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Research Article

Prevalence, Associated Factors, Management Strategies and Outcome of Pneumonia among Children Under 5 Years in the Buea Regional Hospital South West Region of Cameroon

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Abstract

Background: Pneumonia is the leading cause of morbidity and mortality in children under-five years. It was estimated that pneumonia kills 900,000 children under-five years each year worldwide. Approximately 172 deaths per 1,000 live births occurs in sub-Saharan African countries, with pneumonia being the major cause.

Aim: This study aimed to estimate the prevalence, associated factors, management strategies and outcome of pneumonia among children under five years in the Buea Regional Hospital South West Region of Cameroon.

Methods: The study used a hospital-based retrospective study where data was obtained from the paediatric records and patients' files using a review checklist. Data was obtained from files registered for five consecutive years; from 2018 to 2022. Data was collected on the diagnosis of pneumonia, types, associated factors and outcome. Data analysis was done using Microsoft Excel and Statistical Package for the Social Sciences (SPSS) version 25. Statistical significance was set at $P < 0.05$.

Results: The prevalence of pneumonia in the study area was 7.34% (95% CI (4.61 - 11.42). Factors such as cooking inside the living room [adjusted odd ratio (AOR) = 6.2; 95%CI: 1.8 - 21.6], overcrowding (AOR = 3.5; 95% CI: 1.1 - 6.2), HIV positive children (AOR = 6.1; 95%CI: 2.7 - 13.3), malnutrition status (AOR = 2.4; 95%CI: 1.1 - 5.0) and vaccination status (AOR = 3.4; 95% CI: 1.8 - 6.0) were significantly associated with the occurrence of pneumonia in children under-five years. Among the 431 files of children under five years reviewed, most 392 (90.96%) of them improved, while 39 (9.04%) died.

Conclusion: This study showed that prevalence of pneumonia and mortality rates secondary to pneumonia were high. Being malnourished, positive sero-status for HIV infection, and unvaccinated, among others were identified as determinant factors of mortality. Committed, harmonized and integrated intervention needs to be taken to reduce mortality from pneumonia.

Keywords: *Retrospective; Prevalence; Pneumonia; Associated Factors and Strategies to Eradicate Pneumonia*

Abbreviations

AWC: Anganwadi Center; APHC: Additional Primary Health Center; BRH: Buea Regional Hospital; CAP: Community Acquire Pneumonia; CCM: Community Case Management; CCMP: Community Case Management of Pneumonia; DHS: Demographic Health Survey; HIV: Human

Immunodeficiency Virus; IMCI: Integrated Management of Childhood Illness; LRH: Limbe Regional Hospital; LSH: Limbe Sub Divisional Hospital; MDGS: Millenium Development Goals; NMCP National Malaria Control Program; PAS: Pneumonia Awareness Session; SWR South West Region; SDG: Sustainable Development Goals; SCs: Sub Centers; TDH Tiko District Hospital; U5: Under 5 Years; VHND: Village Health and Nutrition Day; WHO: World Health Organisation

Introduction

Pneumonia is defined as an acute inflammation of the lungs' parenchymal structure. It can be classified based on place of acquisition that is, as community acquired or hospital acquired. Also, it is classified based on its causative agents, which is either viral, fungal, aspiration, or ventilator-associated pneumonia [1]. Again, it is classified based on the anatomy of the lungs involved such as lobar pneumonia, bronchial pneumonia or acute interstitial pneumonia and on the basis of its clinical severity; no pneumonia, pneumonia or severe pneumonia [2,3].

Research shows that, Bacteria are the most common cause of community-acquired pneumonia (CAP), with Streptococcus pneumonia isolated in nearly 50% of cases [4] It is estimated that, aspiration pneumonia accounts for 5 to 15% of cases of community-acquired pneumonia, but figures for hospital acquire pneumonia are unavailable.

Globally, research had been conducted to identify risk factors of pneumonia. Despite the disparity in findings, low birth weight, malnutrition, indoor air pollution, parental smoking, being unvaccinated, and maternal education among others were identified as factors associated with the occurrence of pneumonia in under-five children [5].

Pneumonia can cause serious complications such as asthma, particularly in vulnerable groups like the very young and those with other health problems. Potential complications of pneumonia include blood poisoning, pleurisy and lung abscesses. The body's immune response to the infection is so strong that it can cause damage to the lining of blood vessels causing then to leak, which may lead to organ failure and may be fatal [6]. Pleurisy occurs when inflammation spreads to the thin membranes between the lungs and the ribcage. This can cause serious breathing difficulties, which may lead to respiratory failure if left untreated.

The leading risks factors contributing to pneumonia incidence are lack of exclusive breastfeeding, under nutrition, exposure to indoor air pollution, low birth weight, crowding and absence of immunization [7,8]. The deaths resulting from pneumonia are easily preventable by cost-effective interventions like immunization, good nutrition, exclusive breastfeeding, appropriate complementary feeding and hand washing [9]. Therefore, it is important to look at a combination of strategies for reducing the morbidity and mortality from pneumonia. These include preventive strategies such as routine immunizations, zinc, and vitamin A supplementation, control of environmental factors, promotion of breastfeeding, good nutrition, safe drinking water, and good sanitation. Hence, addressing current gaps for the prevention of under-five pneumonia is critical to achieving Sustainable Development Goal (SDG 3) [10].

Aim of the Study

The aim of this research was to determine the prevalence and investigate the associated factors, management strategies and outcome of pneumonia in children less than five years in the Buea Regional Hospital of the South West Region. Findings from this study may promote the prevention and management of pneumonia in children. It may serve as a foundation for health care providers in further research. It is hoped that policy makers might use this information to develop a more comprehensive plan for the prevention and management of pneumonia in children.

Materials and Methods

A hospital-based retrospective study was conducted for a period of four months from February, 2023 to May, 2023 to determine the prevalence and investigate the associated factors, management strategies and outcome of pneumonia in children less than five years old.

A quantitative approach was employed to collect and process data; an extraction checklist was used to collect data. The study targeted records and files of both male and female children less than five years of age admitted to the Pediatric Ward at Buea Regional Hospital from the year 2018 to 2022. Buea Regional Hospital (BRH) was purposively selected because it is accessible. Also, this hospital has Pediatric and ANC Units and it is one of the two referral and teaching hospitals in the SWR of Cameroon. Buea is geographically located at the foot of Mount Cameroon. It is the headquarters of the South West Region (SWR) of Cameroon.

Pediatric records and files of both male and female children less than 5 years of age admitted to the Pediatric Ward with pneumonia registered from the year 2018 to 2022 were reviewed. All pediatric hospital records and files of children less than 5 years with incomplete details, and pneumonia cases that were not admitted at the Buea Regional Hospital (BRH) were excluded from this study. Data was collected on the total number of cases of pneumonia that were admitted in order to determine the prevalence in BRH and investigate the associated factors, management strategies and outcome of pneumonia.

Data collected was entered in to Microsoft Excel and analysed using the Statistical Package for Social Sciences (SPSS) software version 25. To ensure confidentiality, all patients' information was coded. The data entered in to Microsoft Excel was checked on daily basis to ensure correct entry of information, data was entered in the computer and secured by a password known only to the principal investigator and supervisor. Review checklist was kept in a safe form, accessible only by the principal investigator.

The raw data was analysed using IBM SPSS Statistics version 25. The correlation between gender and other variables were assessed using Chi-square test, p-values were obtained using Fisher's exact test. Descriptive statistics and frequencies were used to construct the tables presenting the results. To make the graphs Microsoft Excel 2010 was used. The significance cut off was set to p-value < 0.005. Multivariate logistics regression was used to identify the independent factors associated with pneumonia in children under five years and 95% CI was used to define the prevalence and proportions.

Ethical approval

This study was authorised by the Department of Public Health and Hygiene, Faculty of Health Sciences (FHS), University of Buea, Cameroon. Firstly, ethical approval was obtained from the Institutional Review Board in FHS, University of Buea. Secondly an administrative authorisation was obtained from the Regional Delegation of Public Health (No. 554/586) and then from the head of the health facility. Before reviewing the files, permission was obtained from the heads of the units.

Results

A total of 5871 files of children less than five years old admitted to the Pediatric Unit of the Buea Regional Hospital from January 2018 to December 2022 were reviewed (Table 1). Half, 2936 (50.0%) of the participants were aged 1 - 3 years old. Of the 5871 children's files sampled, 3053 (52.0%) were females. Regarding maternal educational level, 37.0% of the mothers had attended tertiary education and 34.7% secondary education. Less than half of the children were admitted in the Pediatric Unit in the years 2021 (23.3%) and 2022 (21.3%).

Variables	n (%)
Age (in years)	
< 1	2113 (36.0)
1 - 3	2936 (50.0)
4 >5	822 (14.0)
Total	5871 (100)
Gender	
Male	2818 (48.0)

Female Total	3053 (52.0) 5871 (100)
Maternal Educational level	
No formal education	646 (11.0)
Primary	1015 (17.3)
Secondary	2040 (34.7)
Tertiary Total	2170 (37.0) 5871 (100)
Year of review	
2018	1027 (17.5)
2019	1109 (18.9)
2020	1117 (19.0)
2021	1367 (23.3)
2022 Total	1251 (21.3) 5871 (100)

Table 1: *Socio-demographic Characteristics of Children at Buea Regional Hospital (2018-2022).*

Of the 5871 files reviewed, 2409 (41.1%) of the children lived in an overcrowded environment, 2518 (42.9%) did not have a separate kitchen in the house and 560 (9.5%) had smokers as parents (Table 2).

Variables	n (%)
Overcrowding	
No	3462 (58.9)
Yes Total	2409 (41.1) 5871 (100)
Indoor pollution	
No	5031 (85.7)
Yes Total	840 (14.3) 5871 (100)
Lack of separate kitchen	
No	3353 (57.1)
Yes Total	2518 (42.9) 5871 (100)
Parental smoking	
No	5311 (90.5)
Yes Total	560 (9.5) 5871 (100)

Table 2: *Housing and environmental characteristics of the children at Buea Regional Hospital (2018-2022).*

Of the 5871 children files reviewed, 1015 (17.3%) were unvaccinated and 1197 (20.4%) were malnourished (Figure 1).

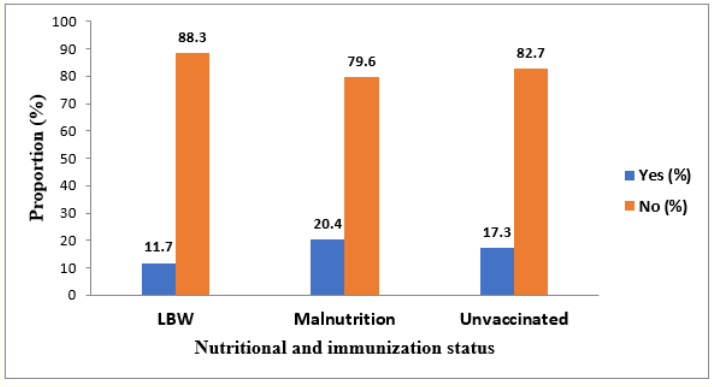

Figure 1: *Immunization and nutritional characteristics of the children at Buea Regional Hospital (2018-2022).*

Of the 5871 children's files reviewed, 170 (2.9%) were HIV positive and 182 (3.1%) had a history of tuberculosis (Figure 2).

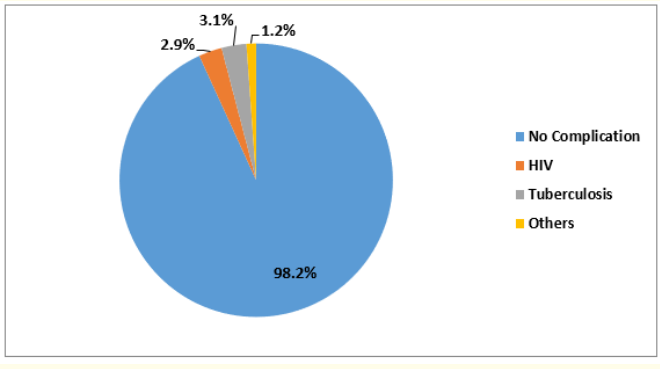

Figure 2: *Pre-existing medical conditions of the children at Buea Regional Hospital (2018-2022).*

The overall magnitude of pneumonia among children aged less than five years old for the study period was 7.34% (95% CI (4.61 - 11.42) as shown on figure 3.

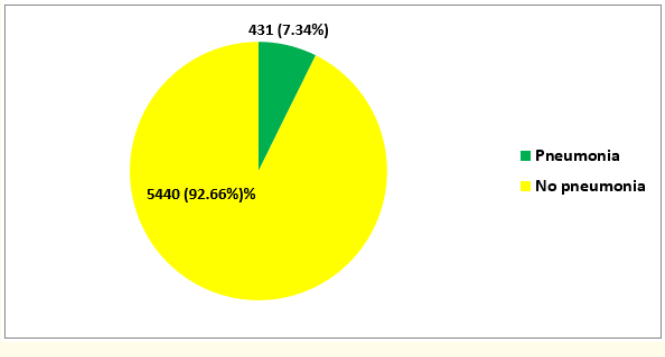

Figure 3: *Prevalence of pneumonia among the children from 2018-2022 at Buea Regional Hospital.*

The prevalence of pneumonia increased steadily from 58 (5.6%) in 2018 to 90 (8.1%) in 2020 and then dropped to 96 (7.7%) in 2022 (Figure 4).

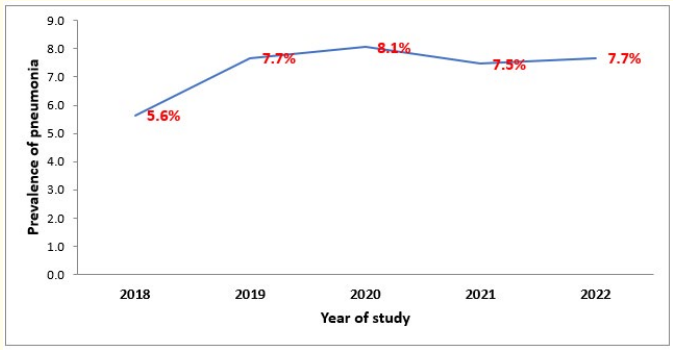

Figure 4: *Prevalence of Pneumonia by Year of Study at Buea Regional Hospital (2018-2022).*

Of the 431 cases of pneumonia recorded, 169 (39.2%) children had CAP, 110 (25.5%) presented with simple pneumonia and 79 (18.3%) had bronchopneumonia (Figure 5). The least types of pneumonia were aspiratory pneumonia (0.46%) and Labour pneumonia (3.71%)

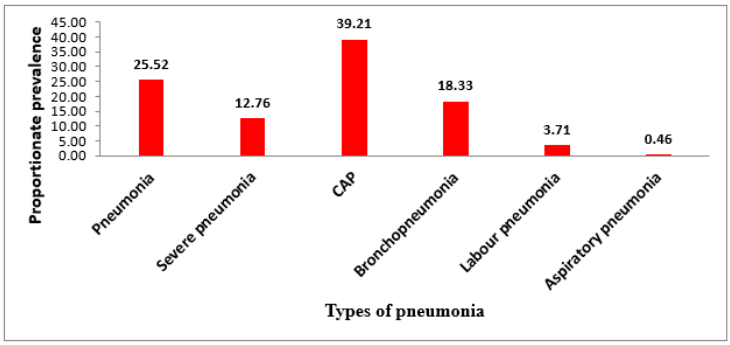

Figure 5: *Types of pneumonia among children 0-5 Years at Buea Regional Hospital (2018-2022).*

A bivariate analysis showed that the variables significantly associated with pneumonia in children less than 5 years were lack of separate kitchen, being malnourished, being HIV positive, overcrowded living conditions, having a history of TB, having low body weight and being unvaccinated. After adjusting for confounding variables from multivariable logistic regression analysis, our results indicated that under five years children whose families lacked a separate kitchen were 6.2 times more likely to develop childhood pneumonia (AOR = 6.2; 95%CI: 1.8-21.6) compared to children whose families had a separate kitchen in the house (Table 3).

The odds of pneumonia among children under five years living in overcrowded conditions were 3.5 times higher compared to those not living in overcrowded spaces (AOR = 3.5; 95% CI: 1.1 - 6.2). HIV positive children were 6.1 times more likely to develop pneumonia (AOR = 6.1; 95%CI: 2.7 - 13.3) compared to their counterparts without HIV. The odds of developing childhood pneumonia were 2.4 times higher in children with acute malnutrition than in children with normal nutritional status (AOR = 2.4; 95%CI: 1.1 - 5.0). The odds of pneumonia among children under five who were not vaccinated against pneumonia were 3.4 times higher than among children who were vaccinated (AOR = 3.4; 95% CI: 1.8-6.0) (Table 3).

Characteristics	Pneumonia		COR (95%CI)	AOR (95%CI)	p-value
	Yes	No			
Separate kitchen					
Yes	122	4908	1	1	
No	309	531	7.7 (4.5-13.3)	6.2 (1.8-21.6)	0.001*
Overcrowded home					
No	76	3386	1	1	
Yes	355	2051	4.0 (2.3-6.1)	3.5 (1.1-6.2)	0.004*
HIV status of child					
Negative	351	5350	1	1	
Positive	80	90	3.5 (2.1-5.5)	6.1 (2.7-13.3)	0.012*
Malnutrition					
No	106	3802	1	1	
Yes	325	872	3.4 (2.0-5.9)	2.4 (1.1-5.0)	0.017*
Unvaccinated against pneumonia					
No	119	4153	1	1	
Yes	312	703	4.4 (2.7-7.9)	3.4 (1.8-6.0)	0.023*
LBW					
No	326	4602	1	1	
Yes	105	582	1.9 (1.0-3.6)	1.2 (0.9 - 2.6)	0.089
Child history of TB					
No	357	5579	1	1	
Yes	74	109	2.3 (1.2 - 3.6)	1.1 (0.8 - 3.5)	0.123

Table 3: *Factors associated with pneumonia in children less than 5 years old at Buea Regional Hospital (2018-2022).*

Oxygen treatment was used in 150 of the 431 (34.8%) cases in Buea. The most common antibiotic treatment was the third generation cephalosporin Ceftriaxone (or equivalent generics) in combination with Gentamycin, followed by Ceftriaxone as single treatment. In 45.4% of the cases, Gentamycin was used despite the fact that it was not included in the treatment guidelines (See table 4).

Antibiotic treatment	n (%)
Third generation cephalosporin + Gentamycin	130 (30.1)
Third generation cephalosporin	90 (20.8)
Ampicillin + Gentamycin	60 (13.9)
No antibiotics	20 (4.6)
Ampicillin or Amoxicillin	50 (11.6)
Ampicillin + clavulanic acid	25 (5.8)
Ampicillin + third generation cephalosporin	25 (5.8)

Ampicillin + third generation cephalosporin + Gentamycin	21 (4.8)
Other	10 (2.3)
Total	431 (100%)

Table 4: *Antibiotic treatments given to the children at Buea Regional Hospital (2018-2022).*

Of the 431 children aged less than five years with pneumonia, 39 (9.04%) died while 392 (90.96%) recovered (Figure 6).

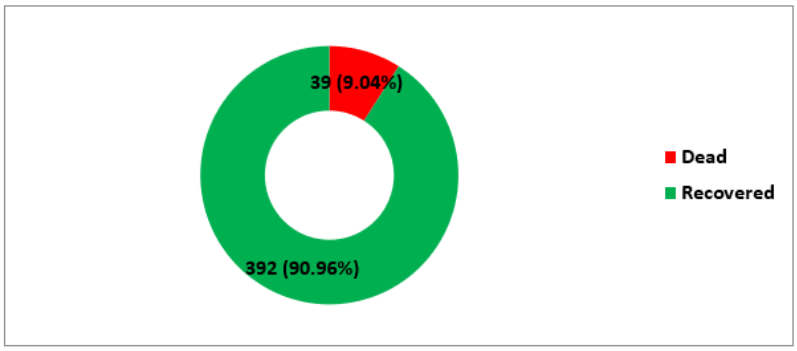

Figure 6: *Overall mortality rate among children with pneumonia at Buea Regional Hospital (2018-2022).*

The mortality rate of children with pneumonia increased steadily from 6.9% in 2018 to 11.1% in 2022 and significantly dropped to 3.9% in 2021 before skyrocketing to 12.5% in 2022 (Figure 7).

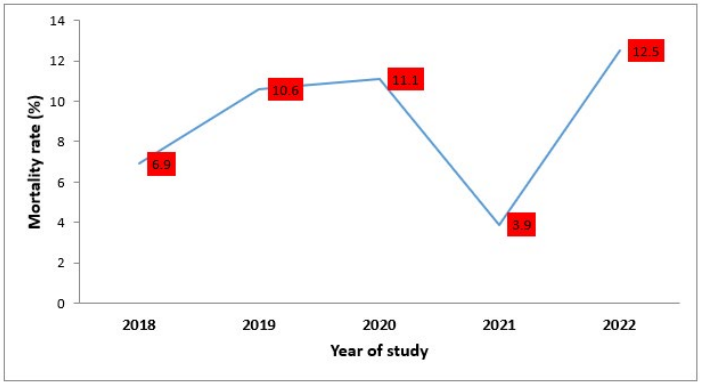

Figure 7: *Mortality rate among the children per year of study at Buea Regional Hospital (2018-2022).*

Malnutrition, age less than one year, maternal educational level, being HIV positive and having Low Birth Weight (LBW) were significantly associated with mortality in children with pneumonia. Vaccination and study period did not show any significant association. Children less than the age of one year were more likely to die of pneumonia compared to their counterparts aged greater than one year (12.9% versus 7.9%, p = 0.021). Children with uneducated mothers were more likely to die from pneumonia compared to their

counterparts with educated mothers (42.9% versus 7.9%, p = 0.001). Children with severe pneumonia were more likely to die compared to their counterparts with simple pneumonia (12.9% versus 4.8%, p = 0.034). The mortality rates were significantly (p = 0.011) higher in HIV positive children with pneumonia (36.4%) compared to HIV negative children with pneumonia (9.2%). Malnourished and LBW children with pneumonia were more likely to die compared to their counterparts with neither of these conditions (Table 5).

Characteristics	Death		X^2-value	p-value
	Yes (%)	No (%)		
Age (in years)				
≥ 1	21 (12.9)	141 (87.1)	5.741	0.021*
< 1	18 (7.9)	211 (92.2)		
Maternal education				
Primary and above	33 (7.9)	384 (92.1)	22.102	0.001*
No formal education	6 (42.9)	8 (57.1)		
HIV status of child				
Negative	35 (9.2)	345 (90.8)	14.365	0.011*
Positive	4 (36.4)	7 (63.6)		
Malnutrition				
No	25 (7.3)	316 (92.7)	5.984	0.016*
Yes	14 (15.6)	76 (84.4)		
Unvaccinated against pneumonia				
No	29 (8.1)	328 (91.9)	3.144	0.214
Yes	10 (13.5)	64 (86.5)		
Severity of the pneumonia				
No	10 (4.8)	197 (95.2)	9.213	0.034*
Yes	29 (12.9)	195 (87.1)		
LBW				
No	26 (7.1)	340 (92.9)	11.541	0.002*
Yes	13 (20.0)	52 (80.0)		
Year of study				
2018	4 (6.9)	54 (93.1)	3.684	0.224
2019	9 (10.6)	76 (89.4)		
2020	10 (11.1)	80 (88.9)		
2021	4 (3.9)	98 (96.1)		
2022	12 (12.5)	84 (87.5)		

Table 5: *Factors associated with mortality in children with pneumonia at Buea Regional Hospital (2018-2022).*

Discussion

This study aimed to estimate the prevalence, associated factors, management strategies and outcome of pneumonia among children under five years in the Buea Regional Hospital, South West Region of Cameroon. It is worth stating that proper planning and delivery of

appropriate health education to parents by nurses will create awareness in parents and upgrade their knowledge on the causes and risk factors of pneumonia. This will in turn assist parents in implementing measures in preventing pneumonia and hence, curb the morbidity and mortality associated with pneumonia in children under five years of age. This is critical to achieving Sustainable Development Goal (SDG).

According to the findings of this study, the prevalence of pneumonia in children admitted in the Buea Regional Hospital from 2018 - 2022 was 7.34%. The peak prevalence of pneumonia was observed in 2020 (8.15%) and the most common forms of pneumonia were CAP, simple pneumonia and bronchopneumonia. These findings are consistent with that of a study conducted by Leweyehu., *et al.* [11] in Angolela Tera District, North Shoa Ethiopia in 2021 whose prevalence rate was 5.8%. These findings are much lower when compared to that gotten from a similar studies carried out in Gondar Referral Hospital by Chekole., *et al.* [12] whose results revealed a prevalence of 18.5%. Such difference could probably results from the fact that the sample size used in our study was smaller compared to that used in a big teaching hospital like University of Gondar Referral Hospital. Also, our findings are similar to those of previous studies conducted by Lema., *et al.* [13] in Ethiopia and Mulambya., *et al.* [14] in Zambia.

With respect to the types of pneumonia in children under five years, our study revealed a prevalence of 39.21%. This finding is contrary to that of a community based cross sectional study carried out by Batu., *et al.* [15], which reported that the prevalence of community acquired pneumonia (CAP) was 17.7%. This prevalence is lower than that of our study, this could be due to seasonal variation.

Our multivariable logistic model indicated that lack of separate kitchen, overcrowding, being HIV positive, malnutrition and being unvaccinated were significantly associated with pneumonia among children under five years. Children living in households using the living room for cooking were more likely to have pneumonia than those households using a separate kitchen. The findings of this study are in line with that of a study conducted in a teaching hospital in Bushenyi District, Western Uganda by Gloria., *et al.* [16] whose results revealed that acute malnutrition, not up to date immunisation status and rural residence ($P < 0.001$) were the main factors associated with pneumonia in under five years children. In addition, our findings are consistent with the findings of the studies conducted by Tazinya., *et al.* [17] and Merera [18] in Cameroon and Ethiopia respectively.

However, our findings are slightly different from the findings of a study conducted in Gamo Zone, Southern Ethiopia by Yerukneh., *et al.* [19] were factors such as cooking food inside the living room (AOR = 5.79), non-exclusive breastfeeding (AOR = 3.26), vitamin A supplementation status (AOR = 5.62) were found to be associated with pneumonia in children 0-5yrs. This slight differences could probably be due to the fact that, the study conducted in Ethiopia was among children whose mothers were working with high educational level, as such majority of them could not practice exclusive breastfeeding due to their jobs. Also, due to the higher status of these women, majority of them would probably use modern kitchens which are built inside the house close to the living room and or sitting room. Again, our findings are slightly different from the findings of studies conducted by Shi., *et al.* [20] and Adane., *et al.* [21].

The current study revealed that out-of the 431 children aged less than five years with pneumonia, 9.04% died. Variables such as malnutrition, less than one year of age, maternal educational level HIV positive status and having LBW were significantly associated with mortality in children with pneumonia. The findings of this study are in line with that of a study conducted by Lu Cao., *et al.* [22] which revealed a mortality rate of 9.3% in children diagnosed with pneumonia. However, the mortality rate is much lower when compared to that of a study conducted by Meliyanti., *et al.* [23], whose results revealed a 47.7% death rate in pediatric patients diagnosed with pneumonia. The discrepancy could have resulted from the fact that Meliyanti., *et al*'s study was carried out in a rural area in a developing country where the children's mothers had poor educational level, low socio-economic status and limited health facilities to access care. The factors associated with mortality were low birth weight, underweight, comorbidities such as anemia and gastrointestinal haemorrhage. According to Dembele., *et al.* [24], bacteria and underweight were the main factors associated with poor clinical outcome in children diagnosed with pneumonia.

Conclusion

In this study, the prevalence of pneumonia in children admitted to the Buea Regional Hospital from 2018 - 2022 was 7.34%. The peak prevalence of pneumonia was observed in 2020 (8.15%) and the most common forms of pneumonia were CAP, simple pneumonia and bronchopneumonia. Lack of separate kitchen, overcrowding, being HIV positive, malnutrition and being unvaccinated were significantly associated with pneumonia among children under five. The mortality rate of children with pneumonia was 9.04%. Being malnourished, being age less than one year, maternal educational level being HIV positive and having LBW were significantly associated with mortality in children with pneumonia. These findings provide strong evidence that pneumonia can be prevented through reinforced community-based interventions that achieve ventilated and improved housing conditions, separate kitchens, vaccination and nutrition.

Based on the findings of this study, it can be seen that there is need to intervene by reducing pneumonia using the Protect, Prevent and Treat Framework. In addition, there is need to provide health education for caregivers or mothers about health benefit of ventilated and improved housing condition, to use kitchen with chimney and not to carry the child on back during cooking. This might assist to curb the incidence and mortality rate of pneumonia in children under five years.

Limitations of the Study

The study employed a retrospective design; there was insufficient information in some files, and others were incorrectly filled. The study was hospital-based; therefore only patients' files with pneumonia admitted to the Buea Regional Hospital were considered. Finally, the study was carried out in a single secondary level health facility which might not be a reflection of all health facilities. However, Buea Regional Hospital is one of the top health facilities in the region, easily accessible and having a very high patient inflow. Hence, results obtained reflect the true picture of the situation. It is recommended that a qualitative study should be carried out to determine the prevalence of pneumonia in children at the community level.

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Authors' Contribution

The first three authors participated at all levels of the study from its commencement to writing. That is, conception and design, acquisition of data, analysis and interpretation of data as well as drafting and or revising and approving the final manuscript. Yoah A analysed the data and Keron B contributed in the discussion section of the manuscript.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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