Evaluation of Cancer Incidence and Age-Adjusted in Regional Cancer Center of Tamilnadu Districts by using Mathematical Technique

K.L. Muruganantha Prasad, B. Thirumeninathan, R. Subramoniam

Abstract--- The term cancer does not stand for a single disease, but represents a collection of diseases characterized by uncontrolled cell proliferation. Now a days cancer is one of the main disease to affect the human beings. Due to this is causes death. It is a challenging one to the society for their health problem. The main objective is to explore the design and trends of the cancer incidence in location of the nine regional cancer centers and cancer treatment facilities in the area. (ie., Coimbatore, Kanniyakumari, Salem, Thanjavur, Tirunelveli, Madurai, Trichy, Chennai, Kanchipuram).The cancer cases were separated district wise regional cancer centers for specific cancer sites and age-standardized incident rates were calculated for females. By using Mathematical Technique we found to the cancer incidence and age adjusted of cancer. ie) which district wise regional cancer centers higher in the cancer incidence and age adjusted and which district wise regional cancer centers least in the cancer incidence and age adjusted ?

Keywords--- Cancer, Age-standardized Rates and Incidence Rates Formulae, Mathematical Technique – ANOVA Table.

I. INTRODUCTION

Cancer is a seemingly unpredictable illness that is prevalent among adults and children around the world. In fact, one out of every five persons will die as a result of cancer. Cancer begins when normal cells genetically mutate into abnormal cells, which have the mutant gene, oncogene (1) .There are four main stages of cancer: initiation stage, promoted stage, tumor growth stage, and metastatic stage. Initiation involves changes to the genotype of the cell. To become fully cancerous, a cell must be promoted. Tumor growth is the result of the excretion of mitogens called vascular endothelial growth factor, VEGF(Vascular endothelial growth factor), which stimulate the growth of vascular pathways to the cancer cells. At the last stage, cancer becomes metastatic, which results in the flow of cells into the blood stream. Cancer has a major impact on society in the many country and cross the world.(3)

Statistics tell us things such as how many people are diagnosed with and die from cancer each year, the number of people who are currently living after a cancer diagnosis, the average age at diagnosis and the numbers of people who are still alive at a given time after diagnosis. Among many others, the areas of mathematics fully or partially developed in response to demands of biology include branching processes, traveling wave solutions of reaction-diffusion systems, Turing bifurcation and diffusive instability, analysis of replicator equations, stochastic coalescent process, evolutionary game theory, and analysis of variance.(4)

Cancer Incidence rate: A Cancer Incidence rate is the number of new cancers of a specific site /type occurring in a specified population during a year, usually expressed as the number per 100,000 population at risk.

IR=(New cancers/population)*100,000.

The population used depends on the rate to be calculated.

Age Specific Rate (ASpR): This refers to the rate obtained by division of the total number of cancer cases by the corresponding estimated population in that age group and sex/site/geographic area/time period and multiplying by 100,000.

Age Adjusted or Age Standardised Rate (AAR): Most cancers increase to occur as age increases. Therefore the higher the proportion of older population the higher the number of cancers.

$$AAR = \frac{\sum_{i=1}^{A} a_i w_i}{\sum_{i=1}^{A} w_i}$$

where, a_i is the age specific rate (ASpR)in age class i

$w_i$is the standard population in age class i

'A' represents number of age intervals.

Material and Data sources

The incidence rate and age- adjusted of cancer must be estimated from different regional cancer centres.

[ie., Coimbatore, Kanniyakumari, Salem, Thanjavur, Tirunelveli, Madurai, Trichy, Chennai, Kanchipuram]. In this study, the relative information of estimate population for each regional cancer centres and Minimum crude incidence rate, minimum age-adjusted incidence rate and minimum truncated incidence rate were calculated. We estimated for females (all ages)based data from more than three laks and above. The cancer data for the proposed study was collected from the development of an atlas of cancer in India.(2)

Revised Manuscript Received on July 10, 2019.

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II. MATHEMATICAL MODEL

Data for Females the following table:

S.NO	REGIONAL CANCER CENTRES	MCIR	MAAIR	MTIR
1.	I - Coimbatore	44	55	134
2.	II - Kanniyakumari	45	52	105
3.	III - Salem	46	47	108
4.	IV - Thanjavur	32	38	89
5.	V - Tirunelveli	39	42	99
6.	VI - Madurai	29	39	91
7.	VII - Trichy	35	38	96
8.	VIII - Chennai	29	34	93
9.	IX - Kanchipuram	38	40	106

* RCC - Regional Cancer Centres ; MCIR- Minimum Crude Incidence Rate; MAAIR- Minimum Age-Adjusted Incidence Rate; MTIR- Minimum Truncated Incidence Rate

III. ANOVA TABLE AND FORMULAE & RESULTS

The analysis of variance procedure is used to test the null hypothesis that the means of three or more populations are the same against the alternative hypothesis that not all population means are the same.The analysis of variance procedure is used to compare three or more population means in a single test.

Analysis of Variance: (ANOVA)

Analysis of variance is a technique that will enable us to test for the significance of the difference among more than two sample means.

The test is based on the analysis of variation in the data obtained from different samples. The application of one-way ANOVA requires that the following assumptions hold true.

Assumptions of One-Way ANOVA: The following assumptions must hold true to use *one-way ANOVA*.

1. The populations from which the samples are drawn are (approximately) normally distributed.

2. The populations from which the samples are drawn have the same variance (or standard deviation).

3. The samples drawn from different populations are random and independent.

The ANOVA test is applied by calculating two estimates of the variance of population distributions: the **variance between samples** and the **variance within samples**. The variance between samples is also called the **mean square between samples.** The variance within samples is also called the **mean square within samples**.(5)

Formulae

- Sum of all items (T)= $\sum X_1 + \sum X_2 + \sum X_3 + ...$
- Correction factor (C.F)= $\frac{T^2}{N}$
- TSS=Total Sum of Square
  =Sum of squares of all the items –C.F
  $= \sum X_1^2 + \sum X_2^2 + \sum X_3^2 + ... - \frac{T^2}{N}$
- SSC=Sum of Squares between Samples
  $= \frac{(\sum X_1)^2}{n} + \frac{(\sum X_2)^2}{n} + \frac{(\sum X_3)^2}{n} + ... - C.F$
- MSC=Mean squares between samples
  =Sum of squares between samples/d.f
- SSE =Sum of squares with in samples
  =Total sum of squares – Sum of squares between samples
- MSE = Mean squares with in samples
  =sum of squares with in samples / d.f
- Usually we taken 5% level of significance

Conclusion: If $F_{cal}<F_{tab}$, we accept Null Hypothesis and If $F_{cal}>F_{tab}$, we reject Null Hypothesis.

Here we take, H_0 is Null Hypothesis and H_1 is Alternative Hypothesis.

Source of variation	Sum of square	Degree of Freedom	Mean square	F-ratio
Between Samples	SSC	V_1=K-1	MSC= $\frac{SSC}{K-1}$	Fc= $\frac{MSC}{MSE}$
With in Samples	SSE	V_2=N-K	MSE= $\frac{SSE}{N-K}$	

Here K-Number of Samples and N-Total number of items in the given data.

Calculation

H_0: Cancer centre is not larger.

[There is no significant difference among the Regional cancer center]

H_1: Cancer center is larger.

Given table,

RCC	MCIR(X_1)	MAAIR(X_2)	MTIR(X_3)
I	44	55	134
II	45	52	105
III	46	47	108
IV	32	38	89
V	39	42	99
VI	29	39	91
VII	35	38	96
VIII	29	34	93
IX	38	40	106

Subtracting by 38 from given data,

RCC	MCIR		MAAIR		MTIR	
	X_1	X_1^2	X_2	X_2^2	X_3	X_3^2
I	6	36	17	289	96	9216
II	7	49	14	196	67	4489
III	8	64	9	81	70	4900
IV	-6	36	0	0	51	2601
V	1	1	4	16	61	3721
VI	-9	81	1	1	53	2809
VII	-3	9	0	0	58	3364
VIII	-9	81	-4	16	55	3025
IX	0	0	2	4	68	4624
	$\sum X_1$=-5	$\sum X_1^2$=357	$\sum X_2$=43	$\sum X_2^2$=603	$\sum X_3$=579	$\sum X_3^2$=38749

Sum of all items (T) = $\sum X_1 + \sum X_2 + \sum X_3$

T =617.

Correction factor (C.F)= $\frac{T^2}{N}$

C.F=14099.59

TSS=Total Sum of Square

=Sum of squares of all the items –C.F

$= \sum X_1^2 + \sum X_2^2 + \sum X_3^2 - \frac{T^2}{N}$

TSS=25609.41

SSC=Sum of Squares between Samples

$= \frac{(\sum X_1)^2}{n} + \frac{(\sum X_2)^2}{n} + \frac{(\sum X_3)^2}{n} - C.F$

SSC=23357.63

MSC=Mean squares between samples

=Sum of squares between samples/d.f

MSC=11678.81

SSE =Sum of squares with in samples

=Total sum of squares – Sum of squares between samples

SSE=2251.78

MSE = Mean squares with in samples

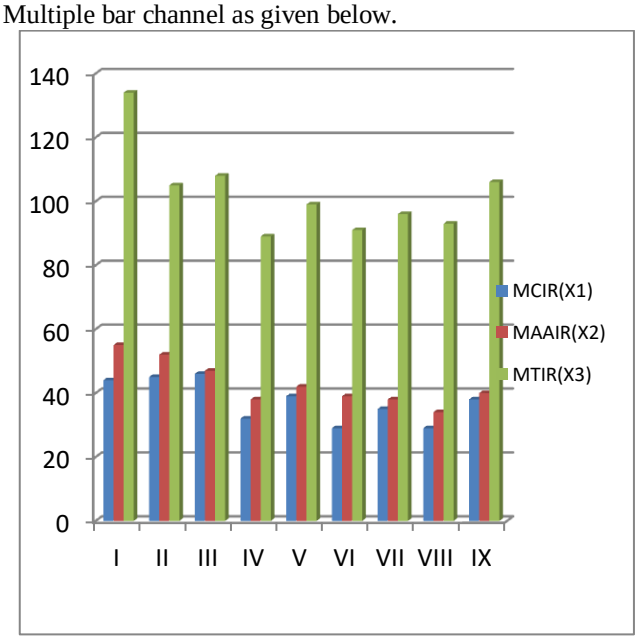
=Sum of squares with in samples / d.f

MSE=97.9

ANOVA Table

Source of variation	Sum of square	Degree of Freedom	Mean square	F-ratio
Between Samples	SSC =23357.63	V_1=K-1=2	MSC= $\frac{SSC}{K-1}$ =11678.81	Fc= $\frac{MSC}{MSE}$ =119.29
Within Samples	SSE =2251.78	V_2=N-K=23	MSE= $\frac{SSE}{N-K}$ =97.9	

Using the data given above, we are able to plot the Multiple bar channel as given below.



IV. CONCLUSION

F for V_1=2, V_2=23 at 5% level of significance is (V_1, V_2) =(2,23)=5.66 and Calculated value of F is Fc=119.29.

Since $F_{cal} > F_{tab}$, we reject Null Hypothesis(H_0).Hence we conclude that the cancer centre larger and also there is a significance difference among the regional cancer centre.

REFERENCES

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts, and J. D. Watson. 1994. *Molecular biology of the cell* 3rd ed. New York: Garland Publishing.
2. A Project of the National Cancer Registry Programme (Indian Council of Medical Research) supported by the World Health Organisation.
3. Kristin Michelle Steely "Applications Of Stochastic Processes To Cancer Research" [p-1-2]
4. Artem S. Novozhilov, Georgy P. Karev, and Eugene V. Koonin*, National Center for Biotechnology Information, National Library of Medicine, National Institutes of Health, Bethesda, MD 20894, " Biological applications of the theory of birth-and-death Processes".
5. Prem S. Mann Eastern Connecticut State University, Rowan University, John Wiley & Sons, INC. Seventh Edition INTRODUCTORY STATISTICS
6. David S. Fay § and Ken Gerow: Department of Molecular Biology, College of Agriculture and Natural Resources, University of Wyoming, Laramie WY 82071, USA & Department of Statistics, College of Arts and Sciences, University of Wyoming, Laramie WY., 82071
7. Kendall DG. (1949) 'Stochastic Processes and Population Growth', *J. of Royal Stat. Soc.*, Vol. 11, pp. 230-282
8. Karlin S, Taylor HM. (1975) *A First Course in Stochastic Processes* edn 2nd. San Diego, New York, Boston, London: Academic Press.
9. Whittemore, A. The age distribution of human cancer for carcinogenic exposures of varying intensity. Am.J. Epidemiol., 106,418-432(1977).
10. Jpn. J. Cancer Res.81,1190-1117,November 1990,Naohito Yamaguchi, shawwatanabe, Keiichi Maruyama and Toshiteru Okubo, Analysis of Stomach Cancer Incidence by Histologic Subtypes Based on a Mathematical Model of Multistage cancer incidence and exponential Growth.