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MATHEMATICAL MODEL FOR DETECTING DIABETES AND STATISTICAL ANALYSIS

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ABSTRACT

This study presents a new Mathematical model to detect the diabetes in human being and their statistical Analysis. The model takes into account all plasma glucose concentration, generalized insulin and plasma insulin concentration. We have taken value of fasting & PP blood sugar of various persons and indicated our findings on the basis of statistical Analysis.

Keywords: *Mathematical Model, diabetes mellitus, Glucose regulatory, Insulin system, statistical analysis.*

I. INTRODUCTION

Over the past years, Mathematics & Statistics have been used to understand and predict the spread of diseases, Public health question to the basic parameters. Diabetes is a disease which is characterized by high sugar level in blood & urine. It is worldwide admitted that diabetes is sweeping the globe silent epidemic largely contributed to the growing burden of non communicable diseases. As per the data shared by world Health organization [1] and International Diabetes endocrine metabolic system characterized by hypoglycemia, which is due to acute sign of excess urine produced resulting compensatory thrust, loss of weight & changes in energy metabolism. In 1980 world Health organization classified the Diabetes of two types i.e. Type-1 & Type-2. Type-1 stands for Insulin Dependent Diabetes Mellitus,Type-2 stands for non Insulin Dependent Mellitus. As per study, there are over 20 million diabetes in America, 6 million of whom must take injection of Insulin daily. Various mathematical & statistical models were devoted to dynamics of Glucose insulin.

Human body need to maintain glucose concentration level in range 70-110, in morning & 90-150 after taking lunch with a gap of 2 hours.

Diabetic patients are associated with large number of abnormalities in insulin metabolism. Three more important factors, Insulin sensitivity, Glucose effectiveness, and pancreatic responsiveness play an important role for glucose disposal.

II. MATHEMATICAL MODEL

There are various mathematical models available to explain glucose | insulin intersections [2] [3] [4]. Here we are developing a mathematical model to test the Diabetes. Let p is amount of glucose concentration q be the excess Insulin concentration at any time t, then at any time t, p=q=0. It is condition of equilibrium. If either p or q is non zero value then body tries to restore the equilibrium. Let us assume that the rate of change of these quantities depends upon the values of p & q. If there is an internal rate at which the glucose concentration is increased and it is assumed that, there is no recent digestion, the following system of differential equations are given by

$\frac{dp}{dt}$ = -ap – bq + re ----------2.1

$\frac{dq}{dt}$ = cp – dq + kr ----------2.2

$\frac{de}{dt}$ = -lp – mq – nr ----------2.3

Where a,b,c,d,k,l,m & n are constants

Differentiating equation (2.1) w.r.t, t, we have

$\frac{d^2p}{dt^2}$ = -a $\frac{dp}{dt}$ - b $\frac{dq}{dt}$ + r $\frac{de}{dt}$ ----------2.4

Now putting the values of $\frac{dq}{dt}$ and $\frac{de}{dt}$ from (2.2) & (2.3) in (2.4), we have

$\frac{d^2p}{dt^2}$ + a $\frac{dp}{dt}$ + (bc+rl)p +(b.k – rn)e + (rm – bd)q = 0 ----------2.5

From equation (2.5), we have

e = $\frac{1}{r}$ ($\frac{dp}{dt}$ + ap)

From equation (2.1) and also assuming q=0

We have

$\frac{d^2p}{dt^2}$ + ($\frac{bk}{r}$ + a – n) $\frac{dp}{dt}$ + (bc + rl + $\frac{bka}{r}$ – na) p = 0

This is of the form of

$\frac{d^2p}{dt^2}$ + 2 α $\frac{dp}{dt}$ + w_0^2 = 0 ----------2.6

α = $\frac{1}{2}$ ($\frac{bk}{r}$ + a – n)

and w_0^2 = ($\frac{1}{r}$ bka + bc + rl – na)

where w_0 is the basic descriptor of the response to Glucose tolerance tosil (GTT).

Above model confirms to predicting that the blood glucose concentration tends to return its normal concentrations. It has been assumed that α^2- w_0^2 is negative, i.e. characteristic roots of equation (2.4) will have the complete roots. If α^2 - w_0^2 > 0, that p(t) drops very rapidly from a fairly high values to negative ones below the equilibrium value. Therefore the human body will interpret as an extreme emergency and large amounts of epinephrine will be secreted.

III. STATISTICAL ANALYSIS OF DIABETIC PATIENTS

We have taken the blood sugar reports of 20 diabetic patients at random from one of reputed hospital & pathology of lucknow so perform the staticscal analysis. Report consists of fasting & PP blood sugar.

S.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Fasting BS	80	105	110	115	110	108	103	100	110	120	115	114	95	88	98	100	106	135	140	125
PP BS	115	135	125	140	128	130	145	160	180	175	165	180	190	130	205	125	130	190	205	200

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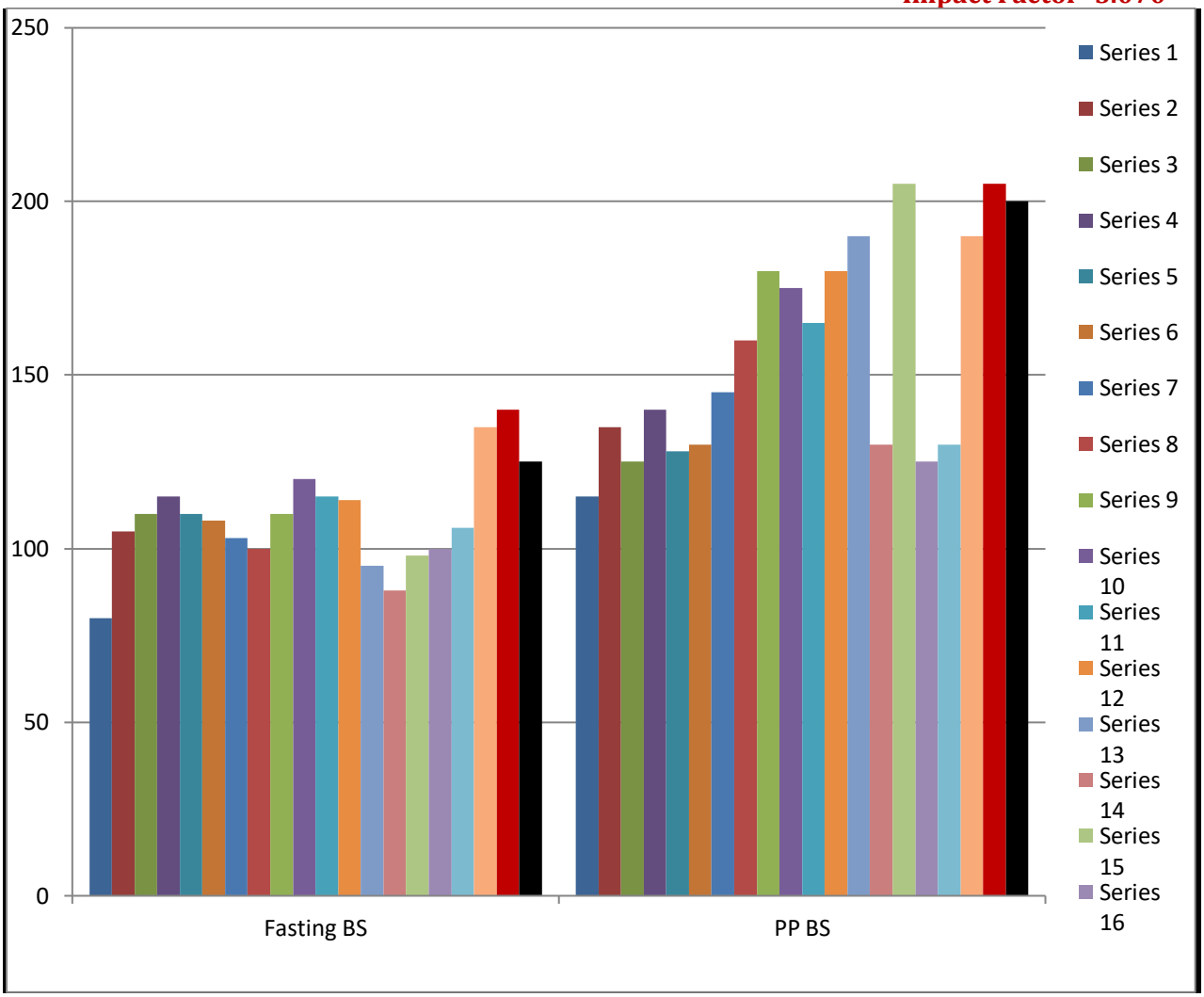

From above numerical & geometrical interpretation, we observe that, in general there is direct positive correlation between fasting & P.P. value of a patient. In some exceptional cases P.P. values of patient decreases in comparison to fasting value it is alarming situation. Every diabetic patient is required to maintain the fasting values in between 70 to 110 mg and PP values in between 90 to 150 mg. Further it is suggested that they should go for HVIAC for average blood sugar of three months to avoid further abnormalities.

REFERENCES

1. *The World health report : Today's Challenges. [http://www.who.int/whr/2003/en] website Geneva, World Health Organization*
2. *International Diabetes Federation: IFD report. [http://www.idf.org/home/index.cfm] website 2003.*
3. *Sarah Wild, Gojka Roglic, Anders Green, Richard Sicree, Hilary Kind (2004): Global Prevalence of Diabetes, Estimates for the year 2000 and projections for 2030. Diabetes Care 27:1047-1053.*
4. *Pacini, G. and Bergman, R.N. (1986) MINMOD: A computer program to calculate insulin sensitivity and pancreatic responsively from the frequently sampled intravenous glucose tolerance test. Computer Methods and Programs in Biomedicine, 23, 113-122.*

5. *Sh. Yasini, M.B. Naghibi-Sistani, A Karimpour (2009): Agent-based Simulation for Blood Glucose Control in Diabetic Patients. International journal of Applied science, Engineering and Technology 5:1*
6. *Read abu zitar (2003): Towards neural network model for insulin/glucose in Diabetes. International journal of computing and information sciences, Vol 1, No. 1.*