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ISSN (Online): 2455-7838
SJIF Impact Factor (2017): 5.705

EPRA International Journal of

Research & Development

(IJRD)

Monthly Peer Reviewed & Indexed International Online Journal

Volume: 3, Issue:3, March 2018

Published By :
EPRA Journals

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SJIF Impact Factor: 5.705 Volume: 3 | Issue: 3 | March| 2018 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)

SEASONAL VARIATION AND DRIFT OUTLOOK OF SEXUALLY TRANSMITTED DISEASES IN BENIN CITY, NIGERIA

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ABSTRACT

This paper presented an analytical concept in terms of seasonality study that is simple and highly relevant to disease surveillance and control. Sexually transmitted diseases (STDs) such as Human immunodeficiency Virus (HIV), Gonorrhoea (GOH) and Hepatitis (HEP) were considered and the data sets cover the period of 2012M1 to 2016M12. The analytical framework for the seasonality study was exemplified and Chi-Square test was used to test the null hypothesis that there is no seasonal variation in the STDs and linear trend model was adopted to check the drift outlook. The results reveal that seasonal variation is significant only for HIV cases and the monthly distribution pattern is the same for both male and female patients. The peaks of prevalence for HIV cases is in the second quarter, HEP and GOH showed highest peaks in the first quarter. The result also indicates a positive drift outlook with the increasing rates of 15.3%, 0.11% and 0.03% for HIV, HEP and GOH respectively. It becomes imperative for the government and stake holders in the health sector to use the results for surveillance and control in order to achieve the sustainable development goal three (SDG3).

KEYWORDS: *Seasonal variation framework, Chi-squares, Least squares, STDs*

1. INTRODUCTION

The increasing rate of sexually transmitted diseases has become a serious health, social and economic challenge in Nigeria. Documented evidence indicates that STDs can be transmitted from a pregnant mother to the baby before; during or after the baby's birth and that some STDs (like syphilis) can cross the placenta and infect the baby in-utero (WHO, 2005). Other STDs (like Gonorrhoea, chlamydia, hepatitis B viruses and Genital herpes) can be transmitted to the baby during delivery through the birth canal (Okonko et al., 2012 and CDC, 2002).

According to Adler (1990), most countries do not have adequate control programs for STDs or training programs for physicians and nurses designated to look after patients. The diseases are associated with considerable morbidity and recently, with the advent of the acquired immunodeficiency syndrome, with considerable mortality. Sexually transmitted diseases constitute great medical, social and economic problems in Nigeria. Apart from the heavy affliction of urban dwellers, there is rapid excursion of these diseases to the rural areas as well. This situation is serious enough to attract government attention so that necessary control measures may be initiated in good time in order to avert the serious consequences (Ogunbanjo, 1989).

This study focused on the seasonality of sexually transmitted diseases (STDs) such as Human immunodeficiency Virus (HIV), Gonorrhoea (GOH) and Hepatitis (HEP) in Benin City, South-Southern Nigeria. Previous studies on the subject matter were centred on risk factor of STDs (De Schryver and Meheus 1990, Mehta et al. 2009, Ogbulie et al, 2003). In Nigeria, there is little or no empirical research on the seasonality of STDs. Anyanwu *et.al*(2008) studied prevalence of sexually transmitted diseases in Owerri, Nigeria. They confirmed that STD at the General Hospital Owerri nearly doubled from 77 in 1990 to 144 in 1993. For the Avigram Medical Laboratories the figures almost tripled 134 and 367 for 1990 and 1993 respectively. Data analysis of the cases confirmed at the Owerri General Hospital and Avigram Medical Laboratories gave no significant difference between the two institutions at the 95% level of confidence using conventional methods. One hundred and fourteen (49.4%) of the subjects harboured various agents including *Candida* spp. (37.8%), *Trichomonas vaginalis* (4.7%), *Gardnerella vaginalis* (3.9%), syphilis (1.7%) and *Neisseria Gonorrhoea* (1.3%). Risk factors associated with

significant infection were young age and level of education. Aboyeji and Nwabuisi (2009) examined the prevalence of sexually transmitted diseases among pregnant women in Ilorin, Nigeria using conventional methods. They observed that one hundred and fourteen (49.4%) of the subjects harboured various agents including *Candida* spp. (37.8%), *Trichomonas vaginalis* (4.7%), *Gardnerella vaginalis* (3.9%), syphilis (1.7%) and *Neisseria Gonorrhoea* (1.3%). Risk factors associated with significant infection were young age and level of education. Aladeniyi *et.al* (2017)carry out a statistical analysis of reported cases of sexually transmitted diseases in Akure, Ondo State, Nigeria. Their findings reveal that the type of sexually transmitted disease and age were found to be significant in predicting survival. Other models were also fitted with logistic regression to determine the individual contribution of the independent variables to survival. Chi-square test was used to determine the association between age, gender, disease type and survival outcome of sexually transmitted diseases (STDs). The result showed that there is no relationship between the age and survival, while there is a significant relationship between sex and survival. Also there is a significant relationship between the type of sexually transmitted disease and the survival. It was discovered that the male gender has a greater chance of surviving any one of the diseases regardless of age.

This present study objectives are as follows; firstly, to examine if the monthly distribution of the STDs are the same across gender using graphical exploration. Secondly, to investigate generally, the seasonal variation of the STDs after adjusting for 30-day and testing if the quarterly means are evenly distributed. Thirdly, the trend patterns of these STDs were also examined for the period under review.

. The rest of the paper is arranged as follows; section 3 deals with the material and methods, section 3 shows data analysis and results, and section 4 presents the conclusion and policy implications.

2. MATERIAL AND METHODS

Benin City is the capital of Edo State, situated at the Niger-delta area, south-southern Nigeria. Benin City has a tropical climate. In winter, there is much less rainfall than in summer. The winter is fairly cold, reaching about 27.5 ^{0}C. The driest month is January, with about 9 mm of rainfall. The summer is hot attaining 34 ^{0}C by day and 25^{0}C at night and the hottest weather occurring in March with an average of about 29 ^{0}C. The weight season begins in July and ends in October with a pick in August with about 25 ^{0}C average. The coldest period occurs in August with temperature attaining 34 ^{0}C by day and 25^{0}C at night The warmest month of the year is April, with an average temperature of 27.5 °C. In July, the average temperature is 24.5 °C. It is the average temperature of the whole year.

2.1 Source and Method of Data Collection

The data sets on the STDs considered in this paper were obtained from the clinical records of Edo State Specialist Hospital, Benin and the data sets cover the period of January, 2012 to December, 2016.

2.2 Method of Analysis

The monthly indices follow a step by step treatment of the data for both male and female patients for the three different STDs under investigation. However, seasonality is a well-known phenomenon in the epidemiology of many diseases, but straightforward analytical method for the examination and evaluation of seasonal patterns are limited. The study employed chi-square test to test the evenness of the quarterly distributions of the reported cases of STDs. Moreover, the trend pattern is also examined using least squares (LS).

2.2.1 Seasonal Variation Framework

This section presents the concept and technical details of how the adjustment for 30-day month as presented in columns (3) and (6) and index of STDs were computed. The procedure is as follows;

- The mean number of STDs adjusted for 30-day month using 31-day months = (Number of reported STDs for such month × 30) divided by (31 × Number of years).
- The mean number of STDs adjusted for 30-day month using 30-day months = (Number of reported STDs for such month × 30) divided by (30 × Number of years).
- The mean number of STDs adjusted for 30-day month for February is computed to take care of the leap-years =, (Number of reported STDs for February × 30) divided by ((28 × Number of none leap-years) + (29 × Number of leap-years)).
- Index of STDs (columns (4) and (7)) = (Mean Number of STDs in 30-month × 100) divided by (total years annual mean).
- Seasonal variation is computed as the sum of monthly indices in each quarter divided by 3.

The notes presented below Table 1, further clarify any ambiguity in the computational procedures.

2.2.2 Chi-Square Goodness-of-Fit Test

Chi-Square Goodness-of-Fit Test was used to test the null hypothesis that there is no seasonal variation in the STDs against the alternative that there is seasonal variation. In other words, the chi-square test is used to test the evenness of the quarterly distribution of the STDs cases in Benin City.

$$\chi^2 = \frac{\sum_{i=1}^{k}\left(O_i^2 + E_i^2 - 2O_iE_i\right)}{E_i} \qquad (1)$$

where, O_i is the observed number of STDs in the i^{th} category, E_i is the expected number of STDs. And the null hypothesis is rejected if $\chi^2 > \chi^2_{0.05,k-1}$.

2.2.3 Trend Method

The linear trend model was used to analyze the trend pattern the three different STDs under

investigation in this study. And the model specification is of the form;

$$STD_i = \alpha_0 + \alpha_1 t + e_i \quad (2)$$

where, α_i is the linear regression coefficients, t is the trend variable and e_i is the random error term and normally distributed with mean μ and variance σ^2. Method of estimation is the least squares (LS).

3. DATA ANALYSIS AND RESULTS

The Table 1 below presents the result analysis of monthly indices of three categories of STDs under consideration with respect to gender.

Table1. Monthly indices of STDs (HIV, Hepatitis and Gonorrhoea) in Benin city with respect to gender

	Male			Female		
Month of Reported cases of STDs (1)	***No of reported STDs (2)***	***Mean no. of STDs in 30-month (3)***	***Index of STDs for Male patients (4)***	***No of reported STDs (5)***	***Mean no. of STDs in 30-month (6)***	***Index of STDs for female patients (7)***
HIV cases						
Jan	2828	547.355	106.656	5826	1127.61	95.620
Feb	2441	515.704	100.489	4257	899.37	76.265
Mar	2170	420.000	81.840	5778	1118.32	94.833
Apr	2784	556.800	108.497	6079	1215.80	103.099
May	1787	345.871	67.396	4398	851.23	72.183
Jun	3165	633.000	123.345	7880	1576.00	133.643
Jul	2013	389.613	75.919	5603	1084.45	91.960
Aug	3639	704.323	137.243	7263	1405.74	119.205
Sep	2707	541.400	105.496	6523	1304.60	110.629
Oct	2303	445.742	86.856	5278	1021.55	86.626
Nov	3392	678.400	132.191	8188	1637.60	138.867
Dec	1964	380.129	74.071	4696	908.90	77.074
Total	**31193**	**6158.34**	**1200.00**	**71769**	**14151.2**	**1200.00**
Hepatitis cases						
Jan	92	17.8065	84.873	115	22.2581	94.654
Feb	94	19.8592	94.657	105	22.1831	94.335
Mar	99	19.1613	91.330	131	25.3548	107.823
Apr	129	25.8000	122.973	127	25.4000	108.015
May	109	21.0968	100.556	134	25.9355	110.292
Jun	107	21.4000	102.001	105	21.0000	89.304
Jul	122	23.6129	112.549	132	25.5484	108.646
Aug	107	20.7097	98.711	142	27.4839	116.877
Sep	117	23.4000	111.534	105	21.0000	89.304
Oct	103	19.9355	95.020	108	20.9032	88.892
Nov	102	20.4000	97.235	123	24.6000	104.613
Dec	96	18.5806	88.563	106	20.5161	87.246
Total	**1277**	**251.762**	**1200.00**	**1433**	**282.183**	**1200.00**

Table 1. Continued

Gonorrhoea						
Jan	57	11.0323	96.860	52	10.0645	97.259
Feb	54	11.4085	100.162	41	8.6620	83.705
Mar	54	10.4516	91.762	40	7.7419	74.815
Apr	58	11.6000	101.844	43	8.6000	83.106
May	68	13.1613	115.552	60	11.6129	112.222
Jun	58	11.6000	101.844	50	10.0000	96.635
Jul	63	12.1935	107.055	53	10.2581	99.129
Aug	52	10.0645	88.363	60	11.6129	112.222
Sep	65	13.0000	114.136	54	10.8000	104.366
Oct	49	9.4839	83.265	66	12.7742	123.444
Nov	66	13.2000	115.892	58	11.6000	112.097
Dec	49	9.4839	83.265	54	10.4516	101.000
Total	**693**	**136.679**	**1200.00**	**631**	**124.178**	**1200.00**

Source: Computed by the Author

Notes:

(1) Calender months

(2) Reported cases of STDs by test confirmation (for Male)
(3) Adjustment for 30 - day month (for Male)
(3a) five years annual mean for male; HIV cases = 6158.34/12 =513.195; Male HEP cases = **251.762**/12 = 20.9802 and Male GOH cases = 136.679/12 = 11.3900
(4) Index of STDs for male patients
(5) Reported cases of STDs by test confirmation (for Female)
(6) Adjustment for 30 - day month (for Female)
(6a) Five years annual mean for Female; **fe**male HIV cases = 14151.2/12 =1179.26; Female HEP cases =282.183/12 = 23.5153 and Female GOH cases = 124.178/12 =10.3482
(7) Index of STDs for Female patients

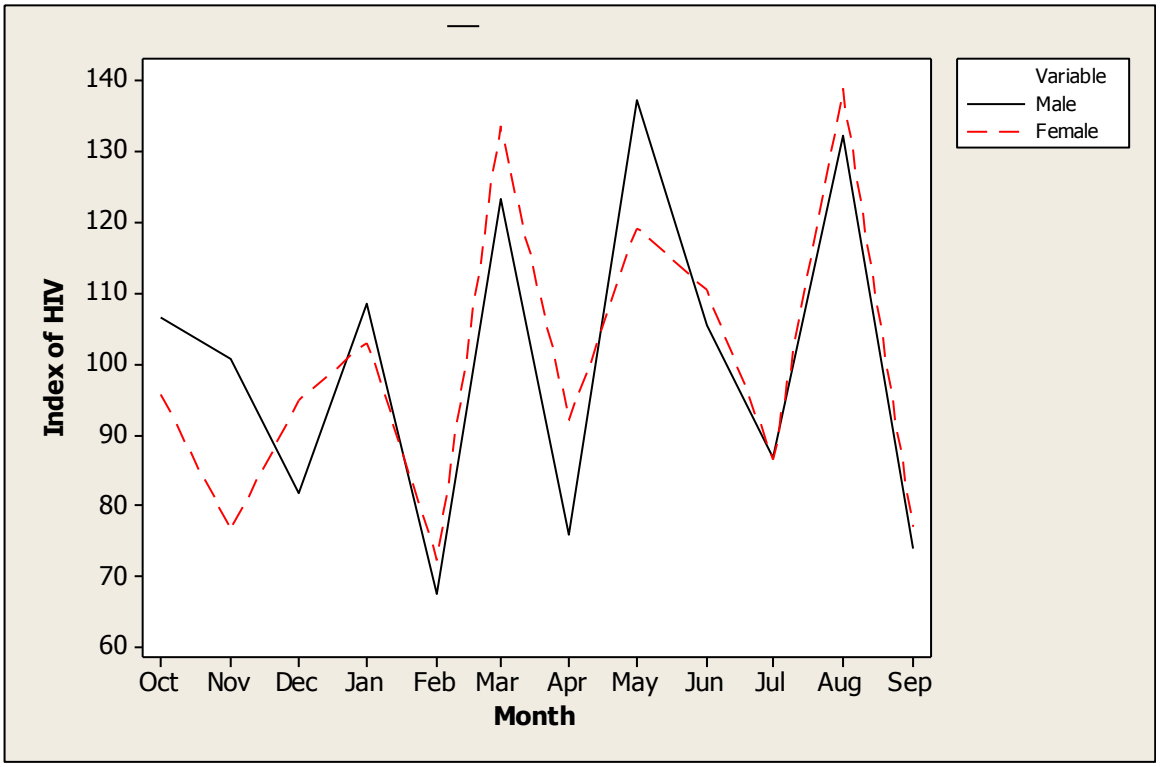

Fig 1. Monthly Index of HIV cases for Male and Female in Benin city (2012 – 2016)

The distribution of monthly indices of HIV cases as shown in Fig 1 above is the same for both male and female in Benin city. This result indicates that when the monthly index of HIV is high for female, it is also high for male and when it is low for female, it is also low for male.

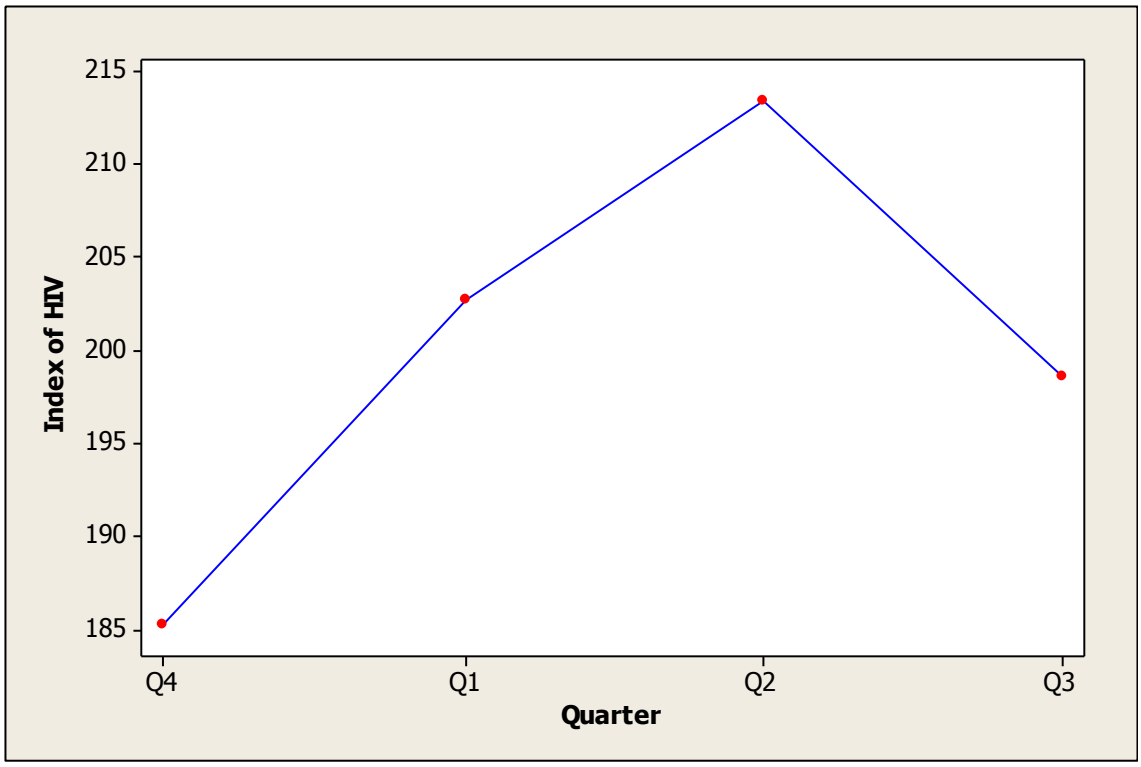

Fig 2. Plot of Seasonal variation in HIV cases in Benin City (2012-2016)

Fig 2 presents the graph of seasonal variation in HIV cases in Benin City from 2012 to 2016. It is observable that the highest peak occurred in the second quarter (April -June) and the lowest occur in the last quarter (October-December). This result indicates HIV cases can be more prevalent in the second quarter than any other season.

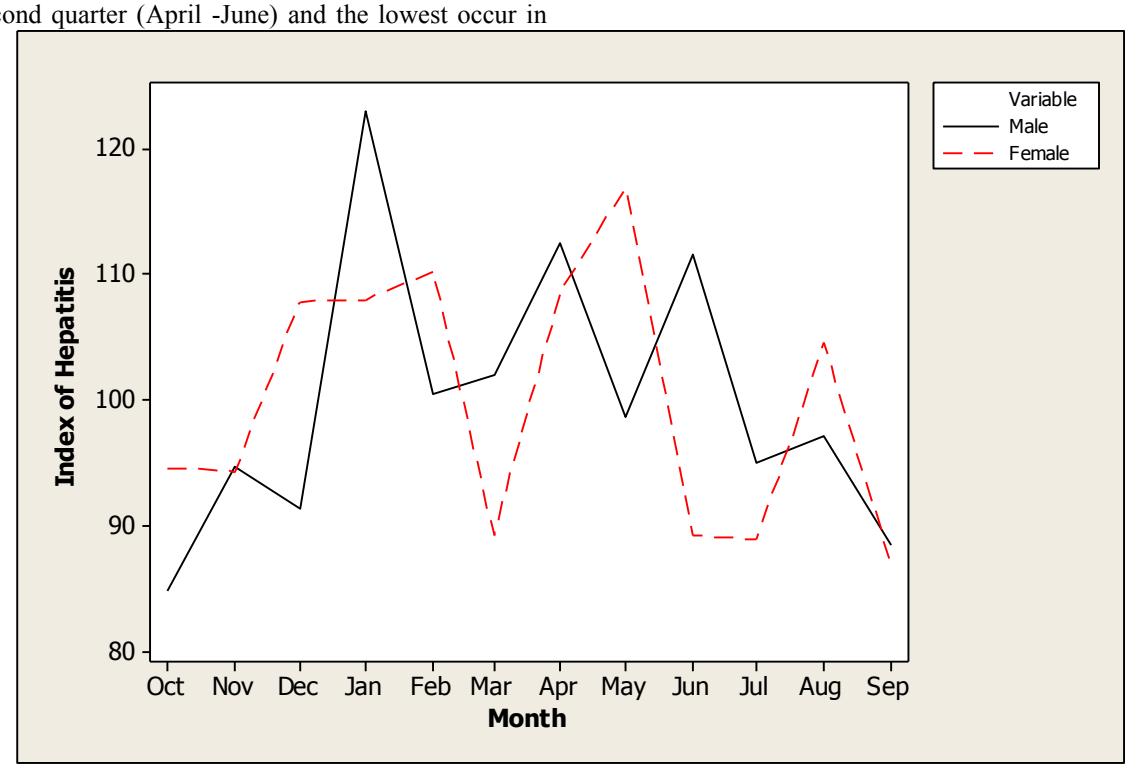

Fig 3. Monthly index of Hepatitis cases for Male and Female in Benin city (2012 – 2016)

The result of Fig 3 shows a seemingly divergent distribution pattern of monthly indices of male hepatitis cases in relation to that of female hepatitis cases in Benin-city. For male, the highest peak occurred in January and the nadir is in October. For the case of female, the highest peak occurred in May lowest index occurred in September

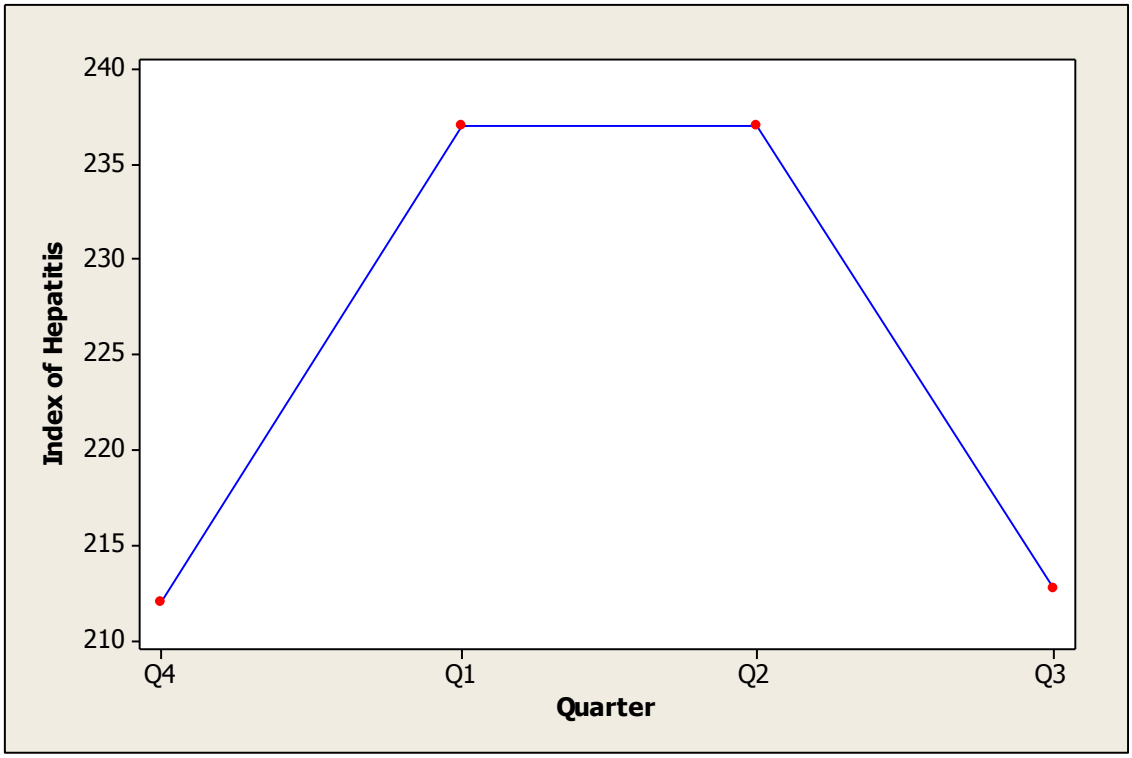

Fig 4. Plot of Seasonal variation in Hepatitis cases in Benin City (2012-2016)

Fig 4 presents the graph of seasonal variation in Hepatitis cases in Benin City from 2012 to 2016. The graph shows two significant peaks in the first (January – March) and second (April -June) quarters and the lowest occur in the third (July- August) and fourth(October-December) quarters. This implies that the prevalent rate is more in the first and second quarter than any other period in the year.

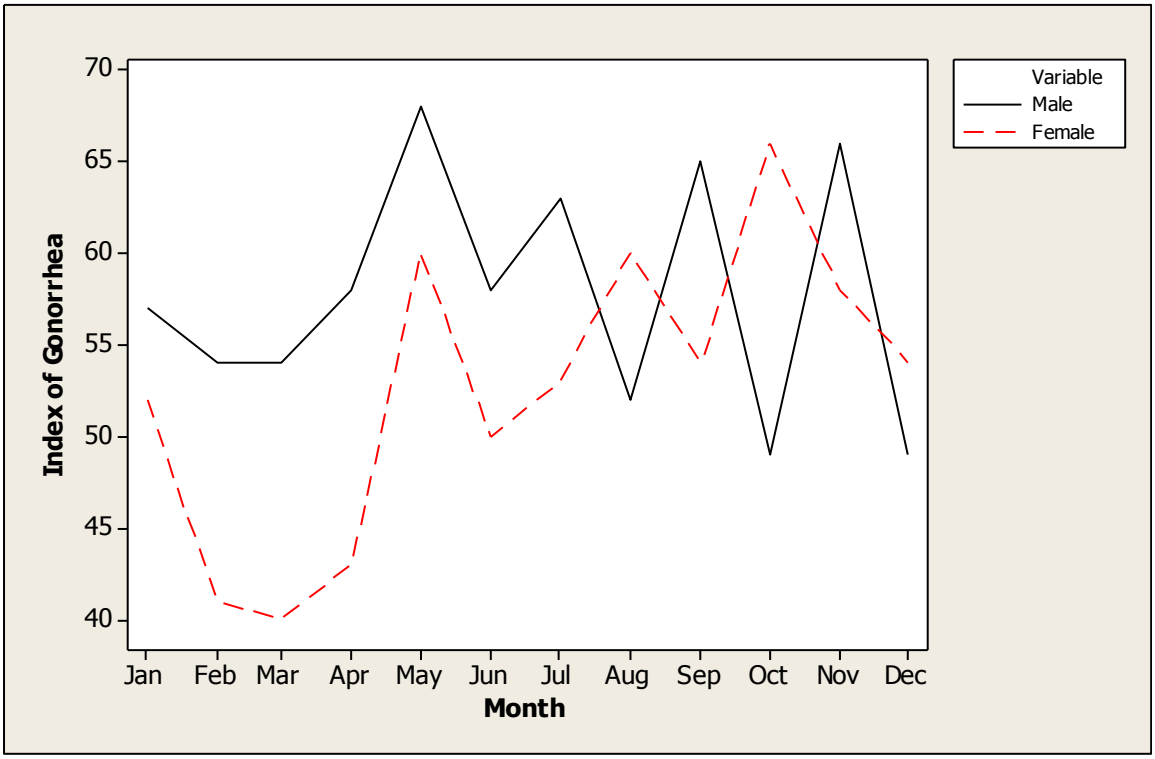

Fig. 5 Monthly index of Gonorrhoea cases for Male and Female in Benin city (2012 – 2016)

The monthly index of gonorrhoea as shown in Fig.5 is more trending in terms of female cases than in male. Both highest peak and lowest nadir occur in female case. Moreover, the distribution of monthly index of gonorrhoea with respect to male and female tend to follow the same pattern in the first half of the year and differs in the second half..

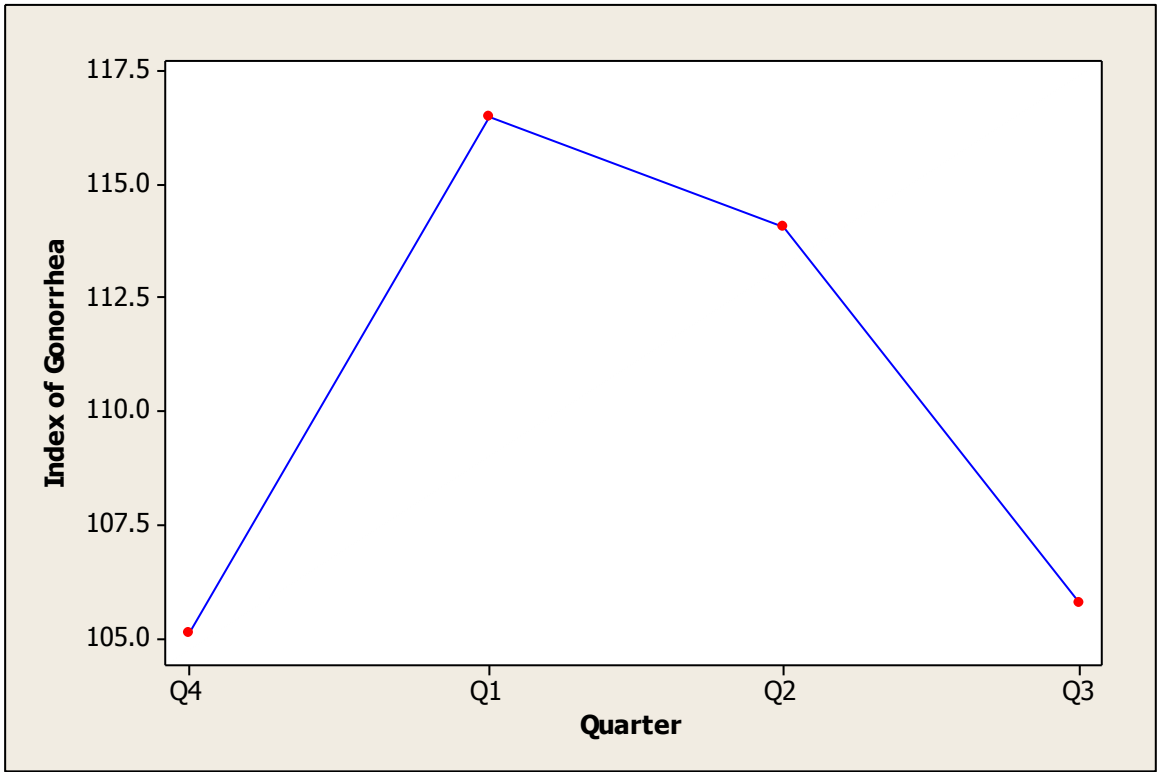

Fig 6. Plot of Seasonal variation in Gonorrhoea cases in Benin City (2012-2016)

Fig 6 presents the graph of seasonal variation in Gonorrhoea cases in Benin City from 2012 to 2016. The graph shows a significant peak in the first quarter (January – March) and the lowest nadir occur in the fourth quarters (October-December). This implies that the prevalent rate is at peak in the first quarter and lowest in the fourth quarter.

3.2. Result of Chi-Square Test

The result of Chi-Square Goodness of Fit test is presented below;

Table 2. Chi-Square Goodness-of-Fit Test for HIV

Category	Observed	Test Proportion	Expected	Contribution to Chi-Sq
1	1542.79	0.25	1692.46	13.2363
2	1726.23	0.25	1692.46	0.6740
3	1810.04	0.25	1692.46	8.1690
4	1690.77	0.25	1692.46	0.0017
		DF	Chi-Sq	P-Value
		3	22.0810	0.000

Since $\chi^2(22.0810) > \chi^2_{0.05,k-1}(7.815)$ in Table 2 above, the null hypothesis that there is no seasonal variation in the incidence of HIV cases in Benin-City, is rejected against the alternative. Chi-Square value is significant at 5% level as p-value (0.000) is less than 5% level of significance. This result implies that there is seasonality in the occurrence of HIV cases in Benin-City.

Table 3. Chi-Square Goodness-of-Fit Test for Hepatitis

Category	Observed	Test Proportion	Expected	Contribution to Chi-Sq
1	42.2077	0.25	44.4955	0.117631
2	46.8774	0.25	44.4955	0.127513
3	47.2516	0.25	44.4955	0.170724
4	41.6451	0.25	44.4955	0.182589
	DF	Chi-Sq	P-Value	
	3	0.598458	0.897	

Since $\chi^2(0.598458) < \chi^2_{0.05,k-1}(7.815)$ in Table 3 above, the null hypothesis that there is no seasonal variation in the incidence of Hepatitis cases in Benin-City cannot be rejected against the alternative. Chi-Square value is not significant as p-value (0.897) is greater than 5% level of significance. This result implies that there is no seasonal variation in the occurrence of Hepatitis cases in Benin-City.

Table 4. Chi-Square Goodness-of-Fit Test for Gonorrhoea

Category	Observed	Test Proportion	Expected	Contribution to Chi-Sq
1	19.7869	0.25	21.7381	0.175138
2	22.1914	0.25	21.7381	0.009451
3	22.6430	0.25	21.7381	0.037666
4	22.3312	0.25	21.7381	0.016180
	DF	Chi-Sq	P-Value	
	3	0.238436	0.971	

Since $\chi^2(0.238436) < \chi^2_{0.05,k-1}(7.815)$ in Table 4 above, the null hypothesis that there is no seasonal variation in the incidence of Gonorrhoea cases in Benin-City cannot be rejected. Chi-Square value is not significant as p-value (0.971) is greater than at 5% level of significance. This result implies that there is no seasonal variation in the occurrence of Gonorrhoea cases in Benin-City.

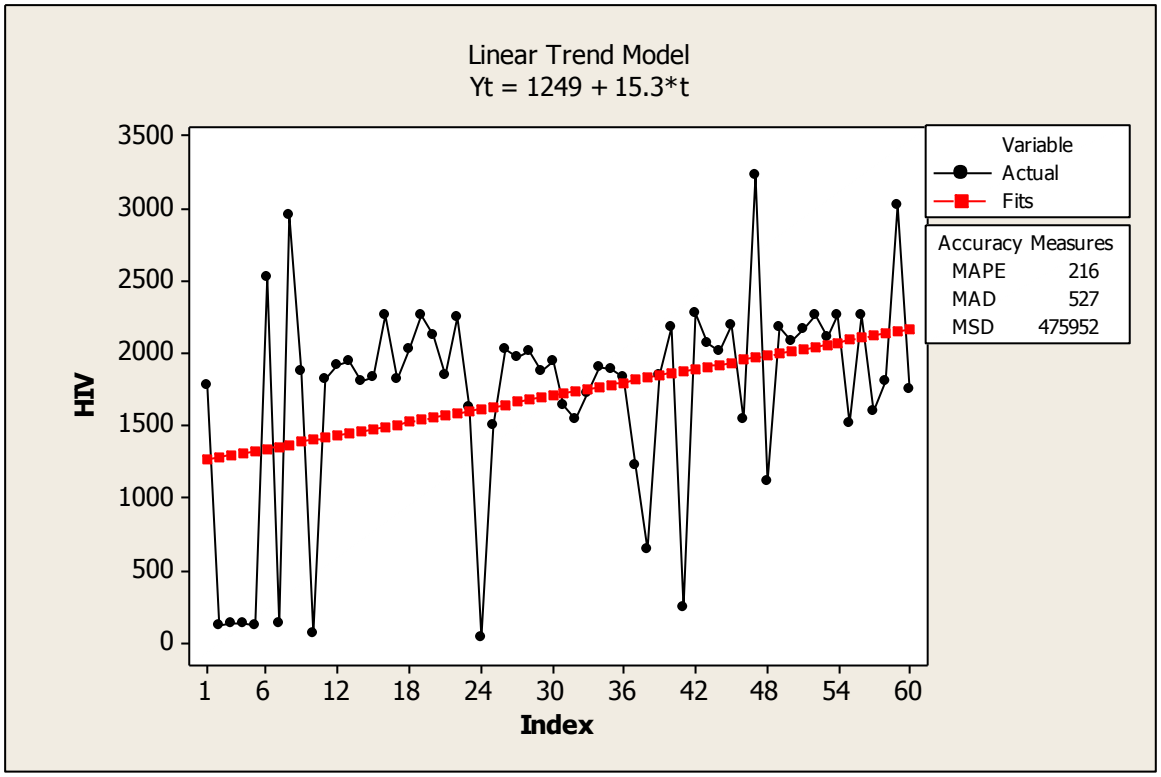

Fig 7 Plot of trend analysis of HIV cases in Benin City (2012-2016)

The result of Fig.7 shows that the coefficient of the trend parameter is positive which implies an upward trend pattern in HIV incidence in Benin-City for the period under investigation. This result indicates that HIV is increasing at the rate of 15.3% in Benin-City, Nigeria.

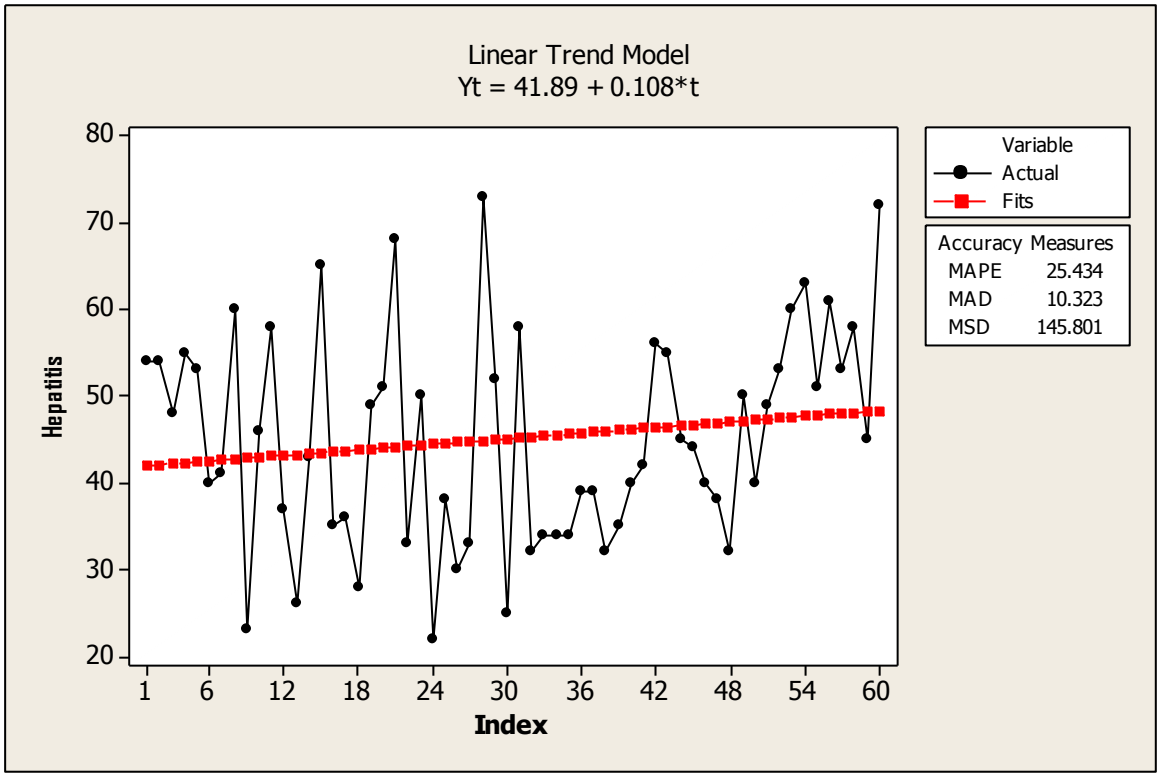

Fig 8 Plot of trend analysis of Hepatitis cases in Benin City (2012-2016)

The result of Fig.8 reveals that the coefficient of the trend parameter is positive which implies an upward trend movement in Hepatitis occurrence in Benin-City for the period under investigation. This result indicates that Hepatitis is increasing at the rate of 0.11% in Benin-City, Nigeria.

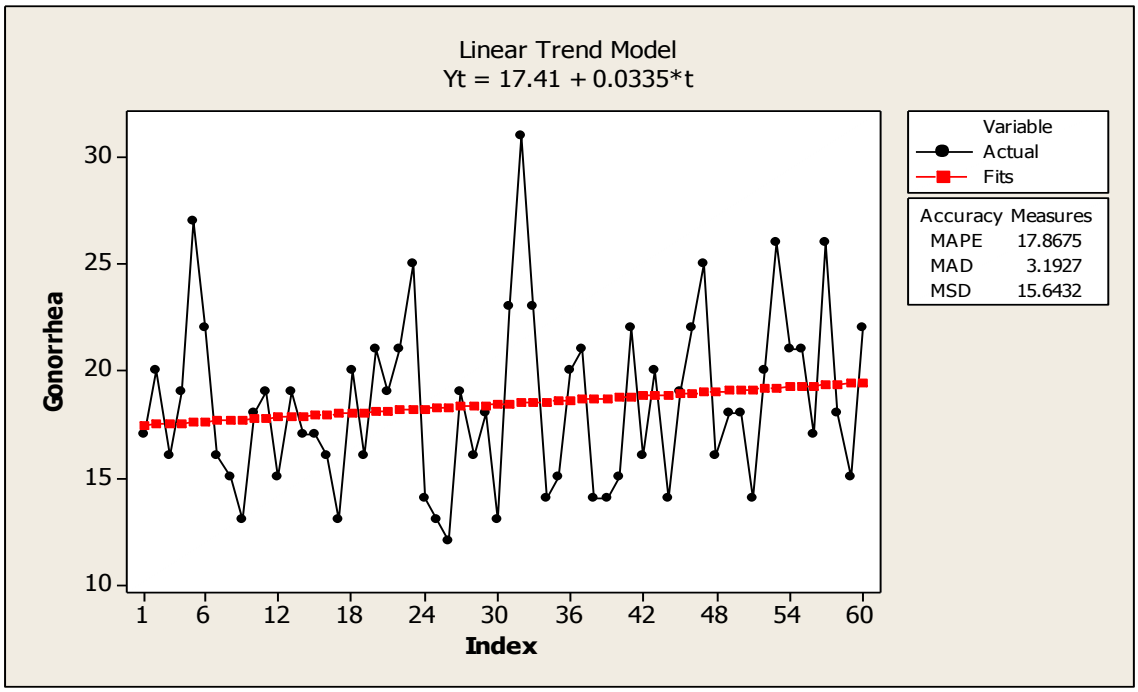

Fig 9 Plot of trend analysis of Gonorrhoea cases in Benin City (2012-2016)

The result of Fig.9 reveals that the coefficient of the trend parameter is also positive which implies an upward trend movement in Gonorrhoea occurrence in Benin-City for the period under investigation. This result indicates that Gonorrhoea is increasing at the rate of 0.034% in Benin-City, Nigeria.

3.3 Discussion of Results

The result of Fig.1 indicates that the monthly index of HIV distribution follow the same pattern for both male and female and the highest peak occurring in the second quarter of the year. The plot of seasonal variation indicates that HIV prevalent rate is at peak in the second quarter. A test for seasonal variation in HIV incidence in Benin-City, Nigeria using chi-square test rejects the null hypothesis that there is no seasonal variation at 5% level. And the result of trend analysis showed an increasing rate of 15.3% in HIV incidence in Benin-City

Fig.3 showed an indirect distribution pattern of monthly indices of male hepatitis cases in relation to that of female hepatitis cases in Benin-city. The plot of the seasonal variation showed that the prevalent rate is more in the first and second quarter than any other period in the year. And the test for seasonal variation in hepatitis incident using chi-square test accepts the null hypothesis that there is no seasonal variation in Benin-City. The result of trend analysis indicates an increasing rate of 0.11% in hepatitis incidence.

The monthly index of gonorrhoea as shown in Fig.5 reveals a more trending pattern in female cases than in male cases with both highest peak and lowest nadir occurring in female. The plot of seasonal variation indicates that the prevalent rate is at peak in the first quarter and lowest in the fourth quarter. The chi-square test for seasonality did not reject the null hypothesis of no seasonal variation in the incidence of gonorrhoea in Benin-City. But the trend result showed an increasing rate of about 0.034%, which is the lowest among the three cases considered.

4. CONCLUSION AND POLICY IMPLICATIONS

The findings of this study indicated that all the STDs under study are increasing over time and the rates of upward trending with respect to HIV, HEP and GOH are 15.3%, 0.11% and 0.034% respectively. The increasing rate of these STDs particularly HIV signals the need for urgent intervention in terms of control measure from relevant government and stake holders in the health sector.

The empirical result generally indicates that the first and second quarters of the year are the peak seasons in the prevalence of these three STDs considered. The study finding also indicates the existence of seasonal variation in HIV cases in Benin, Nigeria. These findings however, can be useful to stake holders in the health sector in planning surveillance and control measures against these STDs in order to improve health standards of the people and achieve good life expectancy in accordance with sustainable development goal three (SDG3).

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