



# ANALYSIS OF CLINICAL CASES OF RESPIRATORY TRACT INFECTIONS AT IKPE ANNANG GENERAL HOSPITAL: EFFECT OF TIME-RELATED VARIABLES

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## ABSTRACT

This work was particularly focused on the impact of time-related variables on the incidence of respiratory tract infections at Ikpe Annang General Hospital, Akwa Ibom State using monthly clinical cases of respiratory tract infections spanning from 2013 to 2022. The data were categorized into quarters/seasons of the year and presented on bar charts to assess the magnitude of respiratory tract infections. High prevalent of respiratory tract infections in the first quarter of the year was revealed. Moreover, common cold and bronchitis were the most frequently diagnosed respiratory infections. There were incidences of upper respiratory tract infections (URTIs) and lower respiratory tract infections (LRTIs) in both dry and wet seasons, but LRTIs were very rampant during the wet season. Chi-square tests of independence and correlation matrices were used to determine the interaction between the time-related variables and incidence of respiratory tract infections. The results revealed that respiratory tract infections are associated with the quarters/seasons of the year and that epiglottitis is linked to pharyngitis, while bronchitis is related to tuberculosis.

**KEYWORDS:** Common cold, charts, correlation matrices, respiratory infections, seasons and time-related variables.

## INTRODUCTION

Morbidity and Mortality among adults and children caused by acute or chronic respiratory infections have serious economic burden on the healthcare systems. Common colds are the most frequently occurring type of respiratory infections among patients, making the patients to visit doctors regularly at the expense of their official duties (Gwaltney, 1993). The second most common cause of upper respiratory tract infections (URTIs) is Coronavirus (Eikkinen and Jarvinen, 2003). Respiratory infections whether community-acquired or hospital-acquired are caused by pathogens (Niederman and Torres, 2022). According to Shi *et al.* (2022), the virus responsible for most acute lower respiratory tract infections in young children worldwide is respiratory syncytial virus (RSV). Moreover, influenza virus, RSV, parainfluenza virus, and metapneumovirus are the most common viruses associated with acute lower respiratory infections (ALRIs) among young children less than five years and elderly ones  $\geq 65$  years (Li *et al.*, 2019).

Rodgers *et al.* (2021) examined possible change in the occurrence of respiratory infections during the COVID-19 pandemic and remarkable reductions in the respiratory emergency department was discovered. Moriyama *et al.* (2020) investigated the seasonality of respiratory viral infections. The result revealed that indoor and outdoor climates are linked to the seasonality of viral respiratory infections. Lepak *et al.* (2021) examined the pattern of change in seasonal respiratory virus as a result of antibiotic prescription for COVID-19 pandemic. The result revealed seasonal variation of respiratory virus during pre-pandemic period.

Many researchers have established the relationship between respiratory infections and climatic conditions. Nichols *et al.* (2021) examined the seasonality of respiratory infections in England and Wales and the associations between weather parameters and cases of seasonal coronavirus. It was discovered that weather conditions affect the existence of coronaviruses especially the seasonal coronaviruses commonly found in winter.

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Neumaann and Kawaoka (2022) examined the seasonality of influenza and other respiratory viruses. The result revealed that influenza viruses spread throughout the year, although the outbreak of the virus tend to rise during the rainy season. In temperate regions, upper respiratory tract infections (URTIs) are often very common in autumn and spring, and persist throughout winter (Eikkinen and Jarvinen, 2003). The transmission of respiratory infections which are more common in the fall and winter is due to indoor crowding and commencement of school activities (Gwaltney, 1993). The aim of this paper is to investigate the interaction between clinical cases of respiratory tract infections and quarters of the year which has not been captured by other researchers. This paper is further organized as follows: Section 2 covers methodology. Results of analysis are captured in Section 3, section 4 takes care of discussion, while Section 5 concludes the study.

## METHODOLOGY

### DATA

Monthly incidence of respiratory tract infections spanning from 2013 to 2022 were sourced from the

General Hospital, Ikpe Annang, Akwa Ibom State and a total number of nineteen thousand, three hundred and fiftyseven (19,357) patients diagnosed with respiratory tract infections within the period were used for empirical illustrations.

## CHI-SQUARE TEST OF INDEPENDENCE

Chi-Square Test of Independence is used to measure the independence of two classifications. For an  $r \times c$  contingency table, it is used specifically to determine the interaction between two variables (Fagerland *et al.*, 2017).

## CONTINGENCY TABLE

According to Lindgren (1978), contingency table is a table in matrix format that displays the observed counts of categorical variables used to measure the relationship between two or more categorical variables. Suppose  $n$  observations are classified according to two variables  $R$  and  $S$  with categories  $R_i$  ( $i = 1, 2, \dots, r$ ) and categories  $S_j$  ( $j = 1, 2, \dots, c$ ), the table is a  $r \times c$  contingency table. A typical  $rc$  contingency table with  $n_{ij}$ , where  $n_{ij}$  are observed frequencies are given below.

**Table 1:**  $r \times c$  Contingency table

Rows	Columns			
	$S_1$	$S_2$	$\dots$	$S_c$
$R_1$	$n_{11}$	$n_{12}$	$\dots$	$n_{1c}$
$R_2$	$n_{21}$	$n_{22}$	$\dots$	$n_{2c}$
$\vdots$	$\vdots$	$\vdots$	$\dots$	$\vdots$
$R_r$	$n_{r1}$	$n_{r2}$	$\dots$	$n_{rc}$

The marginal frequencies are given by

$$n_{i.} = \sum_{j=1}^c n_{ij}, \quad n_{.j} = \sum_{i=1}^r n_{ij}, \quad n_{..} = n = \sum_{i=1}^r \sum_{j=1}^c n_{ij} \quad (1)$$

$p_{i.} = \frac{n_{i.}}{n}$ ,  $i = 1, 2, \dots, r$  are proportions of the different row members,

$p_{.j} = \frac{n_{.j}}{n}$ ,  $j = 1, 2, \dots, c$  are the proportions of the different column members.

$p_{ij}$  is the probability of  $ij$ th cell.

The null hypothesis is

$$H_0: p_{i.}p_{.j}; \quad \sum p_{i.} = 1, \sum p_{.j} = 1 \quad (2)$$

There is interaction between the two criteria of classification, once the null hypothesis is untrue.

Hence, the expected frequency in the  $i$ th row and  $j$ th column is given by

$$E_{ij} = np_{i.}p_{.j} = n \frac{n_{i.}}{n} \frac{n_{.j}}{n} = \frac{n_{i.}n_{.j}}{n}$$

The test statistic is

$$\chi_{cal}^2 = \sum_{i=1}^r \sum_{j=1}^c \frac{(n_{ij} - \frac{n_{i.}n_{.j}}{n})^2}{\frac{n_{i.}n_{.j}}{n}} \quad (3)$$

With  $(r - 1)(c - 1)$  degrees of freedom.

RESULTS

PRELIMINARY ANALYSES

Based on Tables 2 and 3, the elements of the correlation matrices, 0.3276 and 0.3149, reveal weak

association between epighellitis and phargngitis, and between bronchitis and tuberculosis, respectively.

Table 2: Correlation matrix for upper respiratory tract infections

Common cold	Sinusitis	Pharyngitis	Epiglottitis	
1	0.0215	-0.1174	-0.0389	Common cold
	1	-0.0553	-0.0776	Sinusitis
		1	0.3276	Pharyngitis
			1	Epiglottitis

Table 3: Correlation matrix for lower respiratory tract infections

Bronchitis	Pneumonia	Bronchitis	Tuberculosis	
1	-0.0193	0.1345	0.3149	Bronchitis
	1	0.2928	-0.0476	Pneumonia
		1	0.0581	Bronchitis
			1	Tuberculosis

Based on Figure 1, both lower respiratory tract infections (LRTIs) and upper respiratory tract infections (URTIs) are experienced throughout the year, but LRTIs are more common than URTIs and

very rampant in the first quarter of the year. Figure 2 reveals that respiratory tract infections are more prevalent among people in the first quarter of the year than other quarters of the year.

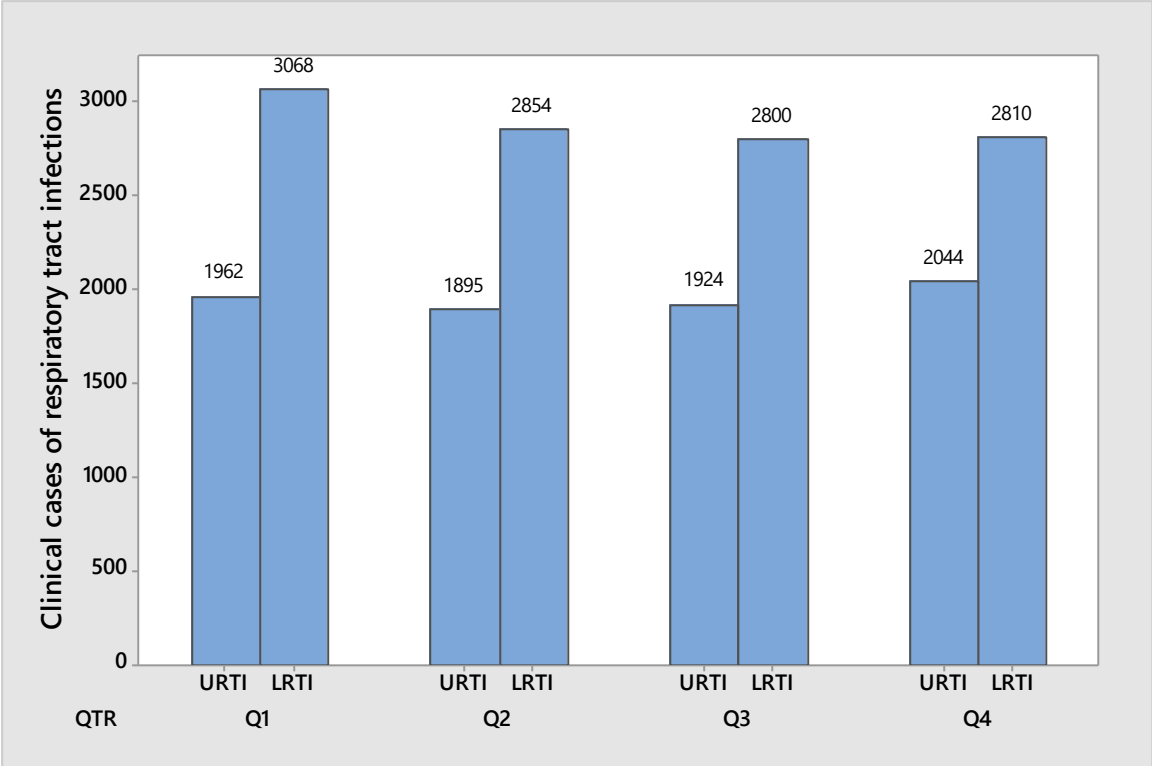


Figure 1: Multiple bar chart showing quarterly incidence of URTIs and LRTIs

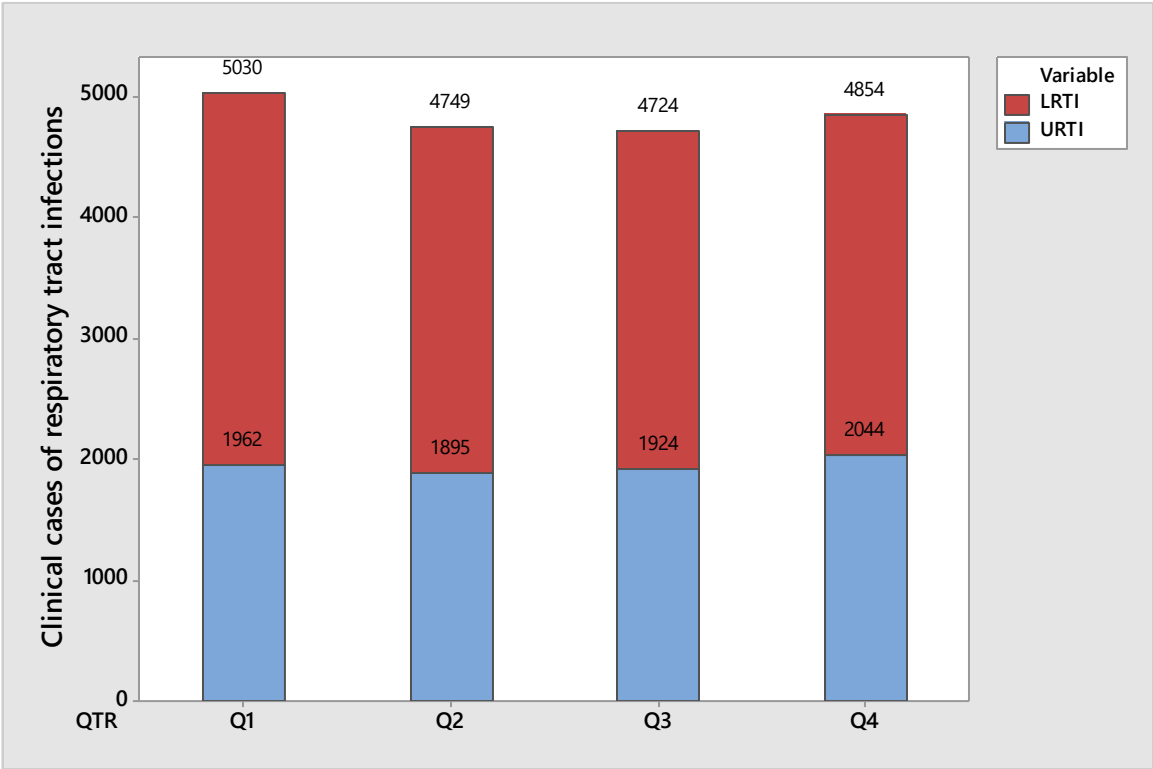


Figure 2: Component bar chart showing quarterly incidence of URTI and LRTI

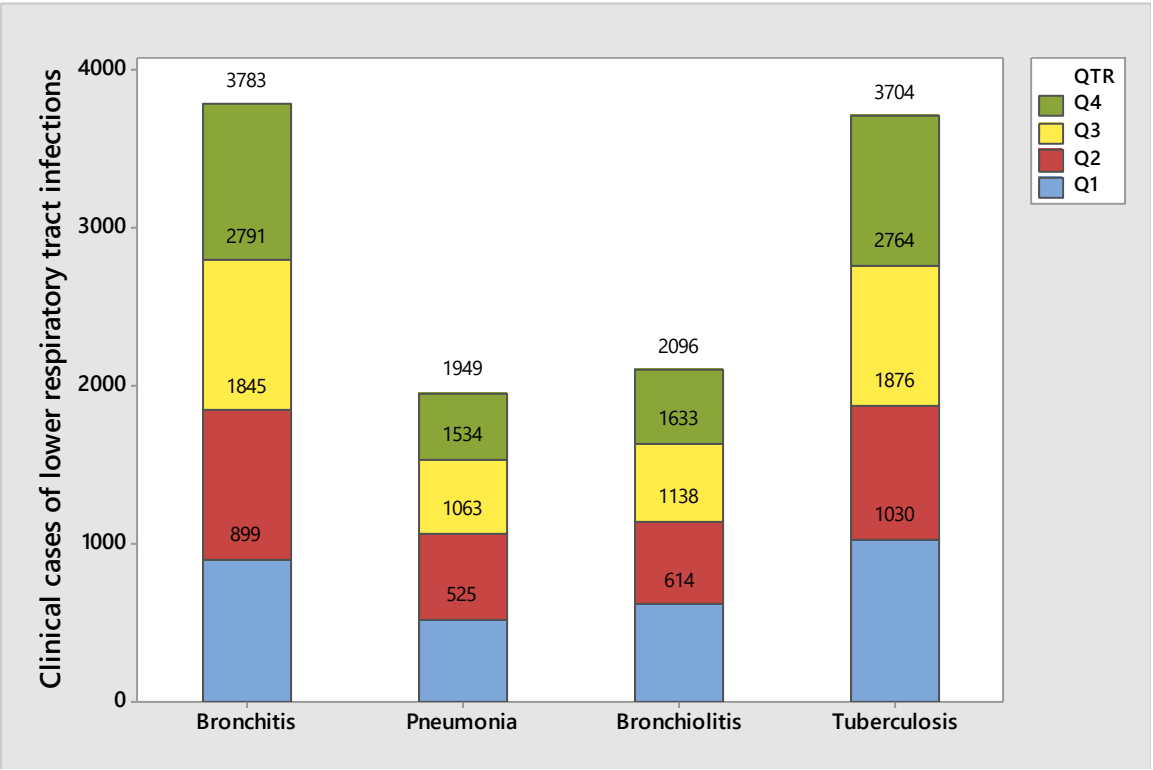
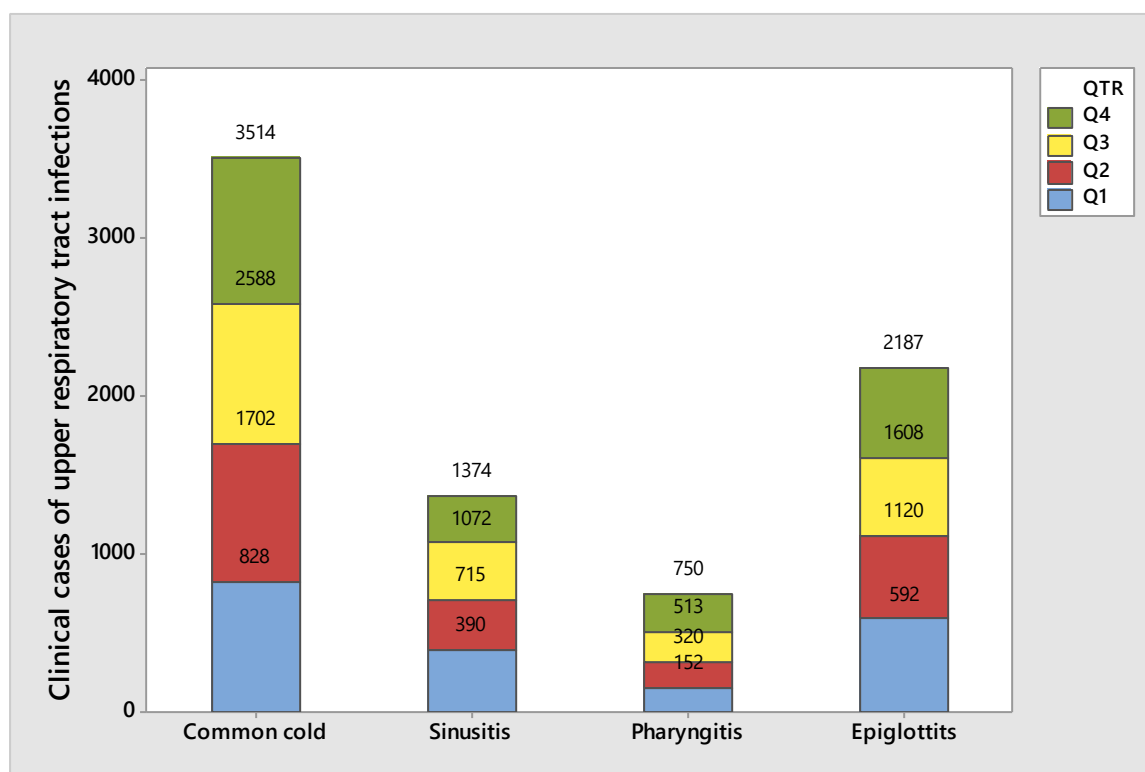


Figure 3: Component bar chart showing quarterly incidence of LRTIs

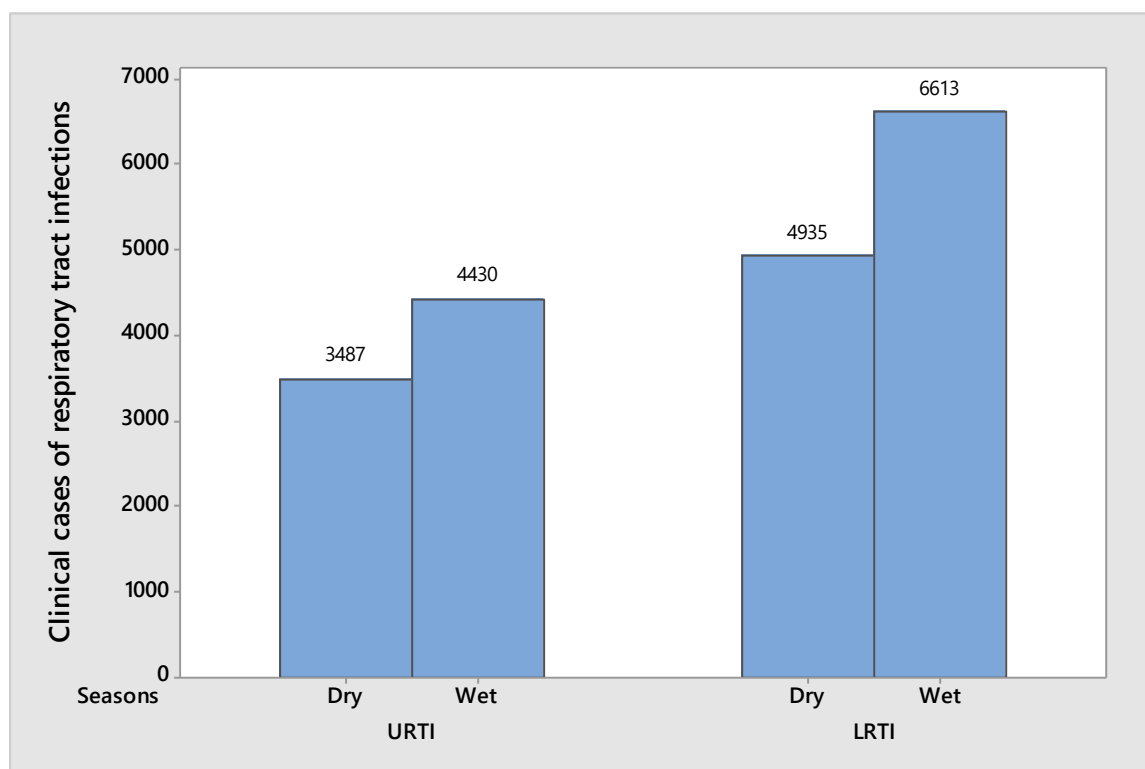
Based on Figures 3 and 4, Bronchitis is the most frequently diagnosed LRTI, while common cold is the

most prevalent URTI and both are very rampant in the fourth quarter of the year.



**Figure 4:** Component bar chart showing quarterly incidence of URTIs.

Although, lower respiratory tract infections are experienced in both dry and wet seasons, they are very rampant in the rainy season (Figure 5).



**Figure 5:** Multiple bar chart showing incidence of URTIs and LRTIs in both dry and wet seasons

**CHI-SQUARE TEST OF ASSOCIATION**

In accordance with Table 4, the occurrence of respiratory infections depends on the quarters of the year since  $\chi^2_{\text{cal}} = 11.44 > 7.81473$ , while Table 5 also indicates interaction between URTI and the quarters of the year since  $\chi^2_{\text{cal}} = 52.75 > 16.919$ . Similarly, Table 6 reveals that LRTI depends on the quarters of the year since  $\chi^2_{\text{cal}} = 51.97 > 16.919$ .

**Table 4:** Quarterly expected and observed frequencies of respiratory tract infections

Quarter	Types of Respiratory Tract Infection		$\chi^2_{\text{cal}}$
	URI	LRI	
Q1	1962 (2033.36)	3068 (2996.64)	11.44
Q2	1895 (1919.77)	2854 (2829.23)	
Q3	1924 (1909.66)	2800 (2814.34)	
Q4	2044 (1962.21)	2810 (2891.79)	
<b>Critical Value (CV) at 5% level of sig.</b>			7.81473

The values in the parentheses are the expected frequencies.

**Table 5:** Quarterly observed frequencies of upper respiratory tract infections

Quarter	Upper Respiratory Tract Infections				$\chi^2_{\text{cal}}$
	Common cold	Sinusitis	Pharyngitis	Epiglottitis	
Q1	828 (881.02)	390 (344.51)	152 (188.05)	592 (548.99)	52.75
Q2	874 (850.99)	325 (332.75)	168 (181.63)	528 (529.63)	
Q3	886 (839.68)	357 (337.84)	193 (184.41)	488 (537.74)	
Q4	926 (917.91)	302 (358.91)	237 (195.91)	579 (571.28)	
<b>CV at 5% level of sig.</b>					16.919

The values in the parentheses are the expected frequencies.

**Table 6:** Quarterly expected and observed frequencies of lower respiratory tract infections

Quarter	Lower Respiratory Tract Infections				$\chi^2_{\text{cal}}$
	Bronchitis	Pneumonia	Bronchiolitis	Tuberculosis	
Q1	899 (1006.44)	525 (518.52)	614 (557.62)	1030 (985.42)	51.97
Q2	946 (936.24)	538 (482.35)	524 (518.73)	846 (916.69)	
Q3	946 (918.52)	471 (473.22)	495 (508.914)	888 (899.34)	
Q4	992 (921.80)	415 (474.91)	463 (510.73)	940 (902.55)	
<b>CV at 5% level of sig.</b>					16.919

The values in the parentheses are the expected frequencies.

Based on Tables 7, 8 and 9, season was one of the factors responsible for the clinical cases of both upper respiratory tract infections and lower respiratory tract infections.

**Table 7:** Expected and observed frequencies of respiratory tract infections based on seasons

Season	Types of Respiratory Tract Infections		CV at 5% level of sig.	$\chi^2_{cal}$
	UR1	LR1		
Dry	3487 (3425.48)	4935 (4996.52)	3.84146	
Wet	4430 (4491.52)	6613 (6551.48)		3.98

The values in the parentheses are the expected frequencies.

**Table 8:** Expected and observed frequencies of upper respiratory tract infections based on Season

Season	Upper Respiratory Tract Infections				CV at 5% level of sig.	$\chi^2_{cal}$
	Common cold	Sinusitis	Pharyngitis	Epiglottitis		
Dry	1491 (1530.55)	694 (664.19)	313 (329.01)	989 (963.25)	7.81473	6.82
Wet	1984 (1944.45)	814 (843.81)	434 (417.99)	1198 (1223.75)		

The values in the parentheses are the expected frequencies.

**Table 9:** Expected and observed frequencies of lower respiratory tract infections based on season

Season	Lower Respiratory Tract Infections				CV at 5% level of sig.	$\chi^2_{cal}$
	Bronchitis	Pneumonia	Bronchiolitis	Tuberculosis		
Dry	1551 (1620.50)	801 (834.18)	945 (897.85)	1638 (1582.46)	7.81473	15.2
Wet	2241 (2171.50)	1151 (1117.82)	1156 (1203.14)	2065 (2120.54)		

The values in the parentheses are the expected frequencies.

## DISCUSSION

Presentation and analyses of Monthly incidence of respiratory tract infections at Ikpe Annang General Hospital from 2013 to 2022 using bar charts, correlation matrices, and chi-square test of independence were carried out. Correlation matrices reveal weak association between epiglottitis and pharyngitis, and bronchitis and tuberculosis for URTI and LRTI, respectively. Multiple and component bar charts indicate frequent occurrence of respiratory infections in the first quarters of the year with lower respiratory tract infections at the peak. Also, the most frequent URTIs and LRTIs are common cold and Bronchitis, respectively which support the finding of Gwaltney (1993). Lower respiratory tract infections affect people in both wet and dry seasons, but very common during the wet season. Chi-Square tests of independence revealed that occurrence of respiratory tract infections depends on the quarters of the year. Also, It was discovered that season was one of the factors responsible for the incidence of both upper respiratory tract infections and lower respiratory tract infections which is not far from the work of Eikkinen and Jarvinen (2003), Nichols et al. (2021) and Gwaltney (1993) that revealed the effect of seasonality on the respiratory tract infections (URTIs).

## CONCLUSION

Epiglottitis is the upper respiratory tract infection weakly correlated with pharyngitis, while bronchitis is the lower respiratory tract infection weakly correlated with tuberculosis. LRTIs are common during rainy seasons. Both URTIs and LRTIs are experienced throughout the year, but LRTIs are more common than URTIs and very rampant in the first quarter of the year. Bronchitis is the most frequently diagnosed URTI among people, while common cold is the most prevalent LRTI and both are very rampant in the fourth quarter of the year. Seasons/quarters of the year influence respiratory tract infections.

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