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Analysis of Hypertension Factors in Diabetic Patients Using Mathematical Model

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Abstract: ***Hypertension is an extremely common co-morbidity of diabetes, affecting 20–60% of individuals with diabetes. Hypertension (HP) is commonly found in large number of diabetic peoples in Tamil Nadu. Therefore, hypertension should be screened for and promptly diagnosed with aggressive blood glucose and lipid profile control in patients with diabetes. In this paper to find out the major diagnostic factors to develop the hypertension in diabetic patients using fuzzy relational map (FRM). Based on this study the major risk factor of hypertension and the preventing measure using it is determined.***

Keywords: Hypertension, Diabetic, Fuzzy relational map, Glucose

1. Introduction

Hypertension is an extremely common co-morbidity of diabetes, affecting 20–60% of individuals with diabetes. The prevalence of hypertension in the diabetic population is 1.5 to 3 times higher than that of non-diabetic age-matched groups. Many patients with diabetes have hypertension at the time of diagnosis, while others develop hypertension as the duration of the disease lengthens. Conversely a number of patients with systemic hypertension develop diabetes in the course of their disease. Therefore, hypertension should be screened for and promptly diagnosed with aggressive blood glucose and lipid profile control instituted in all patients with diabetes [1, 2].

In Vasantha Kandaswamy and Yasmin sultana [3] a new notion called Fuzzy Relational Maps (FRMs) was introduced. To define a FRM a domain space and a range space which are disjoint in the sense of concepts is needed. The number of elements in the range space need not in general be equal to the number of elements in the domain space. In FRMs the very causal associations is divided into two disjoint units for example the relationship between a teacher and a student or relation between doctor and patient and so on. Further it is assumed that no intermediate relations exist within the domain element or node and the range space. Hypertension can be defined as a blood carried from the heart to all parts of the body in the vessels. Each time the heart beats it pumps blood into the vessels (arteries) as it pumped by the heart. Blood pressure measurements for diabetic patients are classified into the four categories: 1.Normal blood pressure less than 120/80, 2. Pre-hypertension 120-139/80-89, 3.High blood pressure (stage 1) 140-159/90- 99 and 4. High blood pressure (stage 2) higher than 160/100. FRM model is used to find out the major diagnostic factor to develop the hypertension in diabetic patients [5]. Diabetic is the major risk factor for hypertension [5, 6].

2. Fuzzy Relational Maps (FRMs)

In Fuzzy relational maps (FRMs) the elements of the domain space are taken from the real vector space of dimension n and that of the range space are real vectors from the vector dimension m (m in general need not be equal to n). Denote R as the set of nodes R1,…,Rm of the range space, where R={(X1,…,Xm)/Xj=0 or 1} for j=1,2,…,m. if Xi=1 it means that the node Ri is in the ON state and if Xi=0 it means that the node Ri is in the OFF state. Similarly D denotes the nodes D1, D2,…,Dn of the domain space, where D={(X1,…,Xn/Xj=0 or 1} for i=1,2,…,n if Xi=1 it means that the node Di is in the ON state and if Xi=0 it means that the node Di is in the OFF state [3].

Definition 1.1.1:
Let Di Rj (or Rj Di), 1≤ j ≤ m, 1≤ I ≤ n.when Ri (or Dj) is switched on and if causality flows through edges of the cycle and if it again causes Ri (or Dj) we say that the dynamical system goes round and round. This is true for any node Rj (or Di) for 1≤ i≤ n, (or 1≤ j≤ m) the equilibrium state of this dynamical system is called the hidden pattern.

Definition 1.1.2:
If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. Consider an FRM with R1,R2,…,Rm and D1,D2,…,Dn as nodes for example, let us start the dynamical system by switching 0on R1(or D1).let us assume that the FRM settles down with R1 and Rm(or D1 and Dn) ON i.e.)the state vector remains as((1,0,…,0,1) in R) or ((1,0,…,0,1)in D).this state vector is called the fixed point.

Definition 1.1.3:
If the FRM settles down with a state vector repeating in the form
A1→A2→A3→…→Ai→A1(orB1→B2→…→Bi→B1)
then this equilibrium is called a limit cycle

Methods of determining the hidden pattern
Let R1, R2…Rm and D1, D2…Dn be the nodes of a FRM with feedback. Let E be the relational matrix. Let us find a hidden pattern when D1 is switched on i.e. When an input is given as vector A1= (1, 0…0) in D1, the data should pass through the relational matrix. This is done by multiplying A1with the relational matrix E. Let A1E= (r1, r2…rm), after thersholding and updating the resultant vector we get

$A1E_{\varepsilon}R$.Now let B=A1E, we pass on B into E^T and obtain BE^T. We update and threshold the vector BE^T so that $BE^T{}_{\varepsilon}D$. This procedure is repeated till we get a limit cycle or a fixed point [7, 8].

Symptoms of hypertension

According to research studies, the risk of dying of a heart attack is directly linked to high blood pressure particularly systolic hypertension. High blood pressure usually causes no symptoms and high blood pressure often labeled"the silent killer"people who have high blood pressure typically don't know it until their blood pressure is measured sometimes people with markedly elevated blood pressure may develop Headache, dizziness, blurred vision, nausea, vomiting, chest pain, shortness of breath, People often do not seek medical care until they have no symptoms arising from organ damage caused by chronic high blood pressure .the organ damage are commonly seen in chronic high blood pressure [9].

Basic Model

The relational between the risk factors and the symptoms of diabetes among adults using fuzzy relational maps A. Victor Devadoss *et al* [10] Diabetes is a problem body fuel system which is Cause due to lack of insulin hormone in the pancreases that is essential for getting energy from food causes of diabetes continues to be a mystery till now it is both genetic and environmental factors. The main causes may be due to genetics and environmental factors. The study shows that diabetes patients increase in the urban population because the low amount of physical activity in the urban population. This leads to increasing urbanization tends to lower the physical activity worldwide.

3. Model: Implementation of FRM Model in Study of Hypertension Problem

100 diabetic patients were interviewed using a linguistic questionnaire regarding hypertension for a period of one month in the Sivaprithi hospital (Thanjavur, Tamil Nadu). The fuzzy concepts, attributes are first given in the form of matrix relational equations and then solved. The patients who have been investigated reported the symptoms of Hypertension. FRM model is used to find the major diagnostic factor develop the hypertension in diabetic patients. Diabetes is assessable on the basis of the diagnosis by ascertaining Glucose, Cholesterol, Triglyceride, Being weight loss, Heamoglobin, Age, Having family history, Insulin, HDL Cholesterol and Other medical problems.

Attributes related to diagnostic factors

The domain space R connected with the diagnostic factors are given by R= {R1, R2…R10}
R1: Glucose
R2: Cholesterol
R3: Triglyceride
R4: Being weight loss
R5: Heamoglobin
R6: Age
R7: Having family history
R8: Insulin
R9: HDL Cholesterol
R10 Other medical problems

Attributes related to the symptoms
The Range space S connected with the symptoms are given by S= {S1, S2…S7}
S1: Headache
S2: Dizziness
S3: Nausea
S4: Chest pain
S5: Blurred vision
S6: Shortness of breath
S7: Tiredness

First Expert's Opinion
The opinion of the first expert is a hypertension from urban and is given vital importance. This opinion is transformed into the fuzzy relational matrix M1 is given by

$$M_1 = \begin{array}{c} \\ R1 \\ R2 \\ R3 \\ R4 \\ R5 \\ R6 \\ R7 \\ R8 \\ R9 \\ R10 \end{array} \begin{pmatrix} S1 & S2 & S3 & S4 & S5 & S6 & S7 \\ 1 & 1 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 & 1 & 1 \end{pmatrix}$$

The hidden pattern of the state X= (0 0 0 1 0 0 0 0 0 0) is obtained by the following method

$XM_1 \hookrightarrow (1\ 1\ 0\ 1\ 1\ 1\ 1) = Y$

$YM_1 \hookrightarrow (1\ 1\ 0\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = X_1$

$X_1M_1 \hookrightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1) = Y_1$

($\hookrightarrow$ Where denotes after thresholding and updating the resultant vector)

When only the nodes R1 Glucose in the ON state and all other attributes to be in the OFF state then all the nodes in the domain space come to ON state. It is seen that the effect of X on the dynamical system M is a fixed point given by the binary pair {(1101111111) (1111111)}.When having glucose node alone in the ON state and let X= (1111111), then the resultant is the fixed point given by the binary pair {(1101111111) (1111111)}.When ON state is taken as node R1. It is seen that the hidden pattern is the fixed point. This is the same binary pair which makes all the nodes to be in the ON state in the Domain Space and also it makes all the nodes in the range space to be in ON state.

4. Conclusion

Hypertension is a silent killer and it is the major risk factor for Diabetic. Based on the graph blood glucose, cholesterol, triglycerides leads to the risks of hypertension. From the study, it is seen that while using FRM, blood glucose is the

major risk factor for hypertension. Hypertension may be prevented by living a healthy lifestyle such as eating a nutritious, low fat diet, exercising regularly, maintaining a healthy weight, monitoring blood glucose level and reduce stress in day to day life.

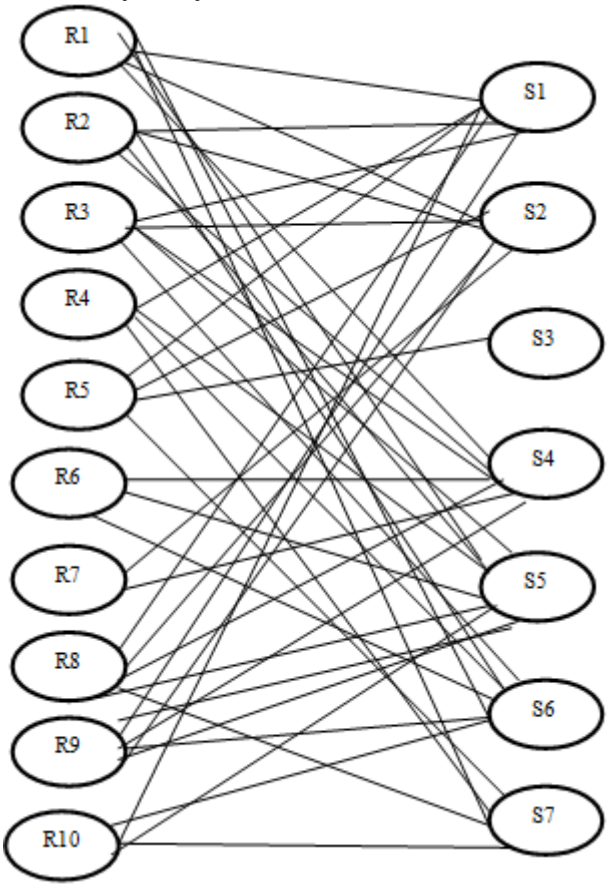

Figure 1: Diagrammatic representation of FRM

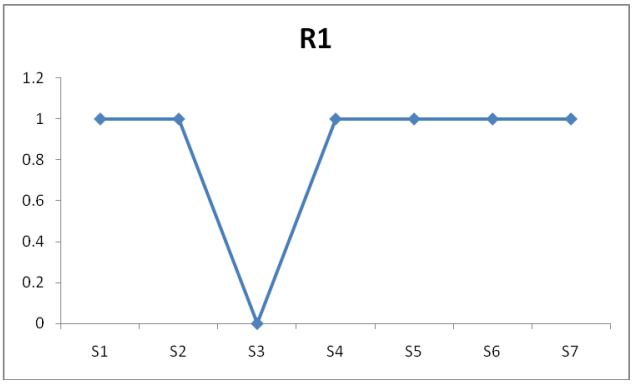

Figure 2: Glucose vs Symptoms

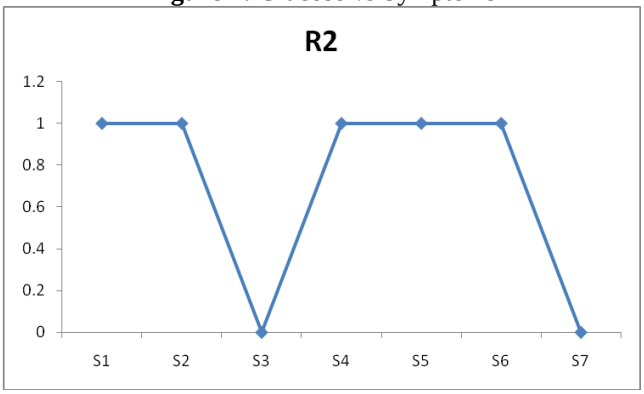

Figure 3: Cholesterol vs Symptoms

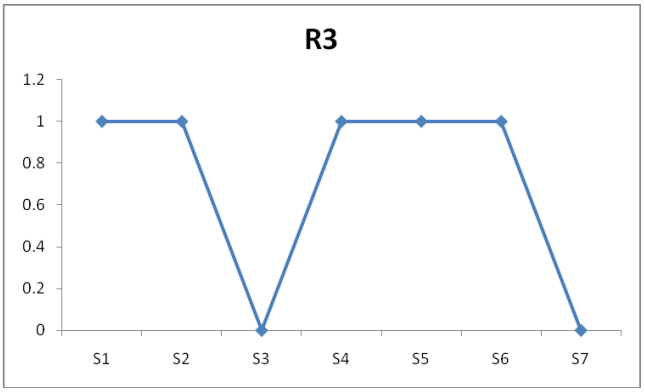

Figure 4: Triglycerides vs Symptoms

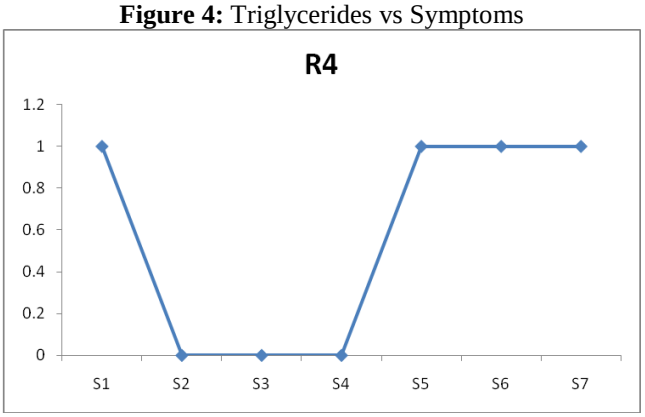

Figure 5: Being weight loss vs Symptoms

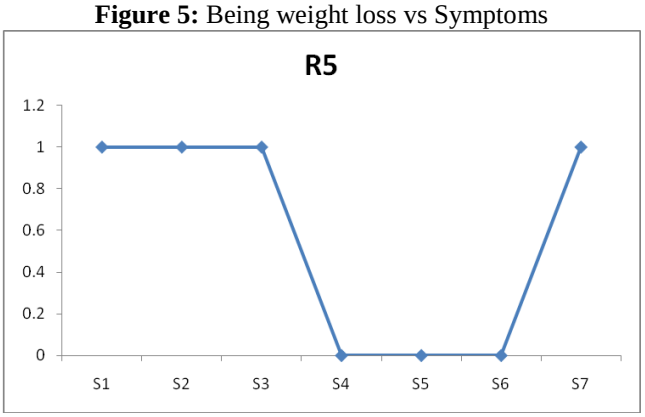

Figure 6: Heamoglobin vs Symptoms

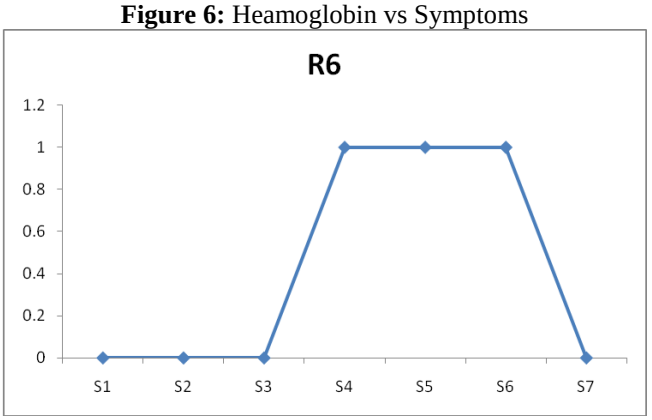

Figure 7: Age vs Symptoms

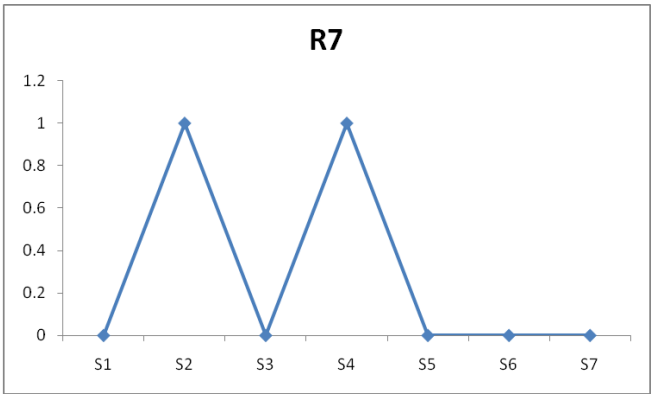

Figure 8: Family history vs Symptoms

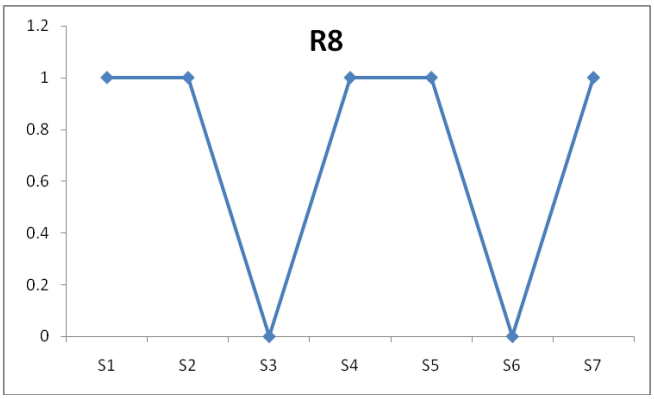

Figure 9: Insulin vs Symptoms

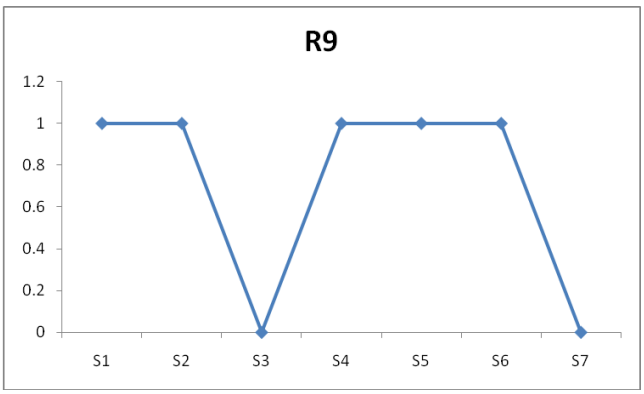

Figure 10: HDL cholesterol vs Symptoms

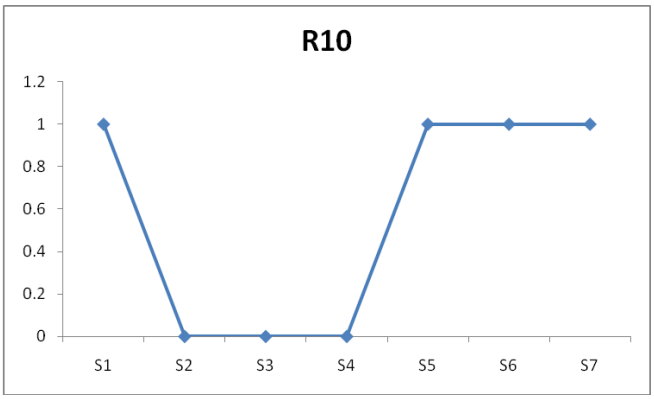

Figure 11: Other medical problems vs Symptoms

References

[1] Senthil KK, Babu K, Kumar MP, Zuber Mand Nithin Raj K. 2012 A Comparative Study of the Hypertension and Diabetes Mellitus Affected Patients in Warangal District. International Journal of Research in Pharmaceutical and Biomedical Sciences. 3 (1): 60 -68

[2] Ahmed N. Advanced glycation endproducts—role in pathology of diabetic complications. *Diabetes Research and Clinical Practice* 67: 2005; 3–21.

[3] Vasantha Kandaswamy W.B and Yasmin sultana FRM to analyses the Employee-Employer relationship model. Bihar math.soc.21 (2001); 25-34.

[4] NICE/BHS clinical guideline 34: hypertension: management of hypertension in adult in primary care: partial update http://www.nice.org.uk/CG034 guidance (accessed June 28, 2006).

[5] Poljicanin T, Ajdukovic D, Sekerija D, Pibernik-Okanovic M, Metelko Z and Mavrinac GV Diabetes mellitus and hypertension have comparable adverse effects on health-related quality of life. BMC Public Health 2010, 10:12.

[6] Roger VL., S.Alan, Donald M, Lloyd-jones, Robert J.Adams, Jarett D.Berry,Todd M.Brown, (2010) heart diseases and stroke statistics 2011 update. A report from the American Heart association circulation 123(4):e18-e209.

[7] KoskoBart Neural Networks and Fuzzy systems.prentince-hall Englewood cliffs, New Jersy (1992).

[8] KoskoBart, Fuzzy Cognitive Maps, International Journal of Man-Machine studies (1986)34, 65-75.

[9] WHO (World Health Organization) India mortality country factsheet. Retrived from http:www.who.int/whosis/mort/profiles/mort_searo_ind_ india.pdf (2006).

[10] Victor Devadoss A, V.Susanna Mystica, The living experience of a diabetic adult in India using Fuzzy Relational Maps (FRM), World-comp.org/P2011/BIC 3157.Pdf July 21,2011(the 2011 world congress in computer science, computer engineering and applied computing Las Vegas, Nevada, USA July 18-21.