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ANALYSIS AND COMPARISON OF LEUKEMIA INCIDENCE AND DEATH RATES BY HISTOLOGICAL TYPES BASED ON MATHEMATICAL MODEL

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Abstract: A Mathematical Model include as a part of a whole processes Age-adjusted Incidence and death rates and 5 years survival (percent) are compared. The model was applied to incidence data of leukemia classified into subtypes of Acute Lymphoblastic (ALL), Acute myeloid leukemia (AML), Chronic Lymphoblastic leukemia (CLL), Chronic myeloid leukemia (CML)and based others. The multistage theory was assumed for cancer induction as in the Armitage –Doll Model. For the period of growth, exponential growth was assumed and clinical surfacing was formulation as a stochastic process relation to tumor diameter. Here estimated for number of stage in Incidence and death rates by using maximum likelihood procedure [1]. The present study should that analysis by subtypes is of the importance in leukemia.

Key words*:* leukemia , Mathematical Model, Armitage –Doll Model, Multistage theory.

1. Introduction

The mathematical model approach in cancer research has a long History. It valuable role between observation in laboratory and those in epidemiology. The incidence or death rate of cancer increases in proportion to the (k-1)-th power of age, if the cancer is induced through a series of *k* steps of carcinogenesis [1]. A mathematical model is proposed in which the period of cancer growth is taken into account in addition to the period of

cancer induction. The model applied the number of stages in cancer induction and the death rate of comparison for each histology types.

2. Materials and methods

Database: The incidence rate of leukemia of a certain histologic type must be estimated from different databases, since the incidence rate is usually reported only for leukemia. In this data, relative frequency of a histologic types was estimated for each Incidence and rates and 5-years relative survival (Percent) by Primary cancer site, sex and time period (SEER Data) [3]. As the histological types of leukemia Acute Lymphoblastic leukemia (ALL),Acute myeloid leukemia (AML), Chronic Lymphoblastic leukemia (CLL), Chronic myeloid leukemia (CML)and based others.

3. Mathematical model

Models can describe a system by means of abstraction and mathematical formalism. They enable extrapolation beyond situations originally analysed, quantitative predictions, inference of mechanisms and falsification of underlying biological hypotheses and quantitative description of relationships between different components of a system. The model may be more statistical in nature and so may predict the distribution of possible outcomes. Such models are said to be stochastic.[6]

4. Armitage –doll model

Hazard Function and Survival Function: Assume that T is a continuous random variables with probability density function f(t) and cumulative distribution function F(t)=P(T< t), i.e. the hazard function is the ration of the probability density function to the survival function is given by $s(t) = P(T \geq t) = 1 - F(t) = \int_t^{\infty} f(x)\,dx$

The failure (or) hazard function r(t) is defined by $r(t) = \frac{f(t)}{1 - F(t)}$ .Explain the meaning, suppose that an item having life time X has survived for 't' hours we expressed the probability. [6] ie) does not survival for an additional time dt. Consider,

$$P\{X \in (t, t + dt) / X > t\} = \frac{P\{(X \in t, t + dt), (X > t)\}}{P(X > t)}$$
$$= \frac{P\{(X \in t, t + dt)\}}{P(X > t)}$$
$$= \frac{f(t)dt}{1 - F(t)} = r(t)dt.$$

Then by the memory less property it follows the distribution of remaining life for a 't'-year time is the same as for new item. Hence r(t) should be constant .ie) r(t)=λ. Thus the hazard function for the exponential distribution is constant. The λ is often referred to as the rate is the reciprocal of the mean.

$$r(t) = \frac{\frac{d}{dt}F(t)}{1 - F(t)}$$

Integrating on both sides we get,

$$\int_0^t r(t)dt + K = -\log(1 - F(t))$$

$$\log(1 - F(t)) = -\int_0^t r(t)dt + K$$

Taking on exponential on the sides and put k=0,

$$(1-F(t)) = e^{k}\exp\left\{-\int_{0}^{t} r(t)dt\right\}$$

$$(1-F(t)) = \exp\left\{-\int_{0}^{t} r(t)dt\right\}$$

Which is called MIEG model.

$$F(t)) = 1-\exp\left\{-\int_{0}^{t} r(t)dt\right\}$$

Which is called Armitage-doll model.

Leukemia:

Leukemia is cancer that starts in the tissue that forms blood. Most blood cells develop from cells in the bone marrow called stem cells. In a person with leukemia, the bone marrow makes abnormal white blood cells. The abnormal cells are leukemia cells. Unlike normal blood cells, leukemia cells don't die when they should. They may crowd out normal white blood cells, red blood cells, and platelets.

There are main types of Acute Lymphoblastic leukemia (ALL), Acute myeloid leukemia (AML), Chronic Lymphoblastic leukemica (CLL), Chronic myeloid leukemia (CML).The Acute and Chronic forms are subdivide of leukemia. Acute leukemia is characterized by a rapid increase in the number of immature blood cells and Chronic Leukemia is characterized by the excessive build up of relatively mature, but still abnormal white blood cells.In particular chronic myelogenous leukemia (CML) and acute myelogenous leukemia (AML), have served as important model diseases in the establishment of modern concepts of cancer development. [1] As it is well described in any biological textbook (see for instance hematopoiesis deals with formation and regulation of blood cells in the body. It all starts in the developing embryo. Blood cells of the early stages are located in the yold sacs also called blood islands. They move then to the spleen, liver and lymph nodes.

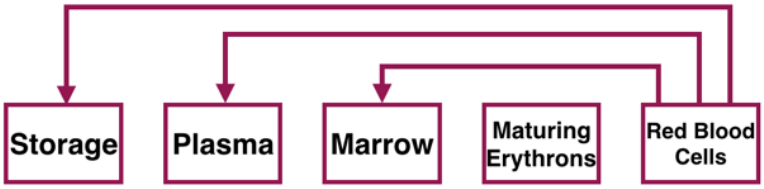


Fig (i) Blood Cells Maturing from Stem Cells [4]

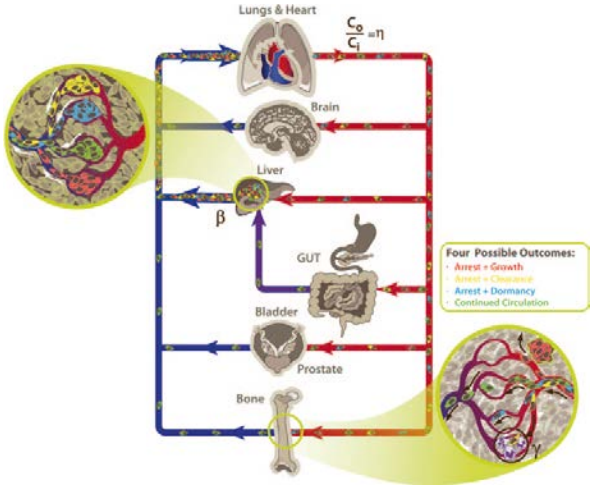


Fig (ii) The human vascular system represented as a network to illustrate the filter/flow perspective.

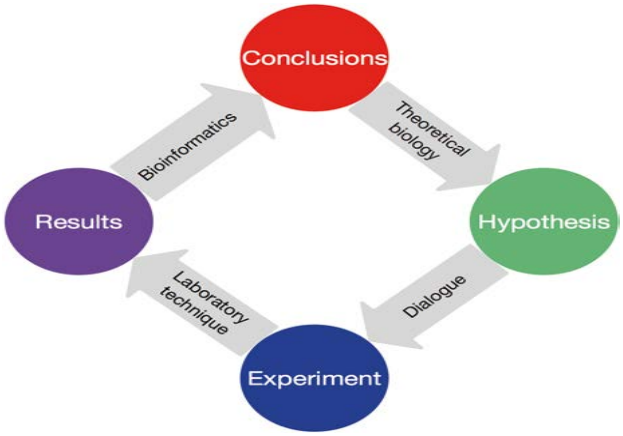


Fig (iii) An overview of the scientific method, and where theoretical/computational scientists fit into this process in the life/medical sciences and biology.[9]

Table(i): Data for Age-adjusted Incidence and death rates and 5 years survival (percent).[3]

SEX / TYPES	INCIDENCE			MORTALITY			SURVIVAL (%)		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**
Acute Lymphoblastic leukemia(ALL)	**6.7**	**8.9**	**5**	**2**	**2.7**	**1.3**	**78.4**	**79**	**77.6**
Acute myeloid leukemia(AML)	**4.1**	**5**	**3.4**	**2.8**	**3.7**	**2.2**	**26.5**	**25.7**	**27.5**
Chronic Lymphoblastic leukemia(CLL)	**4.6**	**6.3**	**3**	**1.3**	**2**	**0.9**	**82.5**	**82.7**	**82.6**
Chronic myeloid leukemia(CML)	**1.8**	**2.3**	**1.3**	**0.3**	**0.4**	**0.2**	**65**	**64.3**	**66**

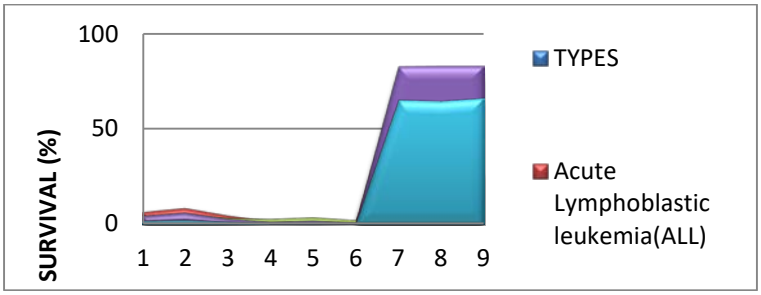
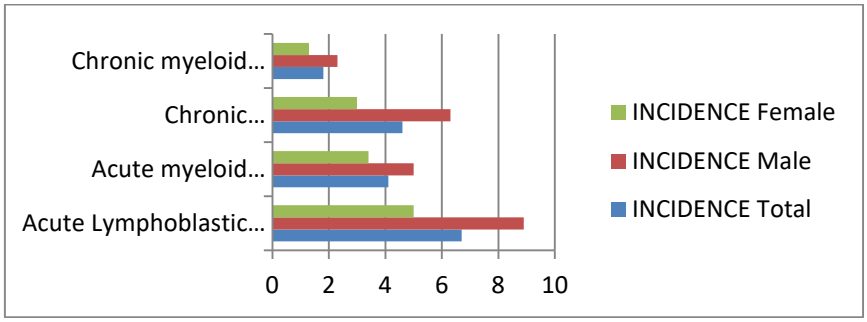
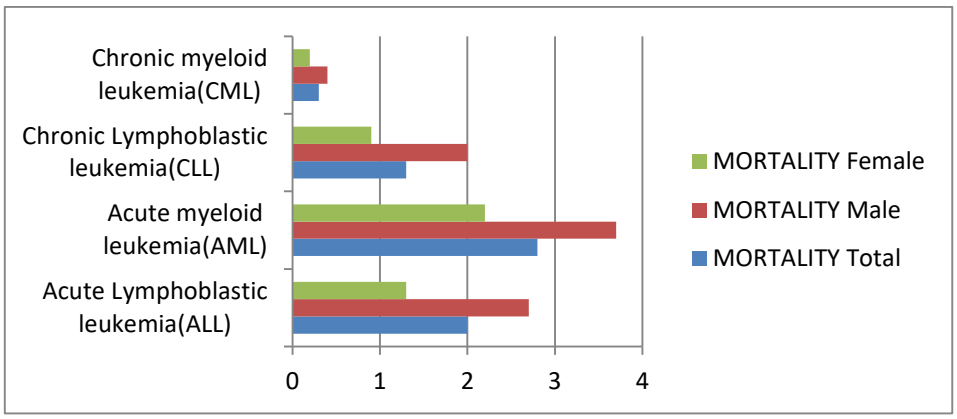


Fig.(i) Survival details for all histological types.



Fig(ii) Incidence details for all histological types.



Fig(iii) Mortality details for all histological types.

5. Discussion

Armitage –Doll model was found to be best- fit method. In the present study, the differences among histological subtypes were highlighted by the number of stages in cancer induction and the death rate of comparison for each types. In fig(ii), ALL had the largest incidence for the Male and female among CML,CLL,AML and in fig (iii) AML had the largest Morality for both Male and Female among CML,CLL,ALL. But fig(i) the total analysis of Survival percent is very high only in CLL. All difference was found to be statistically significant at the 5% level.

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