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A Comparative Analysis of Malaria Incidence In Rural And Urban Areas Of Anambra State: A Manova Approach

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ABSTRACT:

Malaria being a life threatening disease in African and the entire globe as a large demands a thorough investigation for effective prevention. In this study, we carried out a comparative analysis of malaria incidence in rural and urban areas of Anambra State using Beacon and Madonna Hospitals Awka, Awka South L.G.A and Nnamdi Azikiwe and St. Joseph's Hospitals Neni Anaocha L.G.A. in Anambra State as a case study. Multivariate Discriminant Analysis was used to determine the difference in the incidence of malaria between the rural and urban health centers of Anambra State and also access the difference between classified gender groups. From the analysis of the data collected, we discovered that there is a significant difference in the incidence of malaria between rural and urban areas of Anambra State which is as a result of the availability of efficient health facilities in the urban area than rural areas. Also, there exists a clear difference in the rate of malaria incidence among the gender group living in Anambra State.

1.0 INTRODUCTION:

Malaria is a preventable and curable disease and yet more than one million people die from it each year. The treatment of malaria is still problematic and this contributes to worsening burden of the disease in the developing country like Nigeria. Being a common disease with increased morbidity and mortality, the global community is at a critical moment in the fight against malaria. Malaria is a disease that affects millions of people of all ages around the world. While it is preventable and curable, a child dies of malaria every 30 seconds, and more than one million people dies of the disease every year (Roll back malaria; WHO, Annual Report, (2005)). Although there has been funding and support for a very long time ago this has contributed to reductions in malaria illnesses and deaths. Elimination could be achieved if there would be progress in the continuous funding or delivery of services in vulnerable areas. Malaria predominantly affects rural and poor populations that have little or no access to current prevention and treatment tools.

Malaria is a parasitic life-threatening disease transmitted from person through the bite of a female Anopheles mosquito. There are four parasite species that cause malaria in humans-P.falciparum, P.vivax, P.malariae, P.ovale. The organism that causes the most dangerous form of malaria is a microscopic parasite called P.falciparum. In the WHO, World malaria Report (2012), the majority of malaria deaths occur among children in sub-Saharan African child every 30 seconds. Current worldwide malaria statistics suggests that about 3.3 billion people-half of the world's population are at risk of malaria. Furthermore, according to the latest estimates, there were about 219 million cases of malaria in 2013 (with an uncertainty range of 154 million to 289 million) and an estimated 660 000 deaths (with an uncertainty range of 490 000 to 836 000). Therefore, malaria is an important disease requiring special attention. The disease causes fever, shivering, joint pain, headache, and vomiting, etc. In severe cases, patients can have jaundice, kidney failure and anemia, and can result into a coma in some cases. The typical consequences of malaria are: acute febrile (feverish) illness, chronic debilitation, complication of pregnancy, weakening of physical development and learning ability of children. These consequences cause a huge negative social impact in highly affected areas. These could be lost and physical inability to engage in productive work and contribution to economic welfare which directly causes economic loss and impacts negatively in the quality of life of individuals, their dependence and caretakers in case of children.

Hence, malaria as one of the most successful parasites ever known to mankind is responsible for much of the absenteeism, death, illness, loss education time as children are ill or caring for sick parents, and reduced social development in children because of illness. Malaria can therefore be regarded as both an urban and rural disease. Transmission in the southeast (Anambra State) part of the country occurs all year round. The control of vectors is a powerful means of controlling the disease they transmit. In this case, this project therefore explores the comparative analysis on the incidence of malaria in rural and urban areas of Anambra State with Awka and

Anaocha L.G.A of Anambra State as case study. To the best of my knowledge, this can be used to implore the deployment of malaria treatment services within selected regions.

2.0 Methodology.

The statistical analysis employed for the purpose of this study is "designed to look at several dependent variables simultaneously and so is a multivariate test" (i.e. Multivariate Analysis of Variance (MANOVA)) (Andy Field, 2007). It was intended to use linear variates or factors to predict which group a person belongs to (i.e. groups) so as to discriminate groups of people in the region. Therefore, these variates are called Discriminant Functions or Discriminant Function Variates that brings us to the use of Discriminant Analysis.

The data was analyzed for aggregated data from urban and rural hospitals of Awka and Anaocha L.G.As of Anambra State respectively using SPSS Software Packages.

2.0.1 DISCRIMINANT ANALYSIS METHODOLOGY

Discriminant Analysis is a multivariate statistical technique that can be used to predict group membership from a set of predictor variables. It has become a valuable tool in social sciences as discriminant functions (predictor variables) provide a means to classify a case into the group that it mostly resembles and help investigators understand the nature of differences between groups. It was further developed to separate data into multiple groups and to describe differences between the groups after a MANOVA. (Mertler and Vannatta, 2005).

2.0.2 STATEMENT OF HYPOTHESIS

H_0: There are no between-group differences.

H_1: There are between-group differences

2.0.3 TEST STATISTICS

There are four ways in which the values are assessed

1) Pillai-Bartlett Trace (V)
   $V = \sum_{i=1}^{s} \frac{\lambda}{1+\lambda}$
2) Hotelling's T^2
   $T=\sum_{i=1}^{s} \lambda i$
3) Wilks's Lambda (Λ)
   $\Lambda = \prod_{i=1}^{s} \frac{1}{1+\lambda i}$
4) Roy's Largest root
   $\Theta = \lambda_{largest}$

Where λ_i = eigenvalues

2.0.4 DECISION RULES

The calculated value of F of the model is then compared with the critical values of F at V degree of freedom and H_0 rejected or accepted according to whether F is skewed. In other words, we reject H_0 if $F_{cal} > F^{\alpha}_{p,(n-p)}$, otherwise there will be no reason to reject H_0.

Statistical software called SPSS was used to solve the MANOVA. The column of real interest, would be displayed, that is one containing the significance values of $F^{\alpha}_{p,(n-p)}$ together with their exact or calculated statistic which will be used to know which test reach the criterion for significance level. This scenario is interesting, because the test statistic we chose determines whether or not we reject the null hypothesis that there is no between-group difference.

2.0.5 ASSUMPTIONS AND HOW TO CHECK THEM

1) Independence of observations.

2) Random sampling of data from the population of interest measured at an interval level.
3) The dependent variables (collectively) should have multivariate normality within groups.
4) Homogeneity of covariance matrices i.e. the population variance-covariance matrices of the different groups in the analysis is equal.

Andy Field (2007) stated that, the assumption of multivariate normality cannot be tested on SPSS and so the only practical solution is to check the assumption of univariate normality for each dependent variable in turn. For the assumption of equality of covariance matrices to be true the univariate tests of equality of variances between groups should be met. This assumption is easily checked using Levene's test. However, Levene's test does not take account of the covariances and so the variance-covariance matrices should be compared between groups using Box's test.

Next, for the main analysis there are four commonly used ways of assessing the overall significance of a MANOVA and debate exists about which method is best in terms of power and sample size considerations.

2.0.6 CHOOSING A TEST STATISTIC

Andy Field (2007) in his research, investigated that the four test statistic will be the same only when there is one underlying variate. Otherwise, if there is a small and moderate sample sizes, the four statistic differ little in terms of power. If group differences are concentrated on the first variate Roy's Statistic should be most powerful, followed by Hotelling's trace, Wilks's Lambda and Pillai's trace. However, when groups differ along more than one variate, the Pillai's trace is most powerful and Roy's root is least. Finally, when sample sizes are equal the Pillai-Bartlett trace is the most robust to violations of assumptions.

Finally, we also need to think about what analysis to do after the MANOVA: like ANOVA, MANOVA is a two-stage test in which an overall test is first performed before more specific procedures are applied to tear apart group differences.

2.0.7 FOLLOW-UP ANALYSIS

Here we use discriminant analysis, which finds the linear combination(s) of the dependent variables that best separates (or discriminates) the groups. By the use of SPSS, discriminant analysis can be assessed via different menus.

To validate the discriminant function through the use of classification matrices, the sample should have been randomly divided into two groups. The analysis sample group is used to compute the discriminant function. The validation sample group is retained for use in developing the classification matrix is Press's Q Statistic. This simple compares the number of correct classifications with the total sample size and the number of groups. The calculated value is then compared with a critical value from the Chi-Square distribution with 1 degree of freedom. If this value exceeds this critical value, the classification matrix can be deemed statistically better than chance.

The Q statistic is calculated thus:

Press's Q = $\frac{[N-(nk)]^2}{N(k-1)}$

Where N= total sample size

n= number of observations correctly classified

k= number of groups

2.0.8 SHAPIRO-WILK MULTIVARIATE TEST OF NORMALITY

The table will show results from two well-known tests of normality, namely the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test. The Shapiro-Wilk Test is more appropriate for small sample sizes (<50 samples), but can also handle samples sizes as large as 2000. For this reason, we will use the Shapiro-Wilk test as our numerical means of assessing normality.

TEST STATISTIC

$$W=\frac{(\sum_{i=1}^{x} a_i x_{(i)})^2}{\sum_{i=1}^{x}(x_i-\bar{x})^2}$$

Where,

x_i = The ordered sample values (x_1 is the smallest)

a_i = The constants generated from the means, variances and covariances of the order statistics of a sample of size n from a normal distribution.

$\bar{x}$ = The sample mean

2.0.9 LEVENE TEST FOR EQUALITY OF VARIANCES

Levene's test is used to test if K samples have equal variances. It is an alternative to Bartlett test. The Levene test is less sensitive than the Bartlett test to departures from normality.

2.0.10 STATEMENT OF HYPOTHESIS

H_0:$\sigma_1^2 = \sigma_2^2 = \cdots = \sigma_k^2$

H_1:$\sigma_i^2 \neq \sigma_j^2$ for at least one pair (i,j)

TEST STATISTIC

$$W=\frac{(N-K)\sum_{i=1}^{k} N_i(\bar{Z}_{i.}-\bar{Z}_{..})^2}{(K-1)\sum_{i=1}^{k}\sum_{j=1}^{N_i}(Z_{ij}-\bar{Z}_{i.})^2}$$

Where Z_{ij} can have one of the following three definitions:

1) $Z_{ij} = |Y_{ij} - \bar{Y}_{i.}|$ where $\bar{Y}_{i.}$ is the mean of the ith subgroup.

2) $Z_{ij} = |Y_{ij} - \tilde{Y}_{i.}|$ where $\tilde{Y}_{i.}$ is the median of the ith subgroup

3) $Z_{ij} = |Y_{ij} - \bar{Y}'_{i.}|$ where $\bar{Y}'_{i.}$ is the 10% trimmed mean of the ith subgroup

$\bar{Z}_{i.}$ are the groups means of the Z_{ij} and $\bar{Z}_{..}$ is the overall mean of the Z_{ij}.

DECISION RULE

The Levene test rejects the null hypothesis that the variances are equal if $W > F_{\alpha,k-1,N-k}$. OR If P-value $\leq \alpha$, reject H_0 and conclude that the variances are not all equal.

2.0.11 PRESENTATION OF DATA

The number of patients diagnosed of malaria parasite in Awka and Anaocha L.G.A of Anambra State are:

FOR RURAL CASE

NNAMDI AZIKIWE UNIVERSITY

NAUTH (NENI EXTENSION) **ST. JOSEPH'S HOSPITAL ADAZI-NNUKWU**

YEAR	GENDER TOTAL	MALE	FEMALE		YEAR	GENDER TOTAL	MALE	FEMALE
2002	61	15	46		2002	15	8	7
2003	118	20	98		2003	20	11	9
2004	71	11	60		2004	25	11	14
2005	79	23	56		2005	19	8	11
2006	89	29	60		2006	23	6	17
2007	124	30	94		2007	20	8	12
2008	184	44	140		2008	27	7	20
2009	90	29	61		2009	38	15	23
2010	58	16	42		2010	26	10	16
2011	90	38	52		2011	29	7	22
2012	128	48	80		2012	72	32	40
TOTAL	**1092**	**303**	**789**		**TOTAL**	**314**	**123**	**191**

FOR URBAN CASE

BEACON HOSPITAL & MATERNITY, AWKA. **MADONNA HOSPITAL & MATERNITY, AWKA.**

YEAR	GENDER TOTAL	MALE	FEMALE		YEAR	GENDER TOTAL	MALE	FEMALE
2002	32	17	15		2002	24	14	10
2003	44	22	22		2003	29	12	17
2004	38	17	21		2004	34	14	20
2005	29	13	16		2005	31	14	17
2006	40	17	23		2006	33	16	17
2007	30	14	16		2007	44	32	12
2008	31	15	16		2008	37	20	17
2009	47	22	25		2009	44	26	18
2010	40	18	22		2010	53	30	23
2011	46	22	24		2011	65	29	36
2012	51	22	29		2012	46	19	27
TOTAL	**428**	**199**	**229**		**TOTAL**	**440**	**226**	**214**

POOLED

	POOLED RURAL HOSPITALS					POOLED URBAN HOSPITALS		
YEAR	GENDER TOTAL	MALE	FEMALE		YEAR	GENDER TOTAL	MALE	FEMALE
2002	76	23	53		2002	56	31	25
2003	138	31	107		2003	73	34	39
2004	96	22	74		2004	72	31	41
2005	98	31	67		2005	60	27	33
2006	112	35	77		2006	73	33	40
2007	144	38	106		2007	74	46	28
2008	211	51	160		2008	68	35	33
2009	128	44	84		2009	91	48	43
2010	84	26	58		2010	93	48	45
2011	119	45	74		2011	111	51	60
2012	200	80	120		2012	97	41	56
TOTAL	**1406**	**426**	**980**		**TOTAL**	**868**	**425**	**443**

3.0 DATA ANALYSIS AND RESULTS

3.0.1. DESCRIPTIVE STATISTICS

From the Descriptive Statistics, the mean and standard deviation for –female and male groups from rural hospitals are (89.0909, 31.58308); (127.8182, 43.96548); (38.7273, 16.56557) respectively whereas that of urban hospitals are (40.2727, 10.76189); (78.9091, 16.86686); (38.6364, 8.40563). The number of each group from the rural and urban areas in Anambra State is 11.

3.0.2. BOX'S TEST OF EQUALITY OF COVARIANCE MATRICES

This test checks the assumption of homogeneity of covariance across the groups using P< 0.01 as a criterion. As Box's M (14.210) was not significant with (6; 22430.77) degree of freedom since P(0.046) >α(0.01) – indicating that there are no significant differences between the covariance matrices. Therefore this implies that the assumption is not violated, since the null hypothesis is not rejected.

3.0.3. BARTLETT'S TEST OF SPHERICITY

We determine whether to go ahead with MANOVA or series of univariate analysis, we test the null hypothesis that the residual covariance matrix is proportional to an identity matrix. Since our significance value P(0.00) < α(0.05) we therefore reject the null hypothesis of independence and conclude that variables are correlated which implies that there is no need for several univariate analysis and hence the need for MANOVA.

3.0.4. MULTIVARIATE TESTS

In reporting Multivariate tests for the four statistics we reject the null hypothesis that there was a statistically significant difference between the incidence of malaria occurrence in the urban and rural areas of Anambra State,

- Using Pillai's trace statistic, V =0.994, F(4,60) =14.829, P(0.00)< α(0.05).
- Using Wilk's Lambda Statistic, Λ =0.186, F(4,58) =19.124, P(0.00)< α(0.05).
- Using Hotelling's trace Statistic, T =3.408, F(4,56) =23.856, P(0.00)< α(0.05).
- Using Roy's Largest Root Statistic, Θ =3.095, F(2,30) =46.423, P(0.00)< α(0.05).

We will use the Wilk's 'λ′ outcome (0.186) for effect size calculations later. This conclusion implies that the level of malaria incidence differs in both rural and urban areas of Anambra State.

3.0.5. LEVENE'S TEST OF EQUALITY OF ERROR VARIANCES

From the table, the significance (p-value) of Levene's Test for malaria occurrence in rural and urban areas of Anambra State are 0.053 and 0.051 respectively. Since these p-value (0.053, 0.051)> α(0.05), we do not reject the null hypothesis and thereby conclude that the variances are equal across groups. Which implies that (the error/ Residual variances of) the incidence of malaria in rural and urban areas of Anambra State have equal variances, which supports the alternative Bartlett test.

3.0.6. TESTS OF BETWEEN-SUBJECTS EFFECTS

Since P(0.00)< α(0.05), we reject the null hypothesis that there was a significant difference between groups in terms of both rural hospitals (F(2,30)=20.548) and urban hospitals (F(2,30)=36.405). These two results lead to conclusion that the type of hospital area has a significant effect on the groups based on malaria incidence in Anambra State.

3.0.7. BETWEEN-SUBJECTS SSCP MATRIX

From the table, we gain insight into the pattern of the data and looking at the values of the cross-products to indicate the relationship between dependent variables. From the table, the sum of square for the error SSCP matrix (32048.727, 4709.636) are substantially smaller than in the group SSCP matrix (43902.788, 11430.242), and so is the value of their cross-product (1860.455, 18944.303) respectively. This pattern suggests that since MANOVA is significant then there exists relationship between dependent variables (that is important) rather than the individual dependent variables themselves. Since the level of malaria incidence differs in both rural and urban area of Anambra State, then it implies that the dependent variables- gender total, rural and urban hospitals- are related between themselves rather than their individual dependent variables themselves.

3.0.8. RESIDUAL SSCP MATRIX

Here, the variance-covariance matrix represents the average form of the SSCP matrix while correlation matrix represents the standardized form of the variance-covariance matrix. As with the SSCP matrix, these other matrices are useful for assessing the extent of the error in the model.

From the results, the variances are quite different (1068.291 compared to 156.988) and the covariances are different from zero (62.015), so Bartlett's test has come out as nearly significant.

3.0.9. CONTRAST RESULTS (K MATRIX)

This result of simple contrast compares the other groups to the female control group. (Gender Total=1, Male=2, Female=3). The table provides values for the contrast estimate and the hypothesized value (which will always be zero) because we are testing the null hypothesis that the difference between groups is zero.

When we compared Gender Total to Female there was no significant difference in the incidence of malaria in urban hospital (i.e P(0.762) > α(0.05)) which implies that the incidence of malaria in urban hospitals (Beacon and Madonna) do not differ. And in rural hospitals there was significant difference in the incidence of malaria (i.e P(0.00) < α(0.05)) which implies that the incidence of malaria in rural hospitals (Nnamdi Azikiwe and St. Joseph) differ. In the same approach, for male to female there is significant difference in the malaria incidence of both rural and urban hospitals of Anambra state (i.e. P(0.00) < α(0.05)) this implies that the incidence of malaria differ between the urban hospitals (Beacon and Madonna) and rural hospitals (Nnamdi Azikiwe and St. Joseph).

At 95% confidence interval containing the value of the difference between groups for these data- Gender Total Vs Female for rural hospitals with lower and upper bound 21.901 and 78.826 respectively; Male Vs Female for rural hospitals with lower and upper bound 60.628 and 117.554 respectively; and Male Vs Female for urban hospitals with lower and upper bound 29.362 and 51.184 respectively- does not include zero and so this contrasts is significant therefore there exist group differences whereas Gender Total Vs Female for urban hospitals with lower and upper bound -9.275 and 12.547 include zero and so this contrast is non-significant and so there is no group difference in them.

3.0.10. MULTIVARIATE TEST RESULTS

As interpreted previously in Multivariate Test above.

3.0.11. UNIVARIATE TEST RESULTS

Since P(0.00)< α(0.05).we reject the null hypothesis and thereby conclude that there is difference in malaria incidence in both rural and urban areas of Anambra State.

3.0.12. SSCP MATRIX (a)

As interpreted previously in Between-Subjects SSCP Matrix.

3.0.13. DISCRIMINANT FUNCTIONS ANALYSIS INTERPRETATION

The values in this table are useful because they give us some idea of how the relationship between dependent variables (rural and urban hospitals) changes from group to group. From Gender Total group the malaria incidence in rural and urban hospitals have virtually positive relationship because the covariance is not close to zero (i.e. 142.482) so is also the male group (i.e. 44.991)- which implies that as the number of malaria incidence in rural hospital decreases, so does the number of malaria incidence in urban hospital. In the female group, the malaria incidence in rural and urban hospitals have negative relationship, which implies that as the number of malaria incidence in urban hospital increases then the number of malaria incidence in rural hospital decreases (i.e. -1.427). **(See Appendix G).**

3.0.13. WILK'S LAMBDA

In this case with only two variates we get only two steps: the whole model, and then the model after the first variates is removed (which leaves only the second variate). When both variates are tested in combination Wilk's Lamda has the same value (0.186), with 4 degree of freedom and significance (0.00) as in the MANOVA. The important point to note from this table is that the two variates significantly discriminate the groups in combination (P=0.00), but the second variate alone is also significant (P=0.05). Therefore, the group's differences shown by the MANOVA can be explained in terms of one dimension in combination. **(See Appendix G).**

3.0.14. STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

The values in this table are standardized versions of the values of the eigenvectors. Looking at the first variate, urban and rural hospitals have the same effect (i.e. positive relationship), 0.797 and 0.496 respectively. Given these values we can say that approximately both relationships are strong (although urbans have larger contribution to the first variate. Also both urban and rural hospitals have a strong positive relationship with the second variate 0.882 and -0.624 respectively. Given that these values have opposite effect (i.e. rural hospitals has a positive relationship with this variate whereas urban hospital have a negative relationship), we can see that both relationships are strong. The second variate differentiates urban and rural hospitals in the opposite way or differently whereas the first variate differentiates groups on some dimension that affects malaria incidence in urban and rural hospitals in the same way. **(See Appendix H).**

3.0.15. STRUCTURE MATRIX

The values in this matrix are the canonical variate correlation coefficients. These values are comparable to factor loadings and indicate the substantive nature of the variates. The first variate has a positive-strong relationship between the urban and rural hospitals i.e. 0.872 and 0.616 respectively and differentiates groups in the same way whereas the second variate has a strong relationship in the rural and weak relationship in the urban 0.787 and -0.490 respectively and differentiates groups differently**. (See Appendix H).**

3.0.16. CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

As the unstandardized versions of the standardized coefficients described above, the values are the values of b and are less useful than the standardized versions, but used to demonstrate where the standardized versions come. **(See Appendix H).**

3.0.17. FUNCTIONS AT GROUP CENTROIDS & CANONICAL DISCRIMINANT FUNCTION PLOT

The centroids are simply the mean variate scores for each group. For interpretation we look at the sign of the centroid (positive or negative).

The graph and the tabulated values of the centroid tells us that variate 1 discriminates Male group from the Gender Total group. The second variate differentiates the female group from the two other groups. (**See Appendix H & I).**

3.0.18. CLASSIFICATION RESULTS (a)

According to the table, when discriminant fuctions were used to predict the incidence of malaria transmission from the three variables -81.8% of original grouped cases were correctly classified and 18.2% mis-classified for Gender Total; 90.9% of original grouped cases were correctly classified and 9.1% mis-classified for male and 81.8% of original grouped cases were correctly classified and 18.2% mis-classified for female. Which implies in all that 84.8% of individuals in urban and rural hospitals with malaria are correctly classified into the different variables. This shows a sign of good classification. **(See Appendix I).**

3.0.19. TEST FOR NORMALITY

Since we have groups of data, we test each group for normality.

- Since P(0.175, 0.438)> α(0.05) for gender total group for urban and rural areas respectively we conclude that the data are normal.
- Since P(0.05, 0.205)$\geq$ α(0.05) for male group for urban and rural areas respectively we conclude that the data are normal.
- Since P(0.190, 0.642)> α(0.05) for female group for urban and rural areas respectively we conclude that the data are normal. **(See Appendix I).**

4.0. CONCLUSION

From the analysis, there exist is a significant difference in the incidence of malaria in rural and urban areas of Anambra State. This difference is due to the fact that the urban areas are exposed to modern medical/health equipment than the rural areas thereby making malaria incidence less vulnerable in the urban areas of Anambra State.

Also, on whether there is any difference in the rate of malaria incidence among the gender groups living in Anambra State; **Appendix J, K & L** shows graphs of the original data. The graph of the means (Boxplot) shows that for rural hospitals, Male group reduces in number for rural hospitals (Nnamdi Azikiwe and St. Joseph) followed by the female group and then the Gender Total group. For urban hospitals, female group reduces in number followed by Male group and then the Gender Total group. On the relationships of the incidence rate among genders between rural and urban areas of Anambra, show that in the male group there is a positive relationship between the urban and rural hospitals, which implies that as the number of incidence among male gender in urban hospitals (Beacon and Madonna) increases, that of rural hospitals (Nnamdi Azikiwe and St. Joseph) also increases. In the female group there is no relationship at all (urban and rural hospitals differ quite independently). In the Gender Total group there is also a positive relationship between the urban and rural hospitals, which implies that as the number for urban hospitals increases, the number for rural hospitals also increases. Hence, there is a difference in the rate of malaria incidence among the Genders for the urban and rural hospital in Anambra State.

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APPENDIX G

Covariance Matrices

Group		Number of rural hospitals-(Nnamdi Azikiwe+St.Joseph)	Number of urban hospitals-(Beacon+Madonna)
GENDER TOTAL	Number of rural hospitals-(Nnamdi Azikiwe+St.Joseph)	1932.964	142.482
	Number of urban hospitals-(Beacon+Madonna)	142.482	284.491
MALE	Number of rural hospitals-(Nnamdi Azikiwe+St.Joseph)	274.418	44.991
	Number of urban hospitals-(Beacon+Madonna)	44.991	70.655
FEMALE	Number of rural hospitals-(Nnamdi Azikiwe+St.Joseph)	997.491	-1.427
	Number of urban hospitals-(Beacon+Madonna)	-1.427	115.818

Summary of Canonical Discriminant Functions

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	3.095(a)	90.8	90.8	.869
2	.313(a)	9.2	100.0	.488

a First 2 canonical discriminant functions were used in the analysis.

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.186	49.624	4	.000
2	.762	8.037	1	.005

APPENDIX H

Standardized Canonical Discriminant Function Coefficients

	Function	
	1	2
Number of rural hospitals-(Nnamdi Azikiwe+St.Joseph)	.496	.882
Number of urban hospitals-(Beacon+Madonna)	.797	-.624

	Function	
	1	2
Number of urban hospitals-(Beacon+Madonna)	.872(*)	-.490
Number of rural hospitals-(Nnamdi Azikiwe+St.Joseph)	.616	.787(*)

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions

Variables ordered by absolute size of correlation within function.

* Largest absolute correlation between each variable and any discriminant function

Canonical Discriminant Function Coefficients

	Function	
	1	2
Number of rural hospitals-(Nnamdi Azikiwe+St.Joseph)	.015	.027
Number of urban hospitals-(Beacon+Madonna)	.064	-.050
(Constant)	-4.637	.319

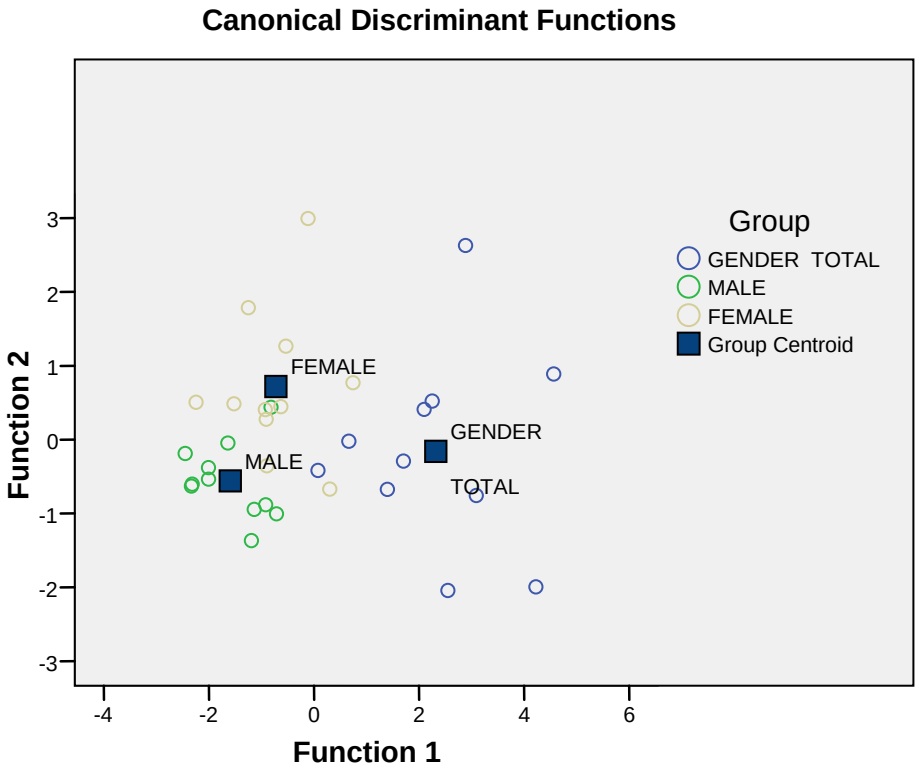
Unstandardized coefficients

Functions at Group Centroids

Group	Function	
	1	2
GENDER TOTAL	2.319	-.159
MALE	-1.593	-.559
FEMALE	-.725	.718

Unstandardized canonical discriminant functions evaluated at group means

APPENDIX I



Classification Results(a)

		Group	Predicted Group Membership			Total
			GENDER TOTAL	MALE	FEMALE	1
Original	Count	GENDER TOTAL	9	0	2	11
		MALE	0	10	1	11
		FEMALE	0	2	9	11
	%	GENDER TOTAL	81.8	.0	18.2	100.0
		MALE	.0	90.9	9.1	100.0
		FEMALE	.0	18.2	81.8	100.0

a 84.8% of original grouped cases correctly classified.

```
SAVE OUTFILE='C:\Program Files (x86)\SPSS Evaluation\PROJECT RESEARCH MY
INPUT.s

    /COMPRESSED.

DATASET ACTIVATE DataSet1.

DATASET CLOSE DataSet2.
```


APPENDIX J

Tests of Normality (b,c,d)

	GROUP P	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	df	Sig.
GENDERTOTAL	RURAL	.175	11	.200(*)	.898	11	.175
	URBAN	.251	11	.051	.933	11	.438
MALE	RURAL	.171	11	.200(*)	.854	11	.048
	URBAN	.213	11	.176	.904	11	.205
FEMALE	RURAL	.200	11	.200(*)	.901	11	.190
	URBAN	.148	11	.200(*)	.950	11	.642

* This is a lower bound of the true significance.

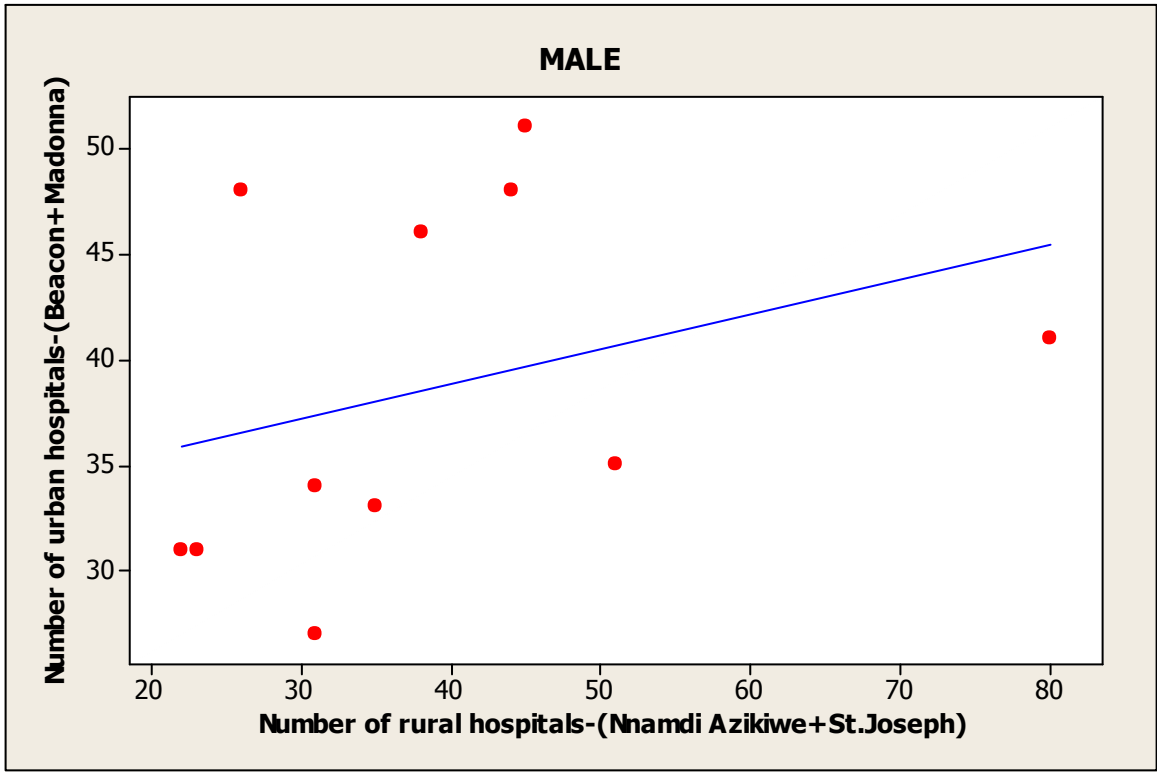
a Lilliefors Significance Correction

b There are no valid cases for GENDERTOTAL when GROUPP = .000. Statistics cannot be computed for this level.

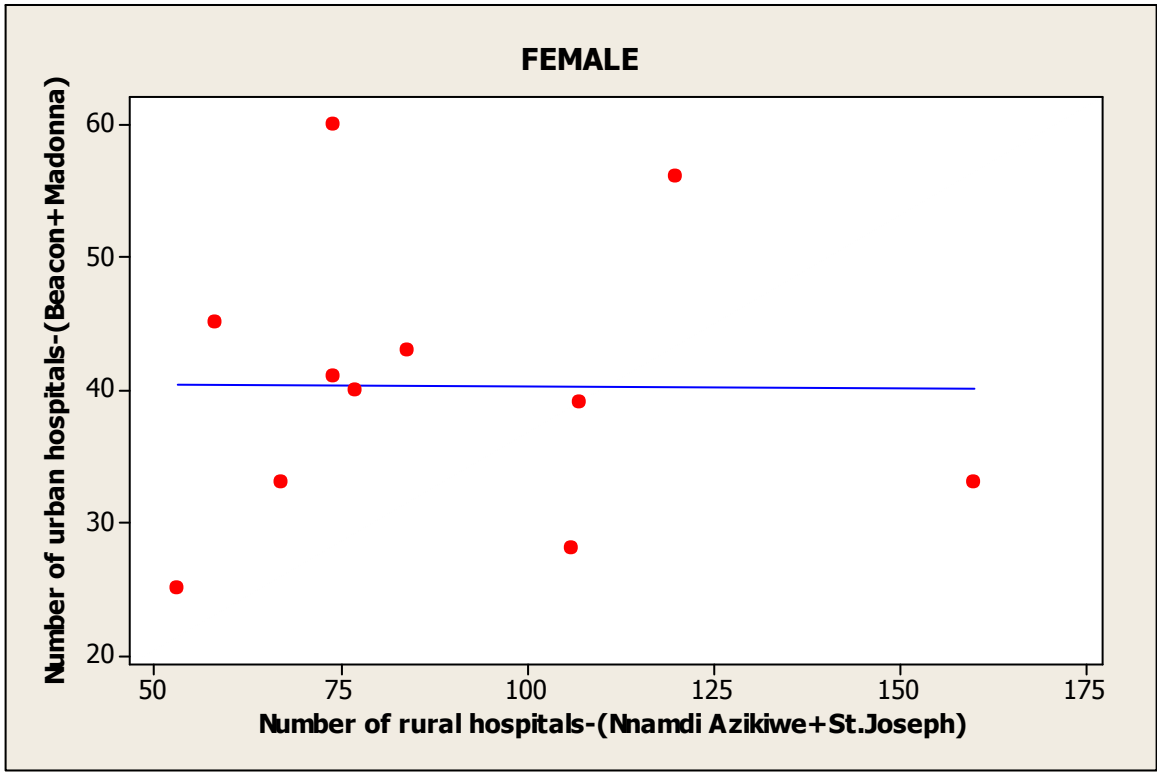
c There are no valid cases for MALE when GROUPP = .000. Statistics cannot be computed for this level.

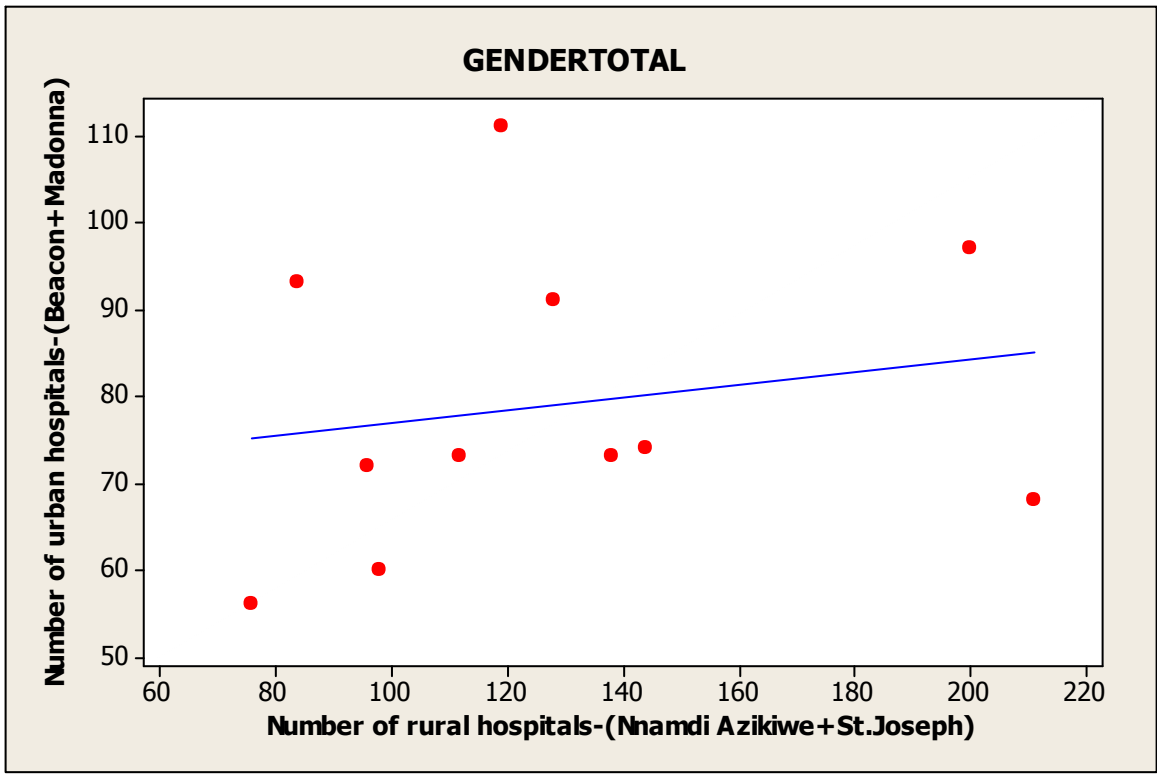
d There are no valid cases for FEMALE when GROUPP = .000. Statistics cannot be computed for this level.

GRAPH SHOWING THE RELATIONSHIPS



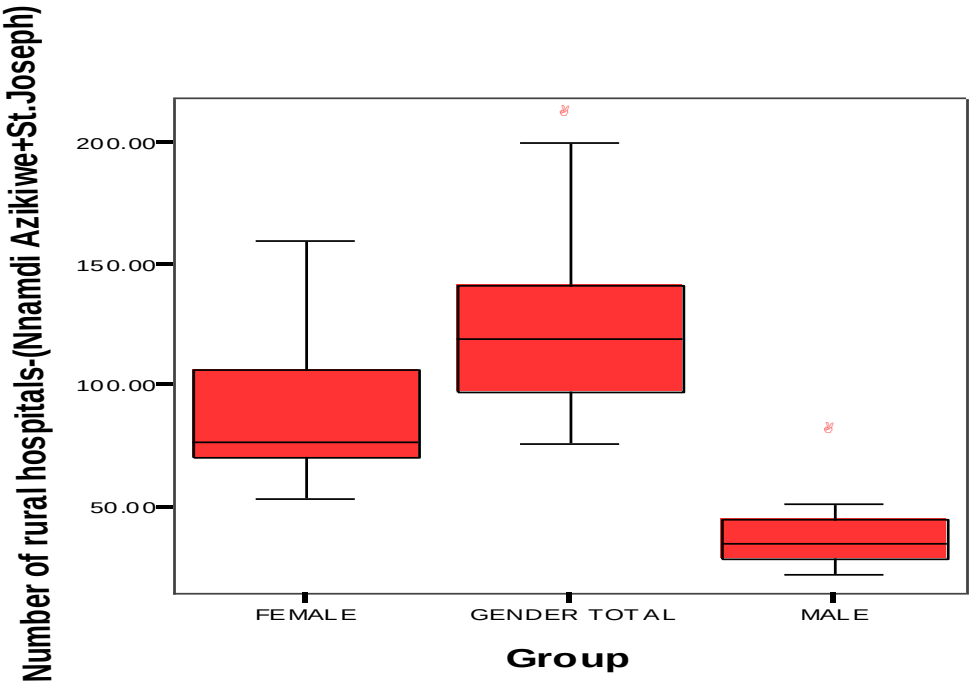
APPENDIX K

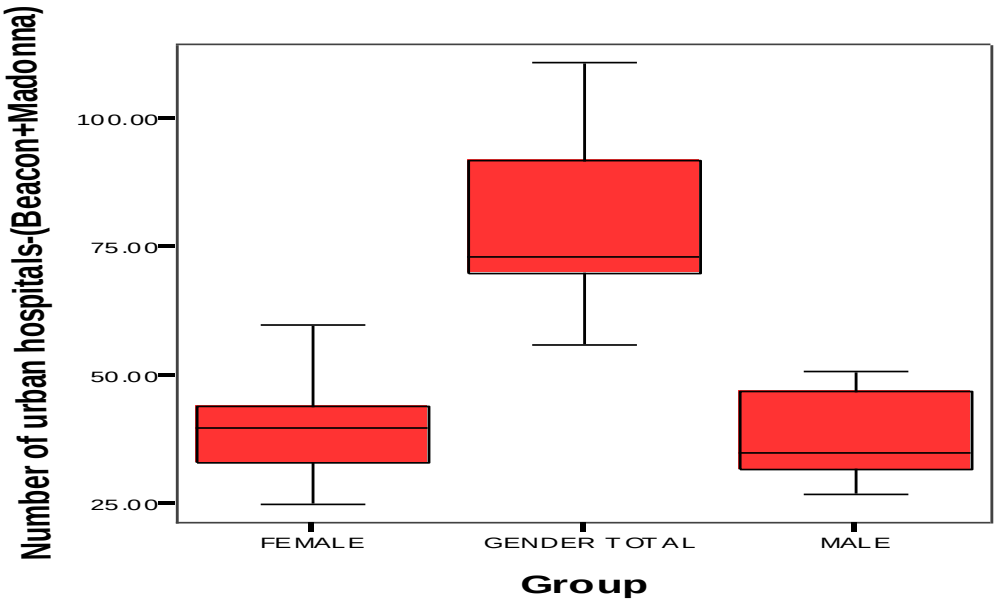




APPENDIX L

Interactive Graph





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