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A Combined Effective Time Dependent Matrix Approach to Analyze the Men Affected by Cardiovascular Disease (CVD) in Chennai

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Abstract: ***The objective of this paper is to find out the peak age of Men affected by cardiovascular disease in Chennai. For that we have collected the data and analyzed the same disease. For the first time in 1998, fuzzy matrix theory was developed by W.B. Vasantha and V. Indira to study the passenger transportation. To study this problem, they divided and defined four types of matrices called Initial Raw Data Matrix, Average Time Dependent Data matrix (ATD Matrix), Refined Time Dependent Data matrix (RTD Matrix) and Combined Effect Time Dependent Data Matrix (CETD Matrix). In the year 2003 the same technique was used by W.B. Vasantha to study the migrant laborers who were affected by HIV/AIDS. In 2012 and 2013, A. Victor Devadoss, M. Clement Joe Anand and A. Felix have studied dimensions of personality of men and women separately using this model. A CETD Matrix Approach to analyze the dimensions of personality of person in 2014 by the same authors. Now we use this model to study the Men affected by cardiovascular disease in Chennai.***

Keywords: Average Time Dependent Data matrix, Refined Time Dependent Data matrix, Combined Effect Time Dependent Data Matrix and cardiovascular disease.

1. INTRODUCTION

This paper has four sections. In the first section we must recall the methods of applications of CETD matrix. In section two we describe the causes of Cardiovascular Disease. In section three we apply the main causes of the CVD by using CETD model to find out the peak age of group of men affected by Cardiovascular Disease. In the final section we derived conclusions and gives suggestions based on our study.

1.1. The method of application of CETD matrix:

We give a very simple but a very effective technique on the collected data. From that data we recognized Men affected by Cardiovascular Disease. Based on the words, emotions and sentiments given by the Men, six attributes are chosen and the entries are recorded in a form of matrix by taking ages along the columns and the disease along the rows.

1.2. Average Time Dependent (ATD) matrix:

Raw data transform it into a raw time dependent data matrix by taking along the rows the age group and along the columns disease using the raw data matrix we make it into the Average Time Dependent Data (ATD) matrix (a_{ij}) by dividing each entry of the raw data matrix by the number of years i.e., the time period. This matrix represents a data, which is totally uniform.

At the third stage we find the average and Standard Deviation (S.D) of every column in the ATD matrix.

1.3. Refined Time Dependent (RTD) matrix:

Using the average μ_j of each j^{th} column and σ_j the S.D of the each j^{th} column we chose a parameter α from the interval [0,1] and the Refined time dependent Matrix (RTD matrix),

Using the formula,

$$a_{ij} \leq (\mu_j - \alpha^* \sigma_j) \text{ then } e_{ij} = -1 \text{ else}$$
$$\text{if } a_{ij} \in (\mu_j - \alpha^* \sigma_j, \mu_j + \alpha^* \sigma_j) \text{ then } e_{ij} = 0 \text{ else}$$
$$\text{if} a_{ij} \geq (\mu_j + \alpha^* \sigma_j) \text{ then } e_{ij} = 1$$

We redefine the ATD matrix into the Refined time dependent fuzzy matrix for here the entries are -1, 0 or 1. Now the row sum of this matrix gives the maximum age group.

1.4. Combined Effective Time Dependent Data (CETD) matrix:

We also combine the above RTD matrices by varying the $\alpha \in [0,1]$, so that we get the Combined Effective Time Dependent Data (CETD) matrix. The row sum is obtained for CETD matrix and conclusions are derived based on the row sums. All these are represented by graphs and graphs play a vital role in exhibiting the data by the simplest means, which can be even understood by a layman.

2. CARDIOVASCULAR DISEASE

Heart is one of our body's most important organs. Essentially a pump, the heart is a muscle made up of four chambers separated by valves and divided into two halves. Each half contains one chamber called an atrium and one called a ventricle. The atria (plural for atrium) collect blood, and the ventricles contract to push blood out of the heart. The right

half of the heart pumps oxygen-poor blood (blood that has a low amount of oxygen) to the lungs where blood cells can obtain more oxygen. Then, the newly oxygenated blood travels from the lungs into the left atrium and the left ventricle. The left ventricle pumps the newly oxygen-rich blood to the organs and tissues of the body. This oxygen provides your body with energy and is essential to keep your body healthy.

What is cardiovascular disease?

The cardiovascular system is made up of the heart and blood vessels. Cardiovascular disease (CVD) is defined as any serious, abnormal condition of the heart or blood vessels (arteries, veins). Cardiovascular disease includes coronary heart disease (CHD), stroke, peripheral vascular disease, congenital heart disease, endocarditis, and many other conditions. Many cardiovascular diseases are preventable.

What are the risk factors for CVD?

Risk factors are variables that predict who is most likely to develop CVD. Most of the risk factors for cardiovascular disease and stroke are modifiable or entirely preventable. By modifying risk factors, you decrease the chances of getting diseases. Modifiable risk factors include tobacco use, high blood pressure, physical inactivity, high blood cholesterol, obesity, heavy alcohol consumption, and poor nutrition. Non-modifiable risk factors are age and family history. The more risk factors one has, the higher the risk of developing disease.

Smoking:
Smoking harms nearly every organ in the body, including the heart, blood vessels, lungs, eyes, mouth, reproductive organs, bones, bladder and digestive organs. The chemical in tobacco smoke harm our blood cells. They also can damage the function of our heart and the structure and function of our blood vessels. This damage increases the risk of atherosclerosis, which is a disease in which a waxy substantial called plaque builds up in the arteries. Over time, plaque hardens and narrows our arteries. This limits the flow of oxygen rich blood to our organs and other parts of our body.

Drinking:
Heavy, long term drinking damages our heart by weakening our heart muscle and causing a condition known as alcoholic cardiomyopathy. Drinking too much alcohol can raise the levels of some fats in the blood. It can also lead to high blood pressure, heart failure and an increased calorie intake. Excessive drinking and binge drinking can lead to stroke and sudden cardiac death.

High cholesterol:
When there is to much cholesterol in our blood, it builds up in the walls of or arteries, causing a process called atherosclerosis, a form of heart disease. The arteries become narrowed and blood flow to the heart muscle is slowed down or blocked.
The blood carries oxygen to the heart and if enough blood and oxygen cannot reach our heart, we may suffer chest pain. If the blood supply to a portion of the heart is completely cut off by a blockage, the result is a heart attack.

Diabetes:
Diabetes can change the makeup of blood vessels, and this can lead to cardiovascular disease. The lining of the blood vessels may become thicker, and this in turn can impair blood flow. Uncontrolled diabetes causes damage to our body's blood vessels making them more prone to damage from atherosclerosis and hypertension. People with diabetes develop atherosclerosis at a younger age and more severely than people without diabetes. Hypertension is more than twice as common in people with diabetes as in people with normal blood glucose levels. People with diabetes are more likely to have a heart attack or stroke, than people who do not, and their prognosis is worse. If we have diabetes you can have a heart attack without realizing it. Diabetes can damage nerves as well as blood vessels so a heart attack can be 'silent' that is lacking the typical chest pain. If you have diabetes you have a two- to three-fold greater risk of heart failure compared to people without diabetes.

High blood pressure:
High blood pressure increases the risk of coronary artery disease (also called atherosclerosis). Coronary Artery disease is the buildup of plaque or fatty matter in the walls of the coronary arteries, this build up leads to narrowing of the arteries over time. The narrowed artery limits or blocks the flow of blood to the heart muscle .the hardened surface of the artery can also encourage the formation of small blood clots. People with high blood pressure are more likely to develop coronary artery disease because high blood pressure puts added force against the artery walls. Overtime; this extra pressure can damage the arteries. These injured arteries are more likely to become narrowed and hardened by fatty deposits. Damaged arteries cannot deliver enough oxygen to other parts of the body. For this reason, high blood pressure can harm the brain and kidneys. High blood pressure also increases the risk for strike, congestive heart failure, kidney disease and blindness.

Abdominal Obesity:
If we have a big belly, we have intra – abdominal fat. This fat affects our blood pressure. Our blood lipid levels and interferes with our ability to use insulin effectively. We use insulin to process glucose derived from food, our body's primary fuel. If we cannot use insulin properly we may develop diabetes, a risk factor of cardiovascular disease. As our body mass index rises, so does our risk for coronary heart disease (CHD).CHD is a condition in which a waxy substance called plaque builds up inside the coronary arteries. These arteries supply oxygen – rich blood to our heart. Plaque can narrow or block the coronary arteries and reduce blood flow to the heart muscle. This can cause angina or heart attack. Angina is chest pain or discomfort. Obesity also can lead to heart failure. This is a serious condition in which our heart cannot pump enough blood to meet our body's needs. Blood pressure is the force of blood pushing the walls of the arteries as the heart pumps blood. If this pressure rises and stays high over time, it can damage the body in many ways. Our chances of having high blood pressure are greater if you are overweight or obese.

3. DESCRIPTION OF THE PROBLEM

In this research we give an algebraic approach to the men affected by the cardiovascular disease in Chennai. For that we have interviewed and recorded 100 men in different ages in Chennai. We analyze these problem using fuzzy matrix, we call

the RTD Matrix as fuzzy matrix for that take their entries from the set {-1, 0, 1}. So the terms RTD matrix or fuzzy matrix mean one and the same matrix.

One of the major and broad its heads of the study causes of Cardiovascular Disease. In this research will discuss six causes' men affected by CVD. Which are taken as the columns of the initial row data matrix the age group in years, 20-27, 28-35, 36-45, 46-53, 54-65, 66-75 and 76-80. The estimation of the maximum age group is five-stage process. In the first stage we give the matrix representation of the raw data. Entries corresponding to the intersection of rows and columns are values corresponding to the live network. The 3 x 6 matrix is not uniform i.e. the number of individual years in each interval may not be the same. So in the second stage we in order to obtain an unbiased uniform effect on each and every data so collected, transform this initial matrix into an Average Time Dependent Data (ATD) matrix. To make the calculations easier and simpler we in the third stage using the simple average techniques convert the above average time dependent data matrix in to a matrix with entries $e_{ij} \in \{-1,0,1\}$. We name this matrix as the Refined Time Dependent Data Matrix (RTD Matrix) or as the fuzzy matrix. The value of e_{ij} corresponding to each entry is determined in a special way described. At the fourth stage using the fuzzy matrices we obtain the Combined Effect Time Dependent Data Matrix (CETD Matrix), which gives the cumulative effect of all these entries. In the final stage we obtain the row sums of the CETD matrix. The tables given are self-explanatory at each stage. The graph of the RTD matrix and CETD matrix are given.

3.1 Estimation of maximum age group of men affected by cardiovascular disease by using 4 X 6 matrices

In this section we apply main causes i.e., O_1-Smoking/drinking, O_2- Abnormal Cholesterol, O_3- Diabetes, O_4-High blood pressure, O_5-Abdominal obesity and O_6-Sedentary lifestyle of men to the CETD model.

Table 1: Initial Raw data Matrix of order 4 X 6

Age	O_1	O_2	O_3	O_4	O_5	O_6
20-35	9	5	5	11	7	7
36-53	29	30	19	28	23	31
54-75	23	25	28	28	22	22
76-80	10	6	8	9	13	5

Table 2: ATD Matrix of order 4 X 6

Age	O_1	O_2	O_3	O_4	O_5	O_6
20-35	0.56	0.31	0.31	0.69	0.44	0.44
36-53	1.61	1.67	1.06	1.56	1.28	1.72
54-75	1.05	1.14	1.27	1.27	1	1
76-80	2	1.2	1.6	1.8	2.6	1

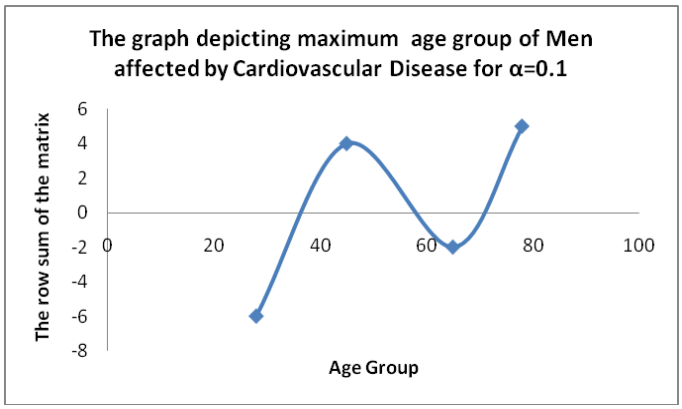
Table 3: Average and S.D of the above given ATD Matrix

Average	1.31	1.08	1.06	1.33	1.33	1.04
S.D	0.63	0.64	0.55	0.48	0.92	0.52

We have taken the value α = 0.1, 0.3, 0.5 and 0.7 to find the CETD Matrix.

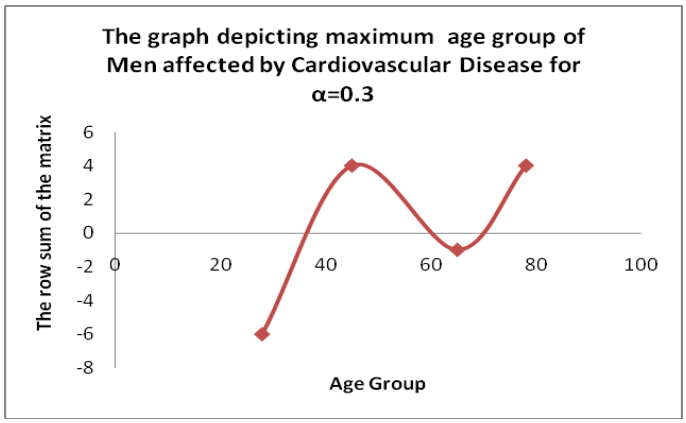
The RTD Matrix for α =0.1 Row sum Matrix

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ 1 & 1 & 0 & 1 & 0 & 1 \\ -1 & 0 & 1 & -1 & -1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 \end{bmatrix} \qquad \begin{bmatrix} -6 \\ 4 \\ -2 \\ 5 \end{bmatrix}$$



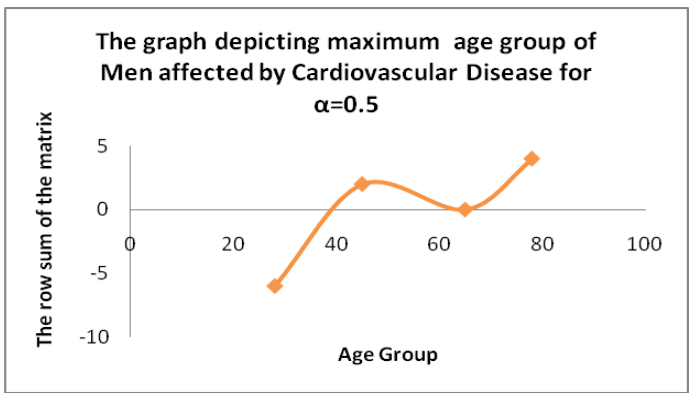
The RTD Matrix for α =0.3 Row sum Matrix

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ 1 & 1 & 0 & 1 & 0 & 1 \\ -1 & 0 & 1 & 0 & -1 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 \end{bmatrix} \qquad \begin{bmatrix} -6 \\ 4 \\ -1 \\ 4 \end{bmatrix}$$



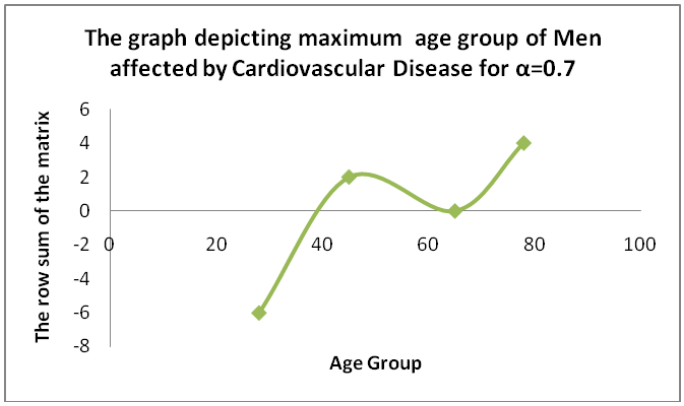
The RTD Matrix for α =0.5 Row sum Matrix

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 \end{bmatrix} \qquad \begin{bmatrix} -6 \\ 2 \\ 0 \\ 4 \end{bmatrix}$$



The RTD Matrix for α =0.7 Row sum Matrix

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 \end{bmatrix} \qquad \begin{bmatrix} -6 \\ 2 \\ 0 \\ 4 \end{bmatrix}$$

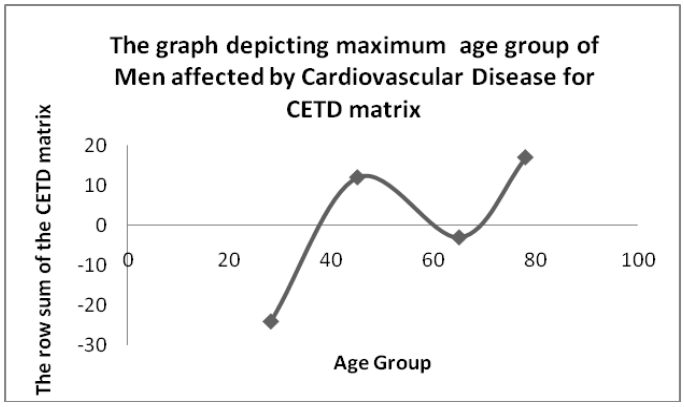


The CETD Matrix

$$\begin{bmatrix} -4 & -4 & -4 & -4 & -4 & -4 \\ 2 & 4 & 0 & 2 & 0 & 4 \\ -2 & 0 & 2 & -1 & -2 & 0 \\ 4 & 1 & 4 & 4 & 4 & 0 \end{bmatrix}$$

Row sum Matrix

$$\begin{bmatrix} -24 \\ 12 \\ -3 \\ 17 \end{bmatrix}$$



3.2 Estimation of maximum age group of men affected by cardiovascular disease by using 7 X 6 matrices

Table 4: Initial Raw data Matrix of order 7x6

Age	O_1	O_2	O_3	O_4	O_5	O_6
20-27	6	2	1	3	2	4
28-35	3	3	4	8	5	3
36-45	15	18	10	16	12	16
46-53	14	12	9	12	11	15
54-65	8	9	12	11	10	9
66-75	15	16	16	17	12	13
76-80	10	6	8	9	13	5

Table 5: The ATD Matrix of order 7x6

Age	O_1	O_2	O_3	O_4	O_5	O_6
20-27	0.75	0.25	0.13	0.38	0.25	0.5
28-35	0.38	0.38	0.5	1	0.63	0.38
36-45	1.5	1.8	1	1.6	1.2	1.6
46-53	1.75	1.5	1.13	1.5	1.38	1.86
54-65	0.67	0.75	1	0.92	0.83	0.75
66-75	1.5	1.6	1.6	1.7	1.2	1.3
76-80	2	1.2	1.6	1.8	2.6	1

Table 6: Average and S.D of the above given ATD Matrix

Average	1.22	1.06	0.99	1.27	1.16	1.06
S.D	0.62	0.62	0.54	0.52	0.75	0.56

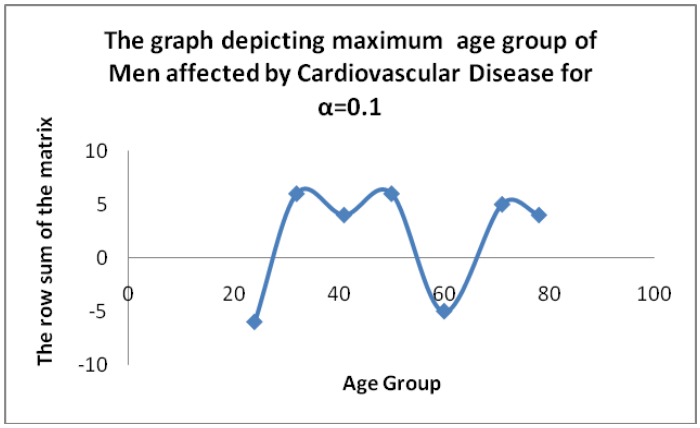
We have taken the value α = 0.1, 0.3, 0.5 and 0.7 to find the CETD Matrix.

The RTD Matrix for α =0.1

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ -1 & -1 & -1 & -1 & -1 & -1 \\ 1 & 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ -1 & -1 & 0 & -1 & -1 & -1 \\ 1 & 1 & 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 & -1 \end{bmatrix}$$

Row sum Matrix

$$\begin{bmatrix} -6 \\ -6 \\ 4 \\ 6 \\ -5 \\ 5 \\ 4 \end{bmatrix}$$

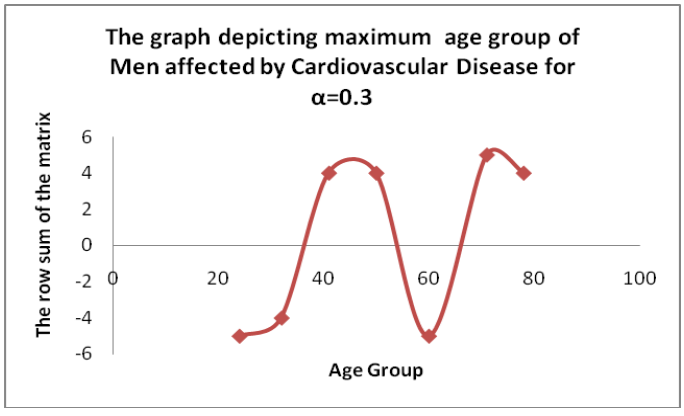


The RTD Matrix for α =0.3

$$\begin{bmatrix} -1 & -1 & 0 & -1 & -1 & -1 \\ -1 & -1 & 1 & -1 & -1 & -1 \\ 1 & 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 & 1 \\ -1 & -1 & 0 & -1 & -1 & -1 \\ 1 & 1 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

Row sum Matrix

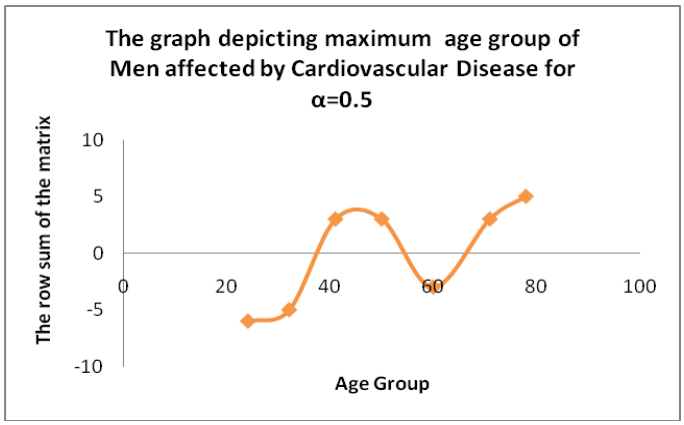
$$\begin{bmatrix} -5 \\ -4 \\ 4 \\ 4 \\ -5 \\ 5 \\ 4 \end{bmatrix}$$



The RTD Matrix for α =0.5

Row sum Matrix

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ -1 & -1 & -1 & 0 & -1 & -1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & -1 & 0 & -1 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 \end{bmatrix} \qquad \begin{bmatrix} -6 \\ -5 \\ 3 \\ 3 \\ -3 \\ 3 \\ 5 \end{bmatrix}$$

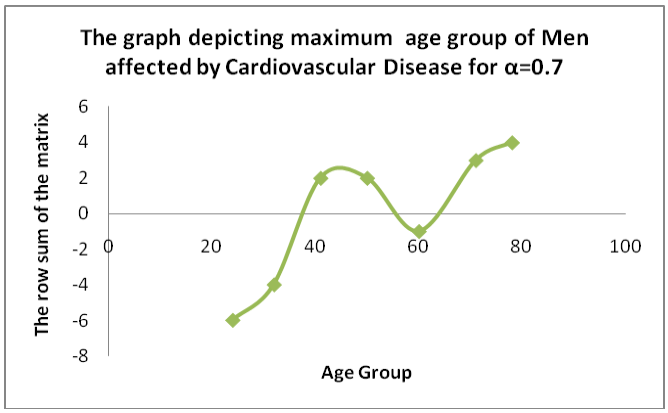


The RTD Matrix for α =0.7

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ -1 & -1 & -1 & 0 & 0 & -1 \\ 0 & 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

Row sum Matrix

$$\begin{bmatrix} -6 \\ -4 \\ 2 \\ 2 \\ -1 \\ 3 \\ 4 \end{bmatrix}$$

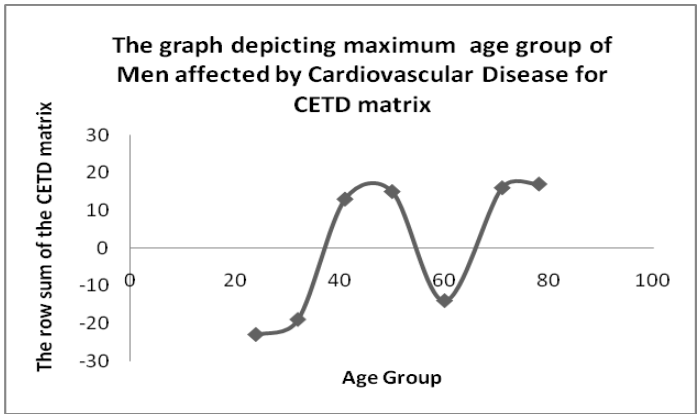


The CETD Matrix

$$\begin{bmatrix} -4 & -4 & -3 & -4 & -4 & -4 \\ -4 & -4 & -2 & -2 & -3 & -4 \\ 2 & 4 & 0 & 3 & 0 & 4 \\ 4 & 3 & 1 & 2 & 1 & 4 \\ -4 & -2 & 0 & -3 & -2 & -3 \\ 2 & 4 & 4 & 4 & 0 & 2 \\ 4 & 2 & 4 & 4 & 4 & -1 \end{bmatrix}$$

Row sum Matrix

$$\begin{bmatrix} -23 \\ -19 \\ 13 \\ 15 \\ -14 \\ 16 \\ 17 \end{bmatrix}$$



4. Conclusion and Suggestions

4.1. Conclusion

From this research, we found out the peak age of men affected by cardiovascular disease is 46 and 72. The peak period of men CVD is 42 to 49 and 70 to 74. It is shown in CETD Matrix. The main causes Smoking/drinking, Abnormal Cholesterol, Diabetes, High blood pressure, abdominal obesity and sedentary lifestyle leads to cardiovascular disease. The educated men are working in Industries, IT Sectors, Teaching filed etc., Due to work load and work pressure men are getting tension, stress depression. Improper food, not having food in right time it is also leads to cardiovascular disease.

4.2. Suggestions

Take responsibility for health: Cardiovascular disease is the major cause of death in India, accounting for 34 percent of deaths, many suddenly and almost all of them premature. This is down from 40 percent just four decades ago, mainly due to treatment of common risk factors. If you have diabetes, your risk increases dramatically. The best prevention against heart disease and stroke is to understand the risks and treatment options. The greatest risk is ignorance or misinformation. The first step is to take responsibility for your health.

Reduce Stress: Stress contributes to cardiovascular disease and, if severe, can cause a heart attack or sudden death. There are plenty of options that help reduce stress, such as regular exercise, adequate sleep, striving for a good marriage, laughing, volunteering or attending religious services. Watching TV generally does not relieve, but can aggravate stress. Also, try to avoid situations and people who make you anxious or angry.

Make exercise a daily habit: The lack of exercise is contributing to the obesity epidemic in Indians. Studies indicate that walking two miles a day is optimal for overall health, and those two miles of walking do not have to be done all at once. Exercise does more than burn calories; it also activates genes that are beneficial to health in other ways. Plus, exercise is one of the best treatments for depression and anxiety. However, exercise can control or reduce your weight.

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