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Evaluating the Management of Community Acquired Pneumonia in Children Under Five Years: A Study Done In Kakamega County Hospital among Healthcare Providers

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Abstract: Background: Childhood Community acquired pneumonia has remained the top killer disease of Children below the age of five years globally. This research evaluated the prevalence, risk aspects of CAP and adherence by the health care providers to the national guidelines in its management at the Kakamega county Referral Hospital. **Methodology**: A hospital based cross sectional study and quantitative approach of data collection was used. Kappa Statistic was used to determine level of agreement between clinicians and observer diagnosing severe pneumonia among 33 cases taken from the 287 who took part in the survey. Descriptive statistics, bivariate logistic and statistical analysis software (SAS) were applied in analysis of data obtained. An odds ratio at 95% confidence interval was calculated to establish the correlation inherent among the dependent and independent variables. A 'p' value not exceeding 0.05 was deemed statistically substantial at 95% confidence interval. **Results:** The outcome revealed that the prevalence of CAP was 72.8% (182/250) in vaccinated and 81.1% (30/37) in non–vaccinated children at Kakamega county Referral hospital. In bivariate analysis maternal level of education none/primary (p=0.02), rating of child's health as good in last three months (p=0.001), type of fuel used in cooking (p=0.04) were associated with CAP. Adherence to national standards in management of CAP by 33 health care participants was low (p=0.0001) and Kappa agreement on diagnosis of severe pneumonia by 2 raters was (57.6%) at the Kakamega county referral hospital. **Conclusion:** The Mean performance was significantly lower than the overall expected score indicating poor performance and adherence to national guidelines. The occurrence of CAP in children below five years was high. **Recommendations:** detected determinants be controlled and avoided by way of community mobilization on health advantages of maternal education, exclusive breast feeding for first six months, improvement of nutrition and improved cooking methods.
Keywords: Community Acquired Pneumonia **(**CAP), Under five, Healthcare provider, Adherence, Risk factors, Prevalence.

1. Introduction

Community Acquired Pneumonia is an infection manifesting in the respiratory system that develops in people with inadequate or lacking of access to healthcare facilities [22]. It is one of the most widespread infectious ailments. It has been known to cause worldwide mortality and morbidity [22]. The microbial etiology of community-acquired pneumonia (CAP) is often uncertain in clinical practice, and earlier researches have resulted in varied findings [1]. Atypical bacterial pathogens are moderately the usual cause of lower respiratory diseases, which include bronchitis, cough, and CAP

[16]. It is caused majorly by viral pathogens [9]. Every year, between 120 and 156 million incidences of acute lower respiratory infections take place in the whole world. 1.4 million of these cases result in death [24]. About 15 countries hold the majority of pneumonia incidents in children below 5 years of age. The South Asia and Sub-Saharan Africa endures the main problem of the disease. The burden they endure is above half of the total cases worldwide [27].

The revised WHO pneumonia classification [29] deems the previous "non-severe" and "severe" pneumonia classes in a single unit now described as "pneumonia" for which outpatient care is now endorsed. Adoption of this new classification has been reluctantly applied, especially in SSA, where policymakers have questioned that children affected by pneumonia manifesting with lower chest wall in drawing characterize a population with a high probability of death [21]. However, the Kenya Basic Paediatric Protocols of 2016 adopted this WHO guidelines. The World Health Organization revised recommendation for control of pneumonia in health organizations [29]. This revision was as a result of the increased burden in less developed countries leading to child mortality. The test result indicates that the mean score of health workers assessing the sick children is significantly different from the total score of 20 ($t = - 9.6$, $p < 0.0001$). Mean performance was significantly lower than the overall expected score indicating poor performance and adherence to national guidelines.

A number of studies that related to pneumonia were done prior to the initiation of the pneumococcal conjugate vaccine in 2011 in Kenya. This research aimed at evaluating the management of Community Acquired Pneumonia in children under five years of age among health care providers at Kakamega county Referral Hospital.

CAP has been linked to many child-related and environmental risk factors which impact the heightening and seriousness of the disease [28]. In the Middle East, the prevalence data was nonexistent. The highest occurrence of CAP was 66.3% in children between 29 days and 12 months in Iran [6]. In Africa, there was no overall data for prevalence of community acquired pneumonia. In Uganda, a research was done on the prevalence of severity of community acquired pneumonia. From the research, it was concluded that severe pneumonia was more prevalent than very severe pneumonia. The prevalence for severe pneumonia was at 83% while that of very severe pneumonia was at 16% [8].

It is observed that pneumonia is more severe in less developed countries and this results in more mortality rates [2]. For Kenya, morbidity as a result of community acquired pneumonia has been approximated to be at 16% and 13 % of community acquired pneumonia is so severe that it requires hospitalization [19]. It is suggested that more efforts should be geared towards eradicating the risk factors for community acquired pneumonia [7].

2.0 Materials and Methods

A descriptive cross-sectional study, applying quantitative approach for analysis.

2.1 Study area

This research was performed in the child welfare clinic, sick child clinic, outpatient department and the Paediatric ward of Kakamega County referral Hospital in Kakamega County.

2.2 Study population

The target population was clinicians attending to children below the age of five years and children below the age of five years diagnosed with community acquired pneumonia at Kakamega County Referral Hospital.

2.3 Sampling procedure

Simple random sampling method was applied in obtaining the study respondents selected from those that visited the clinic and were diagnosed with pneumonia.

2.4 Health care providers

A checklist was applied in the evaluation of adherence to Kenya guidelines by health care providers in management of pneumonia .The data was retrieved from the clinical records of every child diagnosed with pneumonia.

2.5 Sample size determination and sampling technique

The fishers sample size methodology was applied in obtaining the sample size. A prevalence of 50% was used and a population of 10000. N is the sample size for infinite population of less than 10000. Z is the z-value of normal curve; 1.96 for 95% level of confidence. P is prevalence 50% e is the precision 1.962 x 0.5 x $0.5/(0.05)^2$ n=384 . Adjustment of the study was done for finite population as follows, Fishers' et al. (1998)

$n= n_0/1+ (n_o-1)/N$

Where n is the sample size, N is the population size; 154 n_o is calculated sample size for infinite population; 384 =277 Ten percent was added to cater for the margin error, Hence the sample size was 287 participants.

2.6 Research Tool

A structured questionnaire was applied in the gathering of data according to the research objectives.

2.7 Validity of the tool

The survey tool applied in the collection of data reflected the dependent and independent variables the study sought to measure. Any other recommendations were merged in the research tool after consultation and approval by the supervisor.

2.8 Reliability of the tool

To check for reliability, a pretest was performed at the Moi Teaching and Referral hospital in Uasin Gishu County before deploying the tool for live data collection. A checklist was applied in the evaluation of adherence of clinicians to the Kenya clinical guidelines for the management of CAP among children who are below the age of five years. An ethical clearance was obtained from the Ethics Committee of the University. Approval was also sought from the ministry of National Commission for Science, Technology and Innovation, Institutional and Ethics Review Committee of Masinde Muliro University of Science and Technology, County Director of Medical services Kakamega, County administration and the Medical Superintendent Kakamega county Referral Hospital. The data collection was carried out between January 2019 and April 2019.

3.0 Findings and Discussions

3.1 Socio demographic characteristics of the child and caregiver

The Table below shows socio–demographic traits of children attending paediatric clinic for community acquired pneumonia in Kakamega County Referral Hospital. An overall of 287 cases were reviewed. The prevalence of CAP in vaccinated and non–vaccinated children below five years was found to be 72.8% (182/250) and 81.1% (30/37), respectively. Variances observed amongst the two groups was not statistically significant (χ^2=1.1; df=1; p = 0.3). Further analysis showed no statistically significant modification in prevalence of CAP by gender (p = 0.5) although males presented with a higher prevalence (88.2%) than females (85.6%). Prevalence was highest in children aged 12.0-23.0 months (90.7%) and lowest in children aged 24.0-59.0 months (82.4%). Again, the variance not being statistically significant (p=0.3). Whereas the non-CAP group was older (20.4 years) than the CAP group (16.2 years) the variance was not statistically significant (p = 0.4). The mean age difference in children with CAP and non-CAP was not statistically significant (p=0.1) with an average of 20.4 years (SD 17.1). Similarly, no significant variances were observed between CAP and non-CAP group in the following variables: means of transport (p = 0.4), distance to health facility (p = 0.4), birth weight (p = 0.4) and malnutrition status (p = 0.5) suggesting that the two groups were similar for the variables examined.

Table 1. Socio-demographic characteristics of the children attending paediatric clinic for community acquired pneumonia

Variable	Response	CAP	Non-CAP	p value
Children				
Gender	Male	149 (88.2)	20 (11.8)	0.5
	Female	101 (85.6)	17 (14.4)	
Age group in months	1.0 – 11.0	131 (88.5)	17 (11.5)	0.3
	12.0 – 23.0	49 (90.7)	5 (9.3)	
	≥24	70 (82.4)	15 (17.6)	
Mean age in months (mean ± SD)		16.2±14.6 (3.5–59.0)	20.4±17.1 (3.5–59.0)	t-test (t = -1.6; df=285; p = 0.1
Means of transport	Motor bike	64 (25.6)	7 (18.9)	0.4
	Other means	186 (74.4)	30 (81.1)	
Distance to health facility in km	≤5	161 (64.4)	21 (56.8)	0.4
	>5	89 (35.6)	16 (43.2)	
Birth weight	Normal	211 (86.5)	33 (13.5)	0.4
	Abnormal	39 (90.7)	4 (9.3)	
Malnutrition status	-2SD to –SD	21 (84.0)	4 (16.0)	0.5*
	>-1SD	229 (87.4)	33 (12.6)	
Completed PCV10 vaccination	Yes	182 (85.9)	30 (14.1)	0.3
	No	68 (90.7)	7 (9.3)	
***Fisher's Exact Test**				

3.2 Adherence to national guidelines in management of CAP

Adherence to national guideline on administration of CAP was assessed by scoring each task that was supposed to have been undertaken in history taking, examination, classification of pneumonia and treatment and administration of drugs. Mean score was 17.7 with SD of 1.3 and ranged between 14 to 20. One-sample t test was done to find out if the mean score was significantly different from the total score of 20. The null hypothesis specified indicated that mean score of the performance variable should be compared to expected total score of 20. The alpha option of 0.05 was used for 95%CI. Results for the 33 cases used in the validation of performance, the mean and its confidence bounds (upper and lower CL means), the standard deviation are displayed in Table 3. The test result indicates that the mean score of health workers assessing the sick children is significantly different from the total score of 20 ($t = -9.6$, $p < 0.0001$). Mean performance was significantly lower than the overall expected score indicating poor performance and adherence to national guidelines.

Table 2. One-sample t test on adherence to national guidelines in management of CAP

Score on adherence to guidelines	N	Mean	SD	95% CI	df	t–test	p value
	33	17.7	1.3	17.2–18.2	32	- 9.6	< 0.0001

3.3 Kappa agreement on diagnosis of severe pneumonia

Kappa Statistic was used to determine level of agreement between clinicians and observer diagnosing severe pneumonia among 33 cases taken from the 287 who took part in the CAP study. The assumption is that the two raters randomly diagnosed children with severe pneumonia. According to the results, positive diagnosis suggests that the two raters are not doing a good job (57.6%) of diagnosing the presence of severe pneumonia. The value of Kappa is 0.01 (95% CI: -0.33–0.35). Kappa normally varies in values from 0 to 1 with a value of 1 meaning perfect agreement. Kappa values that are high signify a greater strength of agreement. The implication of the results is that the two raters do not agree on the diagnosis. Since the CAP study outcome was based on clinician's own assessment of child's illness presentation, the poor Kappa scores may suggest clinicians adhere to the gold standard decision algorithm that should be used in assessing for severe

pneumonia in children. The same can be seen in the earlier results which age-specific respiratory rate never yielded any significant results in spite of the number of children having been diagnosed with CAP.

Table 3. Kappa level of agreement on diagnosis of severe pneumonia

Diagnosis		**Observer diagnosed severe pneumonia**		**Total**	**K**
		Positive	**Negative**		
		n (%)	**n (%)**		
Clinician diagnosed severe pneumonia	Positive	19 (57.6)	6 (18.2)	25 (75.7)	0.01
	Negative	6 (18.2)	2 (6.1)	8 (24.2)	
	Total	25 (75.7)	8 (24.2)	33	

3.4 Relationship between anaemia and community acquired pneumonia by age group

Bivariate analysis was performed to find out the correlation of anemia and community acquired pneumonia. Classification of anaemia was done based on the expected hemoglobin values by age of child in accordance with WHO guidelines and presented in Table 4. The hemoglobin value was extracted from child's records captured on the day of consultation. Generally, the results show no statistically significant variances amongst the three age groups and CAP. However, in spite of the non-significant results, in each of the three age groups, the proportion of children with anaemia and had CAP was increasing by age, being highest among children aged 2–5 months (84.3%) and lowest among the older children aged 24 months and above (75.8%). Based on the upper limit of the 95% CI of the odds ratio, children with anemia were up to four times likelier to have CAP than with their counterparts.

Table 4. Relationship between anemia and community acquired pneumonia by age group

Age group in months	**n**	**Anaemia**	**g/dl**	**Community acquired pneumonia**		**OR**	**95% CI**	**p value**
				Yes (%)	**No (%)**			
2–5	51	Yes	< 9.5	84.3	15.7	1.3	0.4–4.0	0.6
	36	No	≥ 9.5	80.6	19.4			
6–23	87	Yes	<10.5	83.9	16.1	1.4	0.5–4.1	0.6
	28	No	≥ 10.5	78.6	21.4			
24–59	66	Yes	< 11.5	75.8	24.2	1.4	0.5–4.4	0.6
	19	No	≥ 11.5	68.4	31.6			

3.5 Bivariate logistic analysis on risk factors for CAP among vaccinated and non-vaccinated children

Exhibit outcomes of the bivariate analysis on risk aspects for CAP among vaccinated and non-vaccinated children. The risk factors for CAP were evaluated according to socio demographic, maternal and paternal factors. The only statistically significant result was on mother's education and CAP. Children of mothers with limited or basic level education were 80% less likely to have had community acquired pneumonia unlike children whose mothers had greater level education (OR: 0.2; 95%CI: 0.03-0.81; p = 0.02). In spite of there being no other statistically significant differences in children with CAP and non-CAP and who had either completed or not completed PCV 10 immunization for the remaining variables that were tested, it is significant to show that the percentage of children aged less than 12 months diagnosed with CAP and who had completed vaccination against pneumonia was higher (82.9%) than those who were older (80%). Regarding nutritional standing of the children in the study, the proportion of those who were malnourished, had completed vaccination and had CAP was higher (83.1%) than those who were not malnourished but in the same category of having completed vaccination (79.1%). Results also show that mothers who

were employed and with children who had completed immunization (83.5%) against pneumonia were up to four times more likely to have had CAP compared with mothers who were employed and whose children had completed vaccination (78.6%). Results also indicate that a smaller proportion of children who had completed vaccination against pneumonia and whose mothers were farmers (72%) had CAP as opposed to the proportion of children whose mothers were not farmers (79.2%).

Table 5. Bivariate logistic analysis on risk factors for CAP among vaccinated and non-vaccinated children

Variables	Status of vaccination	n	CAP		OR	95% CI	p value
			Yes (%)	No (%)			
Age group in months							
< 12 months	Yes	88	82.9	17.1	1.2	0.5–2.8	0.6
	No	60	80.0	20.0			
Sex							
Male	Yes	125	77.6	22.4	0.4	0.2–1.2	0.1
	No	44	88.6	11.4			
Female	Yes	87	80.5	19.5	1.2	0.4–3.2	0.7
	No	31	77.4	22.6			
Nutritional status							
Not malnourished	Yes	191	79.1	20.9	0.8	0.4–1.6	0.5
	No	71	83.1	16.9			
Mother's education							
None/Primary	Yes	32	56.3	43.7	0.2	0.03–0.81	**0.02**
	No	18	88.9	11.1			
Secondary and above	Yes	180	82.8	17.2	1.0	0.5–2.2	0.9
	No	57	82.5	17.5			
Father's education							
Secondary and above	Yes	190	80.5	19.5	1.0	0.5–2.0	0.9
	No	63	80.9	19.1			
Parental Occupation							
Mother employed	Yes	79	83.5	16.5	1.4	0.5–4.1	0.6
	No	28	78.6	21.4			
Mother unemployed	Yes	133	75.9	24.1	0.5	0.2–1.2	0.1
	No	47	87.2	12.8			
Father businessman or farmer	Yes	178	79.8	20.2	0.7	0.3–1.6	0.4
	No	58	84.5	15.5			
Father unemployed	Yes	34	73.5	26.5	0.6	0.1–2.6	0.7
	No	17	82.3	17.7			
Source of income							
Employment	Yes	162	80.9	19.1	0.7	0.3–1.6	0.4
	No	51	86.3	13.7			
Farming	Yes	50	72.0	28.0	0.7	0.2–2.2	0.5
	No	24	79.2	20.8			

3.6 Bivariate logistic analysis on clinical risk for CAP among vaccinated and non-vaccinated children

Table 6 shows results on clinical risk for CAP among vaccinated and non-vaccinated children. Rating of child's health in the last 3 months was examined for children who had completed immunization and those who had not, the outcome being CAP or non-CAP. Children whose health

status were rated as good and having completed immunization were 90% hardly likely to have acquired CAP (OR: 0.1; 95% CI: 0.01–0.82; p = 0.01). Likewise, children who were rated as having fair or whose health status was perceived as 'not good' were up to three times more likely to have had CAP, even though the outcomes were not statistically significant (p = 0.5). The study also attempted to find out if someone was coughing in the house and its relationship with CAP for vaccinated and non-vaccinated children. Where someone was coughing, 70.4% of the children who were fully vaccinated had CAP compared with 57.1% who had not completed vaccination but in the same category of homes with someone coughing. On the contrary, a smaller proportion of children who had completed vaccination and coming from homes without anybody coughing had contracted CAP (80%) unlike those who had not completed vaccination (86.8%).

A relatively smaller proportion of children who had asthma (68.6%) and who were fully immunized had CAP in comparison to those who were not fully immunized (80%) and who had CAP, the results being not statistically significant. The association between age-specific respiratory rate, completed vaccination status and CAP did not yield any significant differences. Children who were diagnosed having serious pneumonia and fully vaccinated were upto three-fold more likely to have had CAP though the results were non-statistically significant (0.9). Notably, albeit not statistically significant, the proportion of children who had completed immunization and diagnosed with pneumonia/URTI was lower (74.4%) than children who were not diagnosed with the same illness (84.4%).

Table 6. Bivariate logistic analysis on clinical risk for CAP among vaccinated and non-vaccinated children

Variables	**Status of vaccination**	**N**	**CAP**		**OR**	**95% CI**	**p value**
			Yes (%)	**No (%)**			
Rating of child's health in last 3 months							
Good	Yes	53	58.5	41.5	0.1	0.01–0.82	**0.01**
	No	15	93.3	6.7			
Fair/Not good	Yes	159	85.5	14.5	1.3	0.6–2.9	0.5
	No	60	81.7	18.3			
Duration of illness							
Less than 4 days	Yes	29	46.2	58.8	0.6	0.1–2.3	0.5
	No	10	60.0	40.0			
Four days or more	Yes	173	86.1	13.8	0.9	0.4–2.1	0.7
	No	65	87.7	12.3			
Someone coughing in the house							
Yes	Yes	27	70.4	29.6	1.8	0.3–9.8	0.6
	No	7	57.1	42.9			
No	Yes	185	80.0	20.0	0.6	0.3–1.3	0.2
	No	68	86.8	13.2			
Child has asthma							
Yes	Yes	35	68.6	31.4	0.5	0.1–3.0	0.7
	No	10	80.0	20.0			
No	Yes	177	80.8	19.2	0.8	0.3 – 1.6	0.5
	No	65	84.6	15.4			
Age and respiratory rate of child in months							
2 – 11 and rate > 50/min	Yes	46	76.1	23.9	0.6	0.2–2.1	0.4
	No	30	83.3	16.7			
2 – 11 and rate ≤ 40/min	Yes	166	79.5	20.5	0.7	0.3–1.7	0.5
12 – 59 and rate	Yes	138	79.0	21.0	0.9	0.4–1.8	0.7

≤ 30/min	No	64	81.2	18.8			
Diagnosis							
Severe pneumonia	Yes	91	84.6	15.4	1.1	0.4–2.9	0.9
	No	43	83.7	16.3			
Pneumonia/URTI	Yes	121	74.4	25.6	0.5	0.2–1.5	0.2
	No	32	84.4	15.6			

3.7 Bivariate logistic analysis on child immunization risks of CAP among vaccinated and non-vaccinated children

Presents bivariate analysis on child immunization risks of CAP among vaccinated and non-vaccinated children. In spite of the results presented in this table being non-significant statistically, it is important to point some of the interesting findings. Whereas children who were wholly vaccinated against PCV 10 and were immunized against measles were 40% less likely to have had CAP, those who had not been immunized against measles and fully immunized against PCV 10 were 20% less likely to have had CAP. This may suggest that immunization against measles does not protect children against pneumonia. Regarding Vitamin A administration, a lesser number of children who had received Vitamin A and who were fully immunized (77.1%) had CAP unlike those who had not received the vitamin (85.7%) and who were fully vaccinated against pneumonia.

Table 7. Bivariate logistic analysis on child immunization risks of CAP among vaccinated and non-vaccinated children

Variable	Status of vaccination	N	CAP		OR	95% CI	p value
			Yes (%)	No (%)			
Received measles vaccine							
Yes	Yes	149	77.9	22.1	0.6	0.1–5.0	0.9
	No	7	85.7	14.3			
No	Yes	63	80.9	19.1	0.8	0.3–2.0	0.7
	No	68	83.8	16.2			
Received Vitamin A							
Yes	Yes	170	77.1	22.9	0.5	0.1–2.4	0.5
	No	15	86.7	13.3			
No	Yes	42	85.7	14.3	1.2	0.4–3.6	0.7
	No	60	83.3	16.7			

4.0 Summary, Conclusion and Recommendations

4.1 Summary

The results show that adherence with national guidelines was unsatisfactory in many aspects of the care given to outpatient and hospitalized children with CAP at Kakamega County Referral Hospital. Areas of poor compliance included general medical examination, taking of vital signs (respiratory rate), classification of CAP, initial treatment prescription and drug administration. Data on clinical training were retrieved from patients' medical records, and all children with a diagnosis of CAP were involved in the research. Criteria for making a diagnosis of CAP were met if the patient presented with a history of cough, fever, reduced levels of oxygen saturation and hypothermia. Although clinicians are aware of the WHO guideline classifications, there is a disconnect between disease severity classification and the clinical tasks recorded as well as the settings in which to manage the patients.

Out of the 33 participating health workers, One-Sample t-test results indicate that the mean score of health workers assessing the sick children is significantly different from the total score of 20 suggesting a significantly lower mean performance than the overall expected score indicating poor performance and adherence to national guidelines. This implies that either clinicians could not

correctly classify CAP. A similar study, done in a Kenyan hospital by [17] confirms the current findings and revealed lack of adherence to WHO guidelines. The prevalence of CAP in vaccinated and non - vaccinated children below five years at Kakamega County Referral Hospital was 72.8% and 81.1%, respectively. There is no study conducted in Kenya on CAP prevalence among under five year old children. Most recent report is on the national prevalence of pneumonia which is estimated at 15% for the same age category [13].

Similarly, there is no data for the total frequency of CAP in Africa. However, a CAP study conducted in Uganda reported frequency associated with age, malnutrition, CAP severity, and pathogen. The prevalence of CAP by severity indicated those children with higher prevalence rate (83%), had severe pneumonia compared to children with very severe pneumonia (16%) [25]. Our findings show that a male child is less prone to CAP (77.6%) than a female child (80.5%) for vaccinated children is most likely due to the immune factor in females or inflammatory responses, variances in lung structure or function [15]. Although the prevalence of CAP among children with anemia by age group was varied, results show that those with anaemia were up to 4-fold more likely to have had CAP notwithstanding non-significant results. The negative relationship linking the age of the child and anemia has been shown by [18] who reported a lower risk of anemia in older children.

In the present study, the identified risk factors for CAP were maternal education, rating of child's health and type of fuel used in the house. A significantly smaller proportion of children whose mothers had none or primary education and who were fully vaccinated were less likely to have had CAP. This discovery is contrary to other studies conducted in Ethiopia which showed that maternal education (p=0.01), number of under-five children in the household (p=0.01) and family size (p=0.01) were significantly associated with higher prevalence of CAP in a bivariate regression analysis though in adjusted OR model, education was not significant [4]. Findings in this study, show that a child who was introduced to feeds after 6 months (OR:0.3; 95% CI: 0.04–2.63; p = 0.4) and fully immunized was 70% less likely to have had CAP though the results were not statistically significant. Breast milk and immunization offer protection against CAP. Early age breast feeding has been shown to have an exceptional anti-infective property that gives passive defense against pathogens [4].

The current research examined the risk factors in previously healthy children. The findings show that 84% of the children who were malnourished had CAP compared to 87.4% who were normal (p = 0.5). Research conducted by [26] reported higher prevalence of CAP (75.7%) among malnourished children compared to 22.6% who were normal. The current study failed to assess the influence of chronic malnutrition on CAP which might have affected the results. A relatively smaller proportion of children who had asthma (68.6%) and who were fully immunized in comparison to those who were not fully immunized (80%) had CAP, albeit results being non-significant. The results further strengthen the role of vaccination of children against pneumonia. Diagnosis of CAP is more complex as children with the disease can present at various phases of disease and together with clinical aspects that are hard to distinguish from other mutual pediatric diagnoses. The application of WHO guidelines in low-income countries has revealed over diagnosis of pneumonia in situations of wheezing, with resulting under diagnosis of asthma, leading to substantial respiratory morbidity and, perhaps, even mortality [20]. The findings are comparable to studies done in Kenya, South Africa and Indian where 50% of children had asthma and met WHO's clinical definition of pneumonia [5].

Children whose parent smoked cigarette inside the house were up to five times at a higher danger of developing community acquired pneumonia, although the outcomes were not statistically significant. Passive smoking is another contributing factor to CAP for children below age of five years as pointed out by [11]. The effect of passive smoking on the general public including children is a major concern for the government of Kenya. Regardless of wide-ranging information concerning effectual tobacco control interventions, the frequency of the use of tobacco is still high in Kenya.

Public appreciation of levels of protection issued by laws and regulations on the use of tobacco and contact with tobacco smoke is limited. After endorsement of the Framework Convention on Tobacco Control, Kenya ratified the Tobacco Control Act, 2007, prohibiting public place smoking besides the designated smoking areas [12]. But in some cases, parents disregard such regulations when smoking in their own houses. Considering means of cooking, children from households using firewood and who were fully vaccinated were 70% less likely to have had CAP compared to non-immunized children. This was unexpected finding but could be attributed to the way the question was asked. The question did not specify whether firewood was being used in the same house where the child stays in or a separate kitchen away from the main house which most of the time is the case. Pollution occurring indoors as a result of biomass fuel for cooking had been studied extensively and is one of the environmental risk factors of CAP. Indoor air pollution predisposes the young children to community acquired pneumonia compared to children whose families use cleaner fuels [14].

The referral hospital where the current study was conducted, attracts children from both urban and rural setting. Results indicate that 43.6% of the households use firewood. Firewood and charcoal are seen as the major source of fuel for cooking in majority of the urban and rural areas in Kenya. Statistics obtained from the Ministry of Energy show that above 90% of rural households consume firewood for cooking and heating, while greater than 80% of urban households use charcoal [23]. The meaning of household crowding differs greatly [10]. In the current research, household crowding was described as five or more members who live together in a house with the child. The results indicate that children from households with fewer number of household members (≤ 5) were 40% less likely to have contracted CAP with non-significant results.

As a means of averting CAP, WHO endorses immunization programs that comprise of vaccines against measles, pertussis and influenza as well as Haemophilus influenza type B and pneumococcal conjugate vaccines [3]. It is important to point some of the interesting findings in this study. A smaller proportion of children who were fully vaccinated against PCV 10 and who were immunized against measles (77.9%) were diagnosed with CAP compared to their counterparts (85.7%).

4.2 Conclusion

This chapter offers the overall conclusion and recommendations to the health strategists and Kakamega County Referral Hospital that can be a long-term effort to improve, on adherence to national guidelines by health care workers in management of CAP and reducing the prevalence of CAP, risk factors associated with CAP if implemented. The prevalence of CAP in vaccinated was lower (72.8%) compared with reported prevalence among non–vaccinated children (81.1%) under five years at Kakamega County Referral Hospital. Independent risk factors for CAP were maternal education, rating of child's health and use of firewood as source of fuel in the home. Available evidence also shows that adherence to the national principles in the control of community acquired pneumonia in under-fives was poor.

4.3 Recommendations

Experience based practice may not be the same as evidence-based practice and it would be interesting to understand whether this trend is guided by their practice or there is knowledge gap. It is an area that needs emphasis during training of clinicians and nurses. Health workers should adhere to the WHO guidelines in the assessment and management of CAP while the community should be aware of the danger signs of CAP to avoid delay in access to qualified care. Although PCV 10 against pneumonia is available, there are children who are not fully immunized against the disease which predisposes them to CAP. Numerous avoidable risk aspects of CAP that include an absence of exclusive breast feeding for the first 6 months of life, anemia, malnutrition, and indoor air pollution need to be sufficiently spoken about. County health officers and the Kakamega county referral hospital should work in collaboration with various participants that include the community members in improving on maternal education, the size of the family, preferment of exclusive breastfeeding and immunization, and health seeking behavior of childhood illnesses. To add on that, increased efforts

need to be applied for the purpose of combating malnutrition, which is also connected to poverty in the family and therefore resulting to minimal avoidable mortalities among children, especially those caused by CAP.

- ✓ Kakamega county referral Hospital staffs need continues training on the guidelines for management of childhood CAP.
- ✓ In the dissemination of the guidelines through training areas to concentrate on include; -
- ✓ Teaching skills to recognize disease and classify disease severity
- ✓ Reinforce the guideline recommended treatment is adequate.
- ✓ Inculcate a culture of good documentation in patients' files.
- ✓ Create an enabling environment by introducing job aids such as flow charts and distributing pocket handbooks of the guidelines at every health care desk.
- ✓ As concerns CAP prevalence more studies are required.

Organized efforts for the purpose of mobilizing communities:

- ✓ On health advantages of well aired and proper housing conditions, to have separated rooms for different uses e.g. kitchens, and those kitchens that have chimneys, windows and hoods.
- ✓ Infants at the age group of 2-12 months are to be given vital care and intervention (exclusive breast feed and vaccination)
- ✓ Generate understanding on the initiation and termination of breast feeding, and the vital role it plays in the lessening of childhood illness like pneumonia
- ✓ Educate the mothers / fathers and the community at large on early recognition of the signs and symptoms of CAP.

After endorsement of the Framework Convention on Tobacco Control, Kenya passed into law the Tobacco Control Act, 2007, which banned smoking in public places except in selected smoking areas [12] (Karimi et al., 2016) Kakamega County Director of Health to work with concerned officers from NEMA to curb tobacco smoking in the county to prevent CAP in under-fives.

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