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PREDICTORS OF COMMUNITY ACQUIRED PNEUMONIA IN CHILDREN LESS THAN 5 YEARS IN FAKO DIVISION, CAMEROON

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Abstract

Community acquired pneumonia (CAP) is a major public health problem and a principal cause of morbidity and mortality in children under 5 years of age worldwide. The 13-valent pneumococcal conjugate vaccine is the major intervention strategy used in the prevention of new infections. Though the vaccines have been in use since 2011 in Cameroon, lower respiratory tract infections remain major causes of morbidity and mortality. A community-based case-control study involving 346 children <5 years was conducted between March and June 2018. A data extraction tool was used to identify children <5 years with an episode of pneumonia from consultation registers of two tertiary public hospitals in Fako Division and interviewed in their households. Data were analyzed using Statistical Package for Social Sciences version 20.0. Bivariate and multivariate logistic regression models were carried out to identify factors associated with pneumonia. Significance was obtained through adjusted odds ratio with its 95% confidence interval and a p<0.05.A total of 346 children participated in the study comprising of 164 controls and 182 cases with mean age of 21 (SD 15) months. 50.57% of participants were males. Factors associated with pneumonia were: overcrowding; aOR 3.001, *p*-value <0.001, contact with someone with cough; aOR 2.970, *p*-value <0.001, passive cigarette smoking; aOR 2.560, *pvalue* <0.003 and age of the child (<24 months); aOR 1.153, *p*-value 0.042. Pneumonia is a common infection in children <5 years of age. Overcrowding, passive cigarette smoking, contact with someone with cough symptoms, age of child <24 months, are associated with pneumonia in Fako Division.

INTRODUCTION

Community-acquired pneumonia (CAP) is a major public morbidity and mortality in children under 5 years of age, health problem and the leading infectious cause of killing nearly 2,500 children a day worldwide

The World Health Organization (WHO) estimates that 156 million new cases of pneumonia occur annually worldwide in children under five years of age, with 95% of these cases occurring in developing countries (Fonseca et al., 2016; Liu et al., 2012; CMR, 2018). Although pneumonia can affect people of all ages, it is most prevalent

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in children less than 5 years old (81% in children less than 2 years) (Fischer et al., 2013), adults greater than 65 years, and immunocompromised persons (Roomaney et al., 2016). Pneumonia is an acute form of respiratory tract infection where the lung alveoli become fluid-filled, causing painful breathing and limiting oxygen intake (Tong, 2013). A multitude of agents are responsible for pneumonia, the most common being bacterial agents (e.g., *Streptococcus pneumoniae, Haemophilus influenzae* type b (Hib)) and viral agents (e.g., respiratory syncytial virus (RSV)). The pathogens that cause pneumonia vary by several factors, which may include age (RSV is a common causative agent in children less than 2 years) (Tong, 2013). *S. pneumoniae* is the most common bacterial cause in children from developing countries and of community-acquired pneumonia (CAP) in the elderly (Simonetti et al., 2014).

Pneumocystis jirovecii is a common opportunistic cause of pneumonia infection in HIV patients (Coelho et al., 2014). CAP has been associated with various sociocultural, demographic, and environmental factors in children under 5 years (Fonseca et al., 2016; Liu et al., 2012; CMR, 2018), which include HIV infection (Tazinya et al., 2018), poor maternal education (Tazinya et al., 2018; Cesar et al., 1999; Moustaki et al., 2010), exposure to wood smoke, passive smoking (indoor air pollution) (Dherani et al., 2008; Bruce et al., 2007), and contact with someone with cough symptoms (Tazinya et al., 2018). However, there is limited data on factors associated with acute respiratory tract infections in Cameroon despite the burden of these infections on morbidity and mortality in children under five in the country (Tazinya et al., 2018). This study is therefore aimed at determining the risk factors associated with CAP in children less than 5 years in Fako Division of Cameroon.

Rational

The aim of this study was to determine the risk factors of community-acquired pneumonia in children under 5 years of age. No such study has been done in the South West Region of Cameroon. Most studies on the risk factors for community-acquired pneumonia have been hospital-based, likely because most investigators are hospital-based and patients admitted to the hospital have more severe disease. However, since most patients with CAP are treated as outpatients, the majority of cases are left out from such studies (Koivula et al., 1994; White et al., 1981; Barry et al., 2000). We therefore used a community-based approach to understand the causation of disease that occurs in the community prior to seeking hospital services.

Understanding the risk factors of community-acquired pneumonia will provide information for the development of strategies to control pneumonia in children in our communities. The risk factors for community-acquired pneumonia in children are likely to differ between villages, regions, and countries. This study identifies the factors associated with community-acquired pneumonia in children less than 5 years in Fako Division.

METHODOLOGY

Study area

Fako is a division of the Southwest Region of Cameroon. It covers a total surface area of 2,093 km². By 2005, Fako had a population density of 222.8/km² (United councils and cities of Cameroon, 2018). There are two seasons in Fako, the rainy and the dry season, with annual rainfall ranging between 3,000 and 5,000 mm. The main activity of the population of Fako Division is agriculture, primarily small-scale farming of food crops and fruits that supply not only the local market but also neighboring countries like Gabon and Equatorial Guinea. Two main companies are engaged in industrial cultivation: the Cameroon Development Corporation (CDC), which grows and processes tea in Tole, and Del Monte, which grows and packages bananas for export. The original inhabitants of Fako are the Bakweri people; however, the presence of the University of Buea, the availability of tourist sites in Limbe and Buea, and the position of Buea as a regional capital have led to an influx of people from other ethnic groups (The town of Buea, 2018).

Study design and setting

A community-based case-control study design was used to investigate the risk factors of community-acquired pneumonia in children under 5 years in Fako Division, Cameroon. Limbe and Buea Regional Hospitals are the largest health facilities in the Southwest Region of Cameroon. They are both tertiary health facilities and serve as teaching hospitals for the Faculty of Health Sciences of the University of Buea. Health care services for children are provided by pediatricians, and children visiting these hospitals benefit from vaccines provided by the Expanded Program on Immunization.

Target population

Children under 5 years of age diagnosed with pneumonia at the Limbe and Buea Regional Hospitals were selected for this study. Controls were selected from the neighborhoods of the case participants. Children diagnosed with pneumonia were recruited based on the information available in the registers and traced using the address and contact details available in the registers. However, those without addresses in the registers and those whose parents refused to consent were excluded from the study.

Sample size determination

The sample size required for this study was 362 cases and controls, calculated using the formula.

$$n = \left(\frac{r+1}{r}\right)\bar{p}(1-\bar{p})(Z_{\square}+Z_{\square/2})^2 \,/\, (p1-p2)^2$$

$$OR = \frac{p_{case}\exp}{p_{controls}\exp} = \frac{p_{controls}\exp\,(OR-1)+1}{}$$

Where n = 362 (181 cases and 181 controls).

However, some cases declined responding to the study questionnaire.

Study design

Case-control studies compare the frequency of prior exposures to certain factors or conditions between study participants who have been diagnosed with a disease (cases) and those who have not developed the disease (controls). A case-control study design where cases were presumed was used to have been exposed to certain risks resulting in pneumonia, while controls were presumed not to have been exposed. Selection of potential risk factors for consideration in this study was based on a review of existing literature on the topic. This study determines factors associated with pneumonia in children rather than assessing the magnitude or severity of exposure differences between cases and controls.

Selection of cases

Cases were children selected from the outpatient consultation registers of these Regional Hospitals diagnosed with pneumonia by a medical doctor from January 2016 to April 2018. Cases with incomplete guardian contact information were excluded as well as those whose guardian or parent declined consent to participate in the study.

Selection of controls

One control was crudely matched to each case by selecting a healthy child in the neighborhood of each case with regard to age as, < 2years, 25-48 months, and 49-59 months. Children whose guardians were not available at the time of the interviewer administered questionnaire were excluded from the study.

Data collection

Hospital record review

Outpatient consultation registers of the two major public health facilities in Fako division were reviewed. A pre-designed data collection tool was used to collect information from the outpatient consultation registers of the

Limbe and Buea regional hospitals. The date of diagnosis, age, sex medical diagnosis, address and name of patient and guardian were collected from hospital records and guardians contacted for the study.

Administration of questionnaires

All potential cases selected from the registers at the OPD of the Limbe and Buea Regional Hospitals were contacted on phone and interviewed in their homes using a structured questionnaire. A control was then conveniently selected in the neighborhood of the case by asking the guardian of the case child for directions to a neighbor with a child of the same age range as his/her child. Guardians of cases and controls were interviewed by investigator using a structured questionnaire to collect information on sociodemographic characteristics of child and parent or guardian such as age, sex, residence, family size, level of education, occupation, etc., of guardian. Information on potential risk factors identified from previous studies was equally collected.

Data management and statistical analysis

The data collected were entered into Microsoft Excel 2013, cleaned, and analyzed using Statistical Package for Social Science (SPSS) version 20.0. Chi-square analysis was used to determine the association between categorical variables, and regression models were employed to assess the relationship between the outcome variable (pneumonia) and predictor variables (risk factors). Only variables that were statistically significant at a 95% confidence interval (p-value ≤ 0.05) in the binary logistic regression model were included in the final multivariate regression model analysis. Unadjusted and adjusted odds ratios, along with their corresponding 95% confidence intervals, were calculated.

Ethical considerations

Ethical clearance was obtained from the Institutional Review Board (IRB) of the Faculty of Health Sciences (2018/202/UB/SG/IRB/FHS), University of Buea. Administrative authorization was also obtained from the Regional Delegation of Public Health for the South West Region, as well as from the Directors of the Limbe and Buea Regional Hospitals. The purpose of the study, as well as the roles and benefits of participation, was thoroughly explained to the participants. All guardians or parents of the children read and voluntarily signed the informed consent form.

RESULTS

The demographic characteristics of cases and controls are presented in Table 1. Of the total number of children under 5 years identified with at least one episode of pneumonia, 4.3% of the patients with a contact number were unavailable, 15.7% either did not consent to participate or were busy, and 8.7% did not respond to multiple calls. Following the investigation, a total of 346 completely filled forms were validated for data entry and analysis: 164 cases and 182 controls. However, 8.38% of the controls interviewed reported a history of pneumonia, categorizing them as cases, which resulted in an imbalance in the number of cases and controls despite the matching. A majority of caretakers (56.1%) were in the age range of 21-30 years. Overcrowding in this study was defined as > 3 people sleeping together in one room. The majority of guardians or child's caretakers were the mothers of the children.

Binary logistic regression

A binary logistic regression analysis revealed associations between community-acquired pneumonia and the following factors: age of child, overcrowding, occupation of mother, smoking in the house, passive smoking, and contact with someone with cough symptoms, diagnosis of another disease, and house type. Table 2 presents the identified risk factors for community-acquired pneumonia.

Table 1. Demographic characteristics of cases and controls.

Characteristics	Type of participant		
	Control No. (%)	Case No. (%)	Total No. (%)

Multiple logistic regression analysis

A forward stepwise multinomial regression analysis was then conducted on the significant factors identified from the binary logistic regression associated with CAP. The analyses were limited by the inclusion of effect measures calculated with raw data, unadjusted for potential confounders such as socioeconomic status. However, this methodology has been utilized in previous studies and was not a major limitation to the analyses, given the consistency across many studies with and without adjustment for confounding. The factors found to be associated with CAP in the final regression model were overcrowding (defined in this study as >3 persons living in one room with the child), child exposure to passive smoking, age of child, occupation of mother, and contact with someone with cough. Table 3 presents the risk factors for CAP in children under 5 years in Fako Division.

DISCUSSION

Socio-demographic, environmental predictors of community acquired pneumonia

Fuel source and separation of kitchen from the main house (indoor air pollution from biomass fuels) had no association with developing pneumonia, this is contrary to findings of Habtamu et al. (2014) who reported that households using biomass fuel and kerosene, respectively had higher risks of acute respiratory tract infections OR 2.97 and OR 1.96 respectively (Barry et al., 2000) and a meta-analysis conducted by Dherani et al. (2008) who revealed that indoor air pollution from use of biomass fuels elevates risk of pneumonia in children by approximately 80%. Indoor air pollution from the use of biomass fuels probably had no association because we measured child's presence during cooking hours since measuring the cumulative effect of indoor pollution is difficult considering the use of gas and other sources such as charcoal in cooking which do not produce physical smoke. Children from mothers who had no formal education had a higher risk of developing pneumonia, however this was not statistically significant, and this is similar to a study conducted in Nigeria in children under 5 years indicating a negative association between maternal education and risk of developing respiratory tract infections (Habtamu et al., 2014). This is also in line with a pilot study in Indonesia, which found mother's education level had no direct effect on childhood pneumonia and respiratory illness (Barry et al., 2000). Contrary to these findings are those of Tanzinya et al. (2018) in which women with no education or primary education only had a higher chance of developing respiratory tract infections. Educated women are likely to have higher socio-economic status and reduced exposure to other risk such as living in environments exposed to smokers and overcrowded house etc hence reduced risks for their children, meanwhile uneducated mothers would be have less income and higher exposure to overcrowding, using stoves or wood as sources of fuel for cooking which might act as associated factors for the development of pneumonia.

Occupation of the mother showed significant associations with developing pneumonia, possibly influenced by a high percentage of women reporting selfemployment in roles such as store sales, hawking, and farming. Working in environments where cigarettes are sold and smoked could increase the risk of pneumonia due to environmental exposures and potential droplet infections from customers with cough symptoms. This finding is consistent with research by Divyarani et al. (2014) conducted at a tertiary care hospital in India, which indicated that socio-demographic variables such as paternal and maternal unemployment or unskilled occupations increased the risk of pneumonia in children. Cigarette smoking has been identified as a contributing and causal factor in respiratory tract infections. Both living with a smoker and passive smoking (exposure to cigarette smoke) were associated with developing pneumonia in children under 5 years of age (Shibata et al., 2014; Mannino et al., 2001). Passive cigarette smoking remained a highly significant risk factor even after adjusting for confounders (p-value 0.003), increasing the odds by 2.40 with a 95% CI of 1.3544.257 compared to children who were not exposed. This

finding is consistent with other studies (Tanzinya et al., 2018; Laura and Inessa, 2015; Ujunwa and Ezeonu, 2014; Arifeen et al., 2001), which have shown that the risk of passive smoking can increase by 2 to 4 times that of non-exposed children (Rahman and Rahman, 1997).

aOR= Adjusted Odds Ratio, 95% CI= 95% Confidence interval.

Children living with smoker parent(s) or in neighborhoods with many smokers may unconsciously face frequent exposure to cigarette smoke, exacerbating their risk.

Contact with someone experiencing cough symptoms or respiratory tract disease significantly increased the risk of a child developing pneumonia. This association has been observed in other studies in similar settings, such as those by Tazinya et al. (2018) in the Netherlands. This finding underscores the communicable nature of pneumonia, which can be transmitted via droplets from infected individuals. It highlights the importance of educating caregivers, particularly in infant welfare clinics and antenatal care settings, about the transmission of respiratory infections. Addressing misconceptions, such as linking cough in children to exposure to cold, is crucial for preventing pneumonia and other respiratory tract infections in children.

History of diagnosis with another disease was marginally associated with pneumonia diagnoses. The most commonly reported disease by participants was malaria, which is prevalent in Cameroon as a malariaendemic country. This finding contrasts with Muthumbi et al. (2017) case-control study on CAP among adults in Kenya, where malaria and presence of a BCG scar were identified as protective factors for pneumonia. Further research is needed to determine if there is a relationship between malaria and pneumonia, although this association was not statistically significant after adjusting for confounders in the final regression model.

Children primarily cared for by their siblings (sisters) were 3.81 times more likely to develop pneumonia compared to those mainly cared for by their mother. This could be attributed to siblings being younger and less experienced in caregiving, with higher likelihood of transmission through droplets. However, this association had no significant association with pneumonia after adjusting for confounders in the final model.

Overcrowding, defined in this study as having 3 or more people sharing a room with the child, was significantly associated with pneumonia. This finding is consistent with two case-control studies in South America among young children (Cerqueiro et al., 1990; Victora et al., 1994), and a reanalysis by Parker et al. (1999) which reported relative risks for severe respiratory tract infections associated with overcrowded living conditions. Crowding likely increases the risk of respiratory infections by facilitating cross-infection within the family (Maria et al., 2004).

Infectious agents can be easily transmitted through the air via droplets or aerosols in crowded and poorly ventilated rooms, where individuals may be sneezing, coughing, or speaking. Risk factors for communityacquired pneumonia may vary across regions due to differences in environmental exposures.

Conclusion

The factors associated with community-acquired pneumonia in Fako Division include age (<24 months), overcrowding, passive cigarette smoking, and contact with someone with cough symptoms. Health education about the dangers of smoking should be provided to pregnant women and during infant welfare clinic visits. Additionally, the contributions of overcrowded living conditions and child contact with individuals experiencing cough symptoms should be emphasized as risk factors for developing pneumonia in children.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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