucasians in previous studies 3, 15, 16. Our 0.9 prevalence is consistent with the relatively lower occurrence of clubfoot African descent in the United States 15-17 and also falls within the 0.96 to 1.26 range of pooled prevalence for Africa 3.

Interestingly, LMICs such as Ghana, are said to record about 80% of total clubfoot cases worldwide 2, 11. Studies conducted in other African countries such as Uganda and Nigeria found a clubfoot incidence of 1.2 18 to 3.4 19 per 1000 live births respectively. In Malawi a clubfoot incidence of 2/1000 was found in a clinic based study 20 whereas literature documents a report of 3.5 incidence per 1000 live births among black South Africans 21. Such high incidence figures have enormous implications for prevalence of clubfoot in these countries. These figures also suggest that perhaps not primarily ethnicity, but rather multifactorial causative factors comprising both genetic and environmental components 2 peculiar to LMICs, could account for the higher prevalence reported for developing countries.

There is a chance that the lower prevalence found in our study may be an underestimation of the actual situation, attributable to poor birth defect surveillance of new births and thus an underreporting of clubfoot cases in the Northern region.

Our study captured 112 babies with clubfoot whereas the other studies in Ghana 13, 14 and Africa 11, 18-20 have investigated clubfoot in a greater number of children. For instance in Ghana, Boakye, Afriyie 13 in a six year retrospective study and Aberebrese 14 in a five year review recorded 271 cases 420 cases of idiopathic clubfoot respectively in the same clubfoot clinic. Boakye, Afriyie 13 included only babies between 0 and 6 months who did not default treatment. An Ethiopian, study 21 found 258 clubfoot cases (in two-year review), whereas Ukoha, Egwu 19 found 72 within one year in a Nigeria-based research. A multicentre study in Uganda, one of the least developed countries found 872 cases within two years 18 and a study in a Malawi hospital based also found 64 cases in a two-year retrospective study 20. It should be noted that Malawi is also reported to be a very poor country and although their population is approximately half Ghana’s, it recorded clubfoot incidence that was almost twice the prevalence found in the current study 20.

The Northern region of Ghana is the largest but one of the poorest regions of Ghana 22. In fact, the three northern regions (Northern, Upper East and Upper West regions) have been documented to inhabit 50% of Ghanaians living in poverty and up to 80% of the Ghanaian population living in extreme poverty 22. The poverty in Northern Ghana has been closely linked with the consequential poor health and transportation access and well as poor sanitation and housing conditions [Ibid]. It is interesting therefore, that only 112 cases of clubfoot were recorded within two years in our study. It has been documented that LMICs usually lack thorough birth defect surveillance programmes which make determination of prevalence challenging 11.

The clubfoot clinic used in this study is a relatively newly established referral center within the Tamale Teaching Hospital which is a Tertiary health facility. Looking at the age group categories in our studies, the participants were relatively young with the largest age group being children seven months and below (67.9%) followed by children 8 to 14 months (17%). The four children in the ‘29 months and above’ category also happened to be the neglected cases of clubfoot (according to the clinic records). In Nigeria, the high clubfoot prevalence was attributed to their large numbers of neglected clubfoot cases 11. It is possible that there are more neglected and untreated clubfoot cases in Ghana’s Northern region communities which have not sought medical attention simply because they are unaware that clubfoot is treatable and freely available at the clubfoot clinic. In addition, if health workers in primary and secondary healthcare facilities or traditional birth attendants are not trained to identify clubfoot or know that treatment

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is possible, they will likely not refer cases to centres of treatment. Closely related to case identification in rural settings is treatment seeking behaviour of the rural population which is also found to be strongly influenced by poverty and challenges with physical access to treatment facilities. These situations mentioned can potentially result in the underreporting of clubfoot cases and the eventual under-estimation of the Northern Region’s prevalence rates.

On the other hand, the relatively lower prevalence in this study compared to other African countries may also be a reflection of the variation in prevalence across different developing African countries and not due to underreporting of cases per say. It is worth noting that the majority of these Africa-based studies were conducted in individual hospitals and may not reflect the true prevalence of clubfoot nationally for each country. However, future research which will investigate the predictors of variation in clubfoot prevalence across different African countries could make an important addition to understanding clubfoot in Africa’s LMICs. Likewise, promotion of clubfoot awareness and robust birth defect surveillance of newborns could massively improve research in clubfoot and other congenital deformities in Ghana. Such surveillance database can also be the evidence for underreporting of congenital birth defects like clubfoot to medical facilities.

**Seasonal variation in the annual distribution of clubfoot cases**

Treatment seeking behaviour of our study population could have also influenced this study’s findings with respect to the monthly trend of new cases in the clubfoot clinic within each year. January recorded the most numbers of new cases for both 2015 and 2016 and the numbers significantly declined in the middle and ending of the year (Figure 3). The two seasons in Ghana (rainy and dry seasons) may have influenced this observation due to the associated economic activities during these periods of the year. The indigenous population of the Northern Region are mainly farmers with the majority farming on a small scale. Research indicates that due to the poverty in Northern Ghana compounded by rainfall variations (experienced in this region) in recent years, most northern farmers (male and female) migrate to the south of Ghana during the rainy season (March/April to October) in anticipation of poor harvest and acute food shortage.

Investigating the reason for high number of clubfoot cases in January (dry season) and the sharp decline thereafter was beyond the scope of this study as was including the occupations of parents or caregivers of the participants. However, it is possible that caregivers of children with clubfoot did not seek treatment at other times in the year due to seasonal farming activities during the rainy season period. In January when the harvest period was over, most caregivers may have found it more suitable to seek medical attention for their children with clubfoot. This explanation requires further research to be established as a likely reason for the seasonal variation in reported clubfoot cases in the Northern region of Ghana.

**Phenotypic characteristics of clubfoot in the Northern region of Ghana**

Idiopathic clubfoot was found to be the most frequently presenting type of clubfoot, as was observed in 76 children, making up 67.9% of the 112 cases recorded within the review period. This observation is in agreement with existing studies which have reported that idiopathic clubfoot is the commonest form of the condition. The cause of idiopathic clubfoot is still uncertain but has been associated with some sociodemographic and pregnancy related risk factors including maternal age (at conception of affected child), smoking, marital status, education and diabetes 4,5.

Syndromic clubfoot was seen in 20% of the cases which is quite significant and clinically important considering that this form is more resistant to treatment and likely due to the underlying genetic-linked risk factors for this type. Bacino and Hecht also documented 20-25% of syndromic clubfoot although they included neuropathic forms of clubfoot in their definition of ‘syndromic’. Researchers have postulated that variation in PITX1 as well as TBX4 genes cause syndromic clubfoot and this gene variation has not been observed in non-syndromic forms of clubfoot. Ultimately, maternal smoking and family history is said to increase risk of clubfoot up to about twenty times.

Genetic factors have also been associated with sex and laterality distribution in clubfoot cases. Our study found that male children made up 67% of the babies and thus were twice the number of female clubfoot cases. This result is consistent with reports of higher numbers of male clubfoot cases in existing literature in Africa and other parts of the world. This strongly suggests that the male sex is the most consistently reported risk factor for developing clubfoot. For the various subtypes of clubfoot as well, males had higher numbers than females according to the current study (Table 2). There is no specific reason for the marked male dominance in clubfoot prevalence; other congenital malformations such as spina bifida, orofacial cleft, neural tube defects and some cardiac anomalies have also demonstrated male preponderance for reasons uncertain. Possible attributing factors could be that more male children are generally born than females, thus a higher number of birth defects such as clubfoot could be controlled by sex-specific survival mechanisms. Other theories suggest that there may be sex-specific vulnerability to disease associated teratogenetic factors in favour of female babies resulting in the fewer manifestations of such malformations relative to males exposed to similar teratogens. Also, a threshold effect of these clubfoot-related genes has been suggested such that, females will need a greater genetic load in order to express clubfoot.

Similarly, bilateral clubfoot may result from an increased load of genetic linked factors for clubfoot with resultant manifestation in both feet rather than one. The current study documented twice as many bilateral clubfoot (65.1%) as against unilateral clubfoot (34.9%). The greater bilateral composition of clubfoot in the current study though consistent with literature, is relatively higher than existing findings within and outside Africa, perhaps second only to Malawi where 71% of bilateral clubfoot was documented. In addition, the current study found approximately the same number of right (17.9%) clubfoot as left in the unilateral cases. The side most affected by clubfoot is commonly reported to be the right foot even though slight dominancy of the left clubfoot has been found by some researchers.
Our study did not include sub group analysis to determine laterality distribution between the sexes or their respective severities of the condition in order to lend support or otherwise to the proposed gene threshold theory. This notwithstanding, the postulation that clubfoot in females, bilateral clubfoot and syndromic clubfoot presentations may result from a relatively high clubfoot-associated gene load has important clinical implications for associated severity 28 and thus possible resistance to treatment. Thus, clinicians who manage clubfoot in these sub categories of children could consider the possibility of these groups requiring more casts or having more cases of recurrence attributable to the underlying genetic factors.

**Strengths and limitations of the study**

This study is the first research in Ghana to calculate clubfoot prevalence and to describe associated phenotypic trends in the Northern region and thus it contributes to existing literature in this regard. Also, the findings are generally unanimous with existing data in terms of bilateral, male and idiopathic preponderance of clubfoot presentations. However being purely descriptive, the study did not set out to conduct risk factor investigations for the study population in this research. Also, being a clinic based study, our data was limited to the cases that were identified and referred to the clubfoot clinic and thus the outcome may not be generalisable as the actual reflection of clubfoot characteristics for the entire northern region or for Ghana as a whole. In the absence of a birth defect surveillance database for the region however, there is no objective evidence of ‘missed’ cases.

**Conclusion**

This study found a 0.9 per 1000 live births prevalence of clubfoot in the Northern region of Ghana with twice as many males than females having the condition. In addition, idiopathic clubfoot and bilateral manifestations were the most common disease presentations for the 2015 to 2016 period. The significant numbers of bilateral and syndromic presentations may have important clinical and financial implications for management of clubfoot in this setting.

There remains the possibility that the prevalence rate may be an underestimation of the actual situation and this warrants further research in order to build a case for thorough national congenital defect surveillance as well as mass clubfoot education programmes for interest groups nationwide.

**References**


Prevalence of pneumonia and risk factors of pneumonia mortality among children under five years in Komfo Anokye Teaching Hospital, Kumasi, Ghana.

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Pneumonia prevalence, pneumonia mortality, Komfo Anokye Teaching Hospital, Kumasi, Ghana

Abstract

**Background**

Pneumonia remains the foremost cause of death in children under 5 years of age especially in sub-Saharan Africa killing nearly 1 million annually.

**Purpose**

Identify pneumonia prevalence, mortality rate and associated factors among children under five admitted to Komfo Anokye Teaching Hospital (KATH) in Ghana.

**Methods**

Using a cross-sectional study method, a purposive sampling of 157 children under 5 admitted to the KATH for pneumonia from June to August 2016 was selected. A structured questionnaire was used to collect primary data from their caregivers and secondary data from the patient record using a structured data extraction form. Continuous and categorical variables were described and chi-square test employed to determine the associated factors of pneumonia mortality. Multivariate Poisson regression model was used to test for the strength of the association to unearth the risk factors of pneumonia mortality. The incidence relative risk (IRR) at 95% confidence interval (CI) was presented.

**Results**

The study found a prevalence of pneumonia of 18.40% with a mortality rate of 12.74%. Pneumonia mortality was found to be associated with maternal education (p<0.001), occupation (p=0.010), income (p=0.020), pneumonia severity (p<0.001) and number of rooms occupied by a household (p=0.010). In multivariate Poisson regression model, maternal education increased the incidence rate of pneumonia mortality (IRR=8.0, 95% CI=3.06-21.13, p<0.001) and occupation (IRR=2.8, 95% CI 0.70-11.45, p=0.143). However, pneumonia severity (IRR=3.6, 95% CI=1.50-8.48, p=0.004), income (IRR=0.05, 95% CI=0.01-0.22, p<0.001), and number of rooms occupied by a household (IRR=0.2, 95% CI=0.07-0.51, p=0.001) all showed reduced incidence rate of pneumonia mortality.

**Conclusion**

Pneumonia places a high burden on the health of children under five years admitted to KATH. Health workers need to sensitize caregivers on the signs and symptoms of pneumonia to aid early detection and reporting which could reduce mortality.

Introduction

Pneumonia is a leading cause of hospital admission among children less than five years in sub-Saharan Africa [1]. The global death toll of the disease was estimated at 0.935 million in 2013. [2] It is also estimated that about 81% of pneumonia deaths occur in the first 2 years of life [3]. Research indicates that of the estimated 6.3 million worldwide deaths in children less than 5 years recorded in 2013, infectious diseases accounted for 51.8% (3.257 million), with the largest percentages due to pneumonia (14.9%, 0.935 million). Of
the 3·113 million deaths that occurred in children less than 5 years in 2013 in Africa, pneumonia accounted for 0·493 million representing 15.8% [2]. In Ghana, pneumonia is a significant contributor to under-five hospitalization and mortalities.

Children who live in difficult to reach areas with parents of low socio-economic status are the worst affected. Nutritional status (particularly children not exclusively breastfed), vaccination status, birth weight, child’s age, immunosuppression (due to other co-infections like AIDS, measles, malaria) and environmental factors (crowded living conditions, exposure to indoor air pollution and parental smoking) are important factors that add to the risk of pneumonia and pneumonia mortalities [4–6]. The burden pneumonia places on these families and the health systems further aggravates the existing health inequities.

Even though the disease burden of pneumonia (prevalence, mortality rate and its associated factors) have been studied in some countries, information in Ghana is limited. Some of these studies in Ghana mostly examined the burden among adults and in some cases from the community viewpoint. The estimates do not target the exact population who are affected the most. In this era of harnessing scarce resources towards increasing demand for universal coverage of health care services, pneumonia estimates targeting the most affected population and setting will offer a better opportunity for interventional studies. This study therefore estimates the health burden of pneumonia by measuring the prevalence, mortality and its associated factors among children less than five years who were admitted to Komfo Anokye Teaching Hospital in Ghana.

Methodology

The study was conducted in the paediatric wards of the Komfo Anokye Teaching Hospital (KATH), the second largest hospital in Ghana located in its Ashanti Region. KATH serves a population of over 4 million within and outside Ashanti Region. It is the main referral centre from the middle to the northern zone of Ghana. A prospective cross-sectional study that involved children less than 5 years admitted to the KATH for pneumonia was done from June to August 2016.

A purposive sampling technique was employed to select 157 eligible subjects for the study. The sample size was estimated based on previous study that reported pneumonia burden of 16.8% and 22.3% in rural and urban settings respectively.[7] The sample size was estimated to detect a difference of 8% with a power of 80% which corresponds to 0.84 and 95% confidence interval which corresponds to 1.96 standard values and an alpha of 0.05. A child was included when he/she was admitted with a clinical diagnosis of pneumonia.

A structured questionnaire was used to collect primary data from caregivers of subjects and data collected from the patient medical record using a structured data extraction form. Data was entered into Microsoft Access 2013 and was exported to STATA 13.0 (Standard Edition) for analysis. Basic summary statistics of socio-demographic variables and other variables conducted, and bivariate analysis of association between pneumonia mortality and other variables was also conducted. The prevalence were determined considering the total number of patients hospitalized for pneumonia (numerator) and the total under five admissions (denominator) in the pediatric wards. Chi square test was used to determine the associated factors of pneumonia mortality. Multivariate regression using poisson model with robust error variance was used to test for the strength of the association to unearth the risk factors of pneumonia mortality.

Ethics approval and consent to participate

Permission to conduct the study was obtained from the Committee on Human Research Publications and Ethics (CHRPE), of Kwame Nkrumah University of Science and technology and the Research and Development Unit of Komfo Anokye Teaching Hospital in Ghana. Written Informed consent were obtained from respondents to affirm their willingness to participate. Also in this report, there are no individual details or images included.

Results

Sociodemographic characteristics of respondents

A total of 157 children less than five years with pneumonia were recruited in 8 weeks of the study period. The median age was 7 months ranging from 1 week to 59 months. More than half (59.87% n=94) of the children were less than 1 year old and the male to female ratio was 1.21. Almost sixty percent of the children (59.9%, n=95) had a birth weight of 2.5 and above. More than half (61.8%, n=97) of the respondents resided in urban areas with diverse educational backgrounds. Trading was the most reported (43% n=68) occupation of the caregivers whilst 13.4 % (n=21) of the caregivers were unemployed. The median income of the caregivers was 300 Ghana cedis (USD 76.9) monthly ranging from persons with no monthly income to a monthly income of up to GHCI, 500 (USD 384.6). (Table 1)

Prevalence and mortality rate of pneumonia

The prevalence of pneumonia for children less than 5 years on admission at KATH was 18.4% (157/853). Overall only 16 bacterial isolates were identified in blood cultures (13 Staphylococcus aureus and 3 Streptococcus pneumonia). 27 children representing 17.20% were diagnosed as having severe pneumonia with the rest diagnosed of non-severe pneumonia. About 66% of the participants stayed beyond 7 days post hospitalization with a median hospital stay of 9 days. A total of 20 deaths were recorded among participants accounting for mortality rate of 12.74%. (Table 2)

The commonest co-morbidities reported among clients with pneumonia were bronchiolitis, (17%), sickle cell disease (13%), malaria (12%) and aspiration pneumonitis (11%) (Figure 1).

Risk factors of pneumonia mortality

Outcome of pneumonia hospitalization when compared with sociodemographic characteristics revealed statistical significant difference in terms of maternal education (p<0.001), occupation (p=0.01) and income (p=0.02) (Table 3).
It was further observed that severity of pneumonia (p<0.001) and number of rooms occupied by a household (p=0.01) are significant risk factors of pneumonia mortality. (Table 3 cont)

Table 3: Risk factors of pneumonia mortality. cont.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>Outcome</th>
<th>Survived n (%)</th>
<th>Died n (%)</th>
<th>Total n (%)</th>
<th>z2</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>up to 11 months</td>
<td>84 (63.51)</td>
<td>40 (59.97)</td>
<td>94 (59.87)</td>
<td>8.66</td>
<td>0.07</td>
</tr>
<tr>
<td>- 12-23 months</td>
<td>17 (12.41)</td>
<td>2 (10.00)</td>
<td>19 (12.10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 24-35 months</td>
<td>17 (12.41)</td>
<td>3 (15.00)</td>
<td>20 (12.81)</td>
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<td></td>
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<td>- 36-47 months</td>
<td>10 (7.35)</td>
<td>0 (0.00)</td>
<td>10 (6.37)</td>
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<td></td>
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<tr>
<td>- 48-59 months</td>
<td>9 (6.57)</td>
<td>5 (25.00)</td>
<td>14 (8.92)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex of children</td>
<td>- Male</td>
<td>72 (52.55)</td>
<td>14 (70.00)</td>
<td>86 (54.78)</td>
<td>2.14</td>
<td>0.14</td>
</tr>
<tr>
<td>- Female</td>
<td>65 (47.45)</td>
<td>6 (30.00)</td>
<td>71 (45.22)</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Birth weight</td>
<td>- Up to 2.4</td>
<td>55 (40.15)</td>
<td>7 (35.00)</td>
<td>62 (39.49)</td>
<td>0.89</td>
<td>0.36</td>
</tr>
<tr>
<td>- 2.5 to 3.5</td>
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<td>9 (45.00)</td>
<td>74 (47.13)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 3.6 to 4.6</td>
<td>17 (12.41)</td>
<td>4 (20.00)</td>
<td>21 (13.38)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Health Insurance status</td>
<td>- Have NHIS</td>
<td>114 (83.21)</td>
<td>13 (73.00)</td>
<td>128 (82.17)</td>
<td>0.80</td>
<td>0.37</td>
</tr>
<tr>
<td>- Does not have NHIS</td>
<td>23 (16.79)</td>
<td>5 (25.00)</td>
<td>28 (17.83)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential status</td>
<td>- Rural</td>
<td>50 (36.50)</td>
<td>10 (50.00)</td>
<td>60 (38.22)</td>
<td>1.35</td>
<td>0.25</td>
</tr>
<tr>
<td>- Urban</td>
<td>87 (63.50)</td>
<td>10 (50.00)</td>
<td>97 (61.78)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material education</td>
<td>- None</td>
<td>12 (8.76)</td>
<td>8 (40.00)</td>
<td>20 (12.74)</td>
<td>20.12</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>- Primary</td>
<td>27 (19.71)</td>
<td>5 (25.00)</td>
<td>32 (20.83)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- JHS</td>
<td>47 (34.31)</td>
<td>6 (30.00)</td>
<td>53 (33.79)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- SHS</td>
<td>36 (26.28)</td>
<td>1 (5.00)</td>
<td>37 (23.57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td>- Professionals</td>
<td>10 (13.87)</td>
<td>3 (15.00)</td>
<td>12 (15.95)</td>
<td>15.35</td>
<td>0.01*</td>
</tr>
<tr>
<td>- Skilled/semi-skilled</td>
<td>20 (14.69)</td>
<td>3 (15.00)</td>
<td>23 (15.38)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Catering</td>
<td>8 (5.84)</td>
<td>2 (10.00)</td>
<td>10 (6.67)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Traders</td>
<td>64 (46.72)</td>
<td>4 (20.00)</td>
<td>68 (48.33)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Farmers</td>
<td>9 (6.57)</td>
<td>6 (30.00)</td>
<td>15 (10.52)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Unemployed</td>
<td>17 (12.41)</td>
<td>4 (20.00)</td>
<td>21 (13.38)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>- &lt;200 GHC</td>
<td>40 (29.29)</td>
<td>3 (15.00)</td>
<td>43 (27.39)</td>
<td>12.4</td>
<td>0.02**</td>
</tr>
<tr>
<td>- 200-400</td>
<td>46 (33.58)</td>
<td>14 (70.00)</td>
<td>60 (38.22)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 401-599</td>
<td>6 (4.38)</td>
<td>3 (15.00)</td>
<td>9 (5.86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- &gt;1000</td>
<td>34 (24.82)</td>
<td>6 (30.00)</td>
<td>40 (26.16)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* is less than 0.05 (significant)

It was further observed that severity of pneumonia (p<0.001) and number of rooms occupied by a household (p=0.01) are significant risk factors of pneumonia mortality. (Table 3 cont)
Significant variables were included in a multivariate Poisson regression model. Having severe pneumonia, maternal education and number of rooms occupied by households were found to be predictors of pneumonia mortality. Persons with severe form of pneumonia are three times more likely to die from pneumonia (Adjusted IRR=3.6, 95% CI=1.50-8.48, p=0.004). Also, maternal education (having had no formal education) showed an increased likelihood of pneumonia mortality (Adjusted IRR=8.0, 95% CI=3.06-21.13, p=<0.001)). Income (IRR=0.05, 95% CI=0.01-0.22, p<0.001), and number of rooms occupied by a household (IRR=0.2, 95% CI=0.07-0.51, p=0.001) all showed reduced incidence rate of pneumonia mortality as detailed in Table 5.

### Table 4: Multivariate Poisson regression of associated risk factors of pneumonia mortality

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>Crude</th>
<th>P value</th>
<th>95% CI</th>
<th>Adjusted</th>
<th>P value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal education (Having had no formal education)</td>
<td>4.6</td>
<td>&lt;0.001</td>
<td>2.13-9.81</td>
<td>8.0</td>
<td>&lt;0.001*</td>
<td>3.06-21.13</td>
</tr>
<tr>
<td>Income (Less than USD 250 a month)</td>
<td>0.5</td>
<td>0.440</td>
<td>0.07-3.20</td>
<td>0.05</td>
<td>&lt;0.001*</td>
<td>0.01-0.22</td>
</tr>
<tr>
<td>Occupation (Not working)</td>
<td>1.6</td>
<td>0.344</td>
<td>0.60-4.39</td>
<td>2.8</td>
<td>0.145*</td>
<td>0.70-11.45</td>
</tr>
<tr>
<td>Having a severe form of pneumonia</td>
<td>4.8</td>
<td>&lt;0.001</td>
<td>2.22-10.45</td>
<td>3.6</td>
<td>0.004*</td>
<td>1.50-8.48</td>
</tr>
<tr>
<td>Number of household occupying a room</td>
<td>0.4</td>
<td>0.017</td>
<td>0.16-0.84</td>
<td>0.2</td>
<td>0.001*</td>
<td>0.07-0.51</td>
</tr>
<tr>
<td>IRR: Incidence Relative CI: Confidence Interval</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p is less than 0.05 (significant)

### Discussion

The study has revealed that pneumonia is among the leading cause of admissions in the pediatric wards of KATH with a prevalence rate of 18.4% (about two in every ten cases admitted). A study by Rudan et al (2008) reported a slightly higher under five pneumonia prevalence of 22.3%. Some risk factors of pneumonia mortalities have also been identified in this study; maternal education, income, severity of pneumonia and number of rooms occupied by a household.

It is expected that majority of the study participant will be coming from the urban areas since it was conducted in the city and also referral hospital for most of the critically ill patients. The educational levels of caregivers were even across the educational categories. This signifies the fact that pneumonia does not necessarily affect persons with particular educational status. Various occupational categories were identified in the study with even distribution across categories with trading found to be the dominant occupation. This to a large extent is due to the fact that the study was conducted at a setting where the main occupation is known to be trading.

Pneumonia mortality is generally high. WHO and other studies estimates the case fatality rate between 8% to 16% in children under five years.[8–10] The case fatality rate of 12.7% found in this study compares with a findings by Sehgal et al (1997) which found a case fatality rate of 10.45%.[10] The risk factors that were noted was patients who had a severe form of pneumonia. Age was not a significant risk factor for pneumonia mortality. Other studies[10] found pneumonia mortality to be associated with age. KATH has specialized personnel and machinery to support even critically ill patients of all ages.

Among the cases with comorbidities, Sickle Cell Disease (SCD) emerged as the main comorbidities of pneumonia. SCD is a leading genetic disorder in sub-Saharan Africa. Ghana had a prevalence of about 2% of SCD’s. SCD’s are at risk of Acute Chest Syndrome (ACS), hence it was not surprising that it came out as one main differential diagnosis. However the classical definition of ACS was not used because there were not previous x-rays to confirm new chest infiltrate for these cases. SCD patients are also at risk of other acute respiratory infections (ARI).[11–13] It was therefore not surprising to see SCD emerging as the main chronic condition followed by HIV. HIV continues to be a significant public health burden in Ghana, the average prevalence among the 10 regions currently stands at 1.8%, with Ashanti region as the second highest with a prevalence of 3.2%. It is therefore expected to find retroviral exposed children reporting respiratory pathologies. The increased likelihood of pneumonia mortality among cases with severe form of the disease was not surprising since severe pneumonia is associated with metabolic imbalance, respiratory failure and multi-organ failure.

Malnutrition was observed as a significant pneumonia comorbidity which collaborates with studies by Arpitha et al (2014) which indicated that morbidity and mortality due to Pneumonia is unacceptably high in malnourished children. Undernourished children were found to have a substantially higher risk of suffering childhood death. Studies have shown that under nutrition of children contributes to more than half of all child deaths in developing countries. This phenomenon may place children at an increased risk of developing pneumonia in two ways. First, malnutrition weakens a child’s overall immune system, affecting the immune functions. Secondary, undernourished children have weakened respiratory muscles, which inhibits the system from adequately clearing secretions found in the respiratory tract [15].

International accepted number of persons to live in a room was 2. This study found it to be higher which gives a cause of worry. The average household composition appears to be higher as compared with the national average of 4 [16]. A previous study conducted at
the same study site found overcrowding to be a risk factor of pneumonia mortality.[17]

The findings of this study is relevant and call for comprehensive study of the risk factors identified, as the use of cross-sectional design, sampling technique and the study site (tertiary institution) limits the strength of any generalizability of the findings. A multi-center comprising of rural and urban setting and case control study design is recommended for future studies.

Conclusion

The study has revealed that pneumonia places a high burden on the health of children under five years admitted in the pediatric wards of KATH. Community health workers at the healthcare facilities need to sensitize caregivers to be aware of the signs and symptoms of pneumonia in order to detect early and report promptly to healthcare facilities as this could reduce the burden of the disease. Despite the increasing vaccination rates being recorded for the vaccines preventable diseases, the burden of pneumonia continues to be high among reported cases in healthcare facilities. It is therefore of urgent need to further test the immunogenicity of children being given pneumonia vaccines.

Acknowledgement

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References


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CASE REPORT

Reframing Ethics when Unintended Consequences Arise: A Case Report of a Multiple Micronutrient Study During Pregnancy in Ghana
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Abstract
In a study of dietary supplementation among women in Ghana, a disproportionately high number of pregnant study participants were found to no longer be pregnant, leading researchers to suspect that the very early identification of pregnancy status made possible by study participation may have contributed to an elevated incidence of elective abortion among study participants. While abortion is legal in Ghana under certain circumstances, misinformation regarding its legality and persistent stigmatization result in many Ghanaian women choosing abortion methods that are unsafe and often illegal. While the study of the potential benefits of dietary supplementation during pregnancy initially appeared to pose very little risk to participants, the unintended and unforeseen consequence of unsafe abortions required researchers to reevaluate study protocol. In the following discussion of this case, we explore the ethical considerations researchers must address when unintended consequences emerge in global health research.

Introduction
Despite dramatic improvements in recent decades, malnutrition continues to be a pervasive public health burden in low income countries, particularly among pregnant women.1, 2 Although there are many approaches to alleviating the health burden of malnutrition, dietary supplementation is the most widely practiced intervention, since it is comparatively cost-effective and has the potential for a relatively immediate impact on the health of the receiving population.3 In recent decades, dietary supplementation programs in low and middle income countries have increasingly relied upon a complete micronutrient supplement with studies showing improvements in a number of pregnancy and birth outcomes, including reductions in low birthweight, neonates that are small for gestational age, preeclampsia, neural tube defects, and other congenital malformations.4

While there is evidence to suggest that multiple micronutrient supplementation during pregnancy may play an important role in improving maternal health in low and middle income countries, the World Health Organization currently only recommends iron and folate supplementation during pregnancy, though guidelines containing recommendations regarding micronutrient supplementation are planned for release in 2016. Before new recommendations could be made, more research was needed to assess both the comparative advantage of micronutrient supplementation and the potential adverse effects associated with overuse or interactions between micronutrients.5 In response to the call for more research on the comparative advantages and risks of multiple micronutrient supplementation during pregnancy, a community-intervention study was launched by institutions in Ghana and from a high income country among women of reproductive age in rural Ghana in 2013. During the course of the study, unintended consequences emerged that necessitated study modification, leading researchers to explore the ethical considerations of study modification during an active study.

Case
Ten communities in the Barekese sub-district of Ghana were randomized to receive either the complete micronutrient or the iron-folate supplement. In order to identify women within one month of conception, the community health workers were also tasked with conducting urine pregnancy tests at each monthly visit. Community health workers began visiting women and distributing the supplements in July 2013. These community health workers were tasked with visiting the women in their communities monthly to educate them on the benefits of supplementation, perform pill counts, and distribute another month’s supply of the appropriate supplement. Additionally, because the purpose of the study was to identify the comparative effects of the two supplementation methods across time, blood serum samples were collected at three points associated with the women’s pregnancy: in the first month of pregnancy, in the third trimester, and at three months post-delivery. In order to obtain a serum sample in the first month of pregnancy, women also received monthly pregnancy testing, which informed them of their pregnancy status within 1-2 weeks of conception. The three blood samples were then analyzed for six important biomarkers to provide a detailed picture of the comparative impact of the two supplements from conception through lactation. By the end of January 2014, a total of 13 of the 41 women identified as pregnant by blood tests were found to no longer be pregnant. These participants may have terminated the pregnancies.
Discussion

The proportion of women in the study who were found to no longer be pregnant represented a surprising increase over what the Ghana-specific statistics would have predicted. According to a recent study of maternal health in Ghana, 9% of pregnancies in Ghana end in miscarriage and 7% of pregnancies end in induced abortion.8 In this case study, 32% of pregnancies ended unexpectedly and were suspected by study personnel in Ghana to be primarily from induced abortions.

Although legal, professional abortion services are not offered widely and continue to be highly stigmatized across Ghana, resulting in women often seeking underground, and likely unsafe, abortions.8-12 In this study, women received monthly urine pregnancy testing, informing them of their pregnancy status within weeks of conception, which was much earlier than would have been possible using traditional methods of pregnancy identification. Early detection, as a result of study participation, may have created a longer window in which women could access abortion services before signs of pregnancy became publicly recognizable, thus allowing women to avoid the stigmatization associated with abortion. The high rate of terminated pregnancies suggested that the study procedures had introduced an element into the participating communities that was altering practices related to pregnancy termination in unanticipated ways. Because of the lack of access to safe abortion services, it is likely that many of the suspected induced abortions were conducted in an unsafe manner and put the women at risk for complications. While the termination of pregnancy was not caused by taking the micronutrient supplements, participation in the study likely contributed to unanticipated behavior change among the women that introduced the potential for harm to participants. This unintended consequence of monthly pregnancy testing put participants in the study at greater risk and necessitated redesign of study protocol.

In order to remove the unintended consequence, the decision was made to alter the study design to remove this element of influence by stopping monthly pregnancy testing. Instead, women were enrolled in the study according to self-report of pregnancy status and/or seeking of professional prenatal care. After such unintended consequences arise, researchers must consider the ethical implications of emergent potential harm to participants in an otherwise minimal risk study, some of which are outlined below.

Recommendation on Ethical Issues

Internal monitoring
- What should be included to internal monitoring for studies that do not include experimental interventions? (In this case, micronutrient supplementation has been shown to be very safe and does not require the same oversight required for studies of untested pharmaceuticals or devices).
- How often should internal research be conducted?

Study design modification
- How can researchers identify whether observed effects outside the scope of the project represent harm or undesirable consequences as a result of study participation?
- Ethical justification for altering the study design in this case hinged on the evident abrupt alteration of typical patterns of behavior among study participants. Under what circumstances should researchers alter the study design? How can researchers weigh whether study modification is ethically necessary?

When unintended consequences outside the scope of the research focus emerge, what responsibilities do researchers have to stakeholders (e.g., the funding organization, participating communities)?

Communication of unanticipated findings
When significant changes to research participation are made after participants have been enrolled, how should the study team work with study participants to help them understand the changes to their own participation in the study?

When should research guidelines at the ethics board review level be modified to manage new risk to study participants?

Unanticipated findings outside the scope of the research focus are inherently not the result of rigorous scientific inquiry, yet may represent important discoveries. What is the appropriate medium for dissemination of such findings to the scientific community?

Conclusion
In our case study, we outline three areas for discussion when an intervention is associated with increased risk of, or actual, harm to participants: internal monitoring, study design modification, and communication of unanticipated findings. Unintended events in the research context, as described here, require evaluation of ethical concerns as well as exploration of the cultural and policy differences that led to the behaviors that manifested as unacceptable risk or harm.