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APPROXIMATE ANALYTICAL AND NUMERICAL SIMULATION OF AN ALCOHOL DRINKING MODEL

[1] **Dr.S.Kalaiselvi Natarajan, Assistant Professor of Mathematics**

The Standard Fireworks Rajaratnam College for women,sivakasi,TamilNadu-626123,India.

Abstract : In this paper, A mathematical model for the analytical and numerical simulation of an alcohol drinking model is discussed here. An approximate analytical expression for the Potential drinkers S(t), Moderate drinkers M(t), Heavy drinkers H(t), Rich heavy drinkers T(t), Poor heavy drinkers W(t),Quitters drinkers Q(t) are obtained using Homotopy Perturbation Method (HPM). The main objective is to propose an analytical solution for the synthesis of biodiesel model. Furthermore, in this paper the numerical simulation of the problem is also reported using Matlab program. An agreement between analytical solution and numerical results is noted.

***IndexTerms* - Non-Linear Equations, Mathematical Modelling, Alcoholism, HomotopyPerturbation Method, Numerical Simulation.**

I. INTRODUCTION

Alcoholism is a social phenomenon that affects all social classes and people with different educational levels and age groups and can have an impact on many aspects of life. It is a chronic disorder that causes the person to drink uncon- trollably; as a result, it can destroy people's relationships and make them lessproductiveaswellasharmtheirphysicaland mental health. Long-term abuse can also cause severe damage to the brain and liver. Alcohol has several social, economic,andhealtheffectsontheindividualandsocietyas a whole including heart disease, waste of money, poverty, crime, family disintegration, and liver disease and also causes ulcers,diabetescomplications,sexualproblems,birth defects,boneloss,visionproblems,increasedriskofcancer, and suppressed immune function which need treatment in hospitals and private or public addiction treatment centers. Alcoholismremainsoneofthemostfrequentandimportant topics discussed by the world community due to its dire consequences [1]. According to the World Health Organization (WHO),initsreport"WorldStatusReportonAlcoholand Health 2018," alcohol addiction causes the death of three millionpeopleworldwideeveryyear,whichrepresents one in every 20 deaths. For example, alcohol consumption kills more than AIDS, tuberculosis, and violence com-bined [1].

In 2016, alcohol has killed around 3 million people worldwide, compared with 3.3 million in 2012. Three quarters of the deaths are in men. According to these figures, there is a clear reduction in the number of deaths caused by alcohol addiction. In the European region and in the Americas region, the harmful consequences including illness and injury resulted from the use of alcohol are detrimental in comparison with other regions. Several diseases, more than 200, are related to alcohol consump- tion. 28% of the 3 million deaths ascribed to alcohol were linked to traffic accidents, violence, suicides, and other violent acts, 21% to digestive disorders, and 19% to car- diovascular diseases. The other cases of deaths are resulted from infectious diseases, cancers, mental disorders, and other health problems [1].

Many studies and research in social, medical, and po- litical sciences have focused on this topic and other related topics ([2–4] and the references cited therein). But the mathematical studies and research on this topic are still limited and most of them have focused on the statistical aspect of the phenomenon ([5–8]).

Mathematical models can be used to analyze the spread of infectious diseases or the social behavior of individuals [9–20]. As regard to drinking, several different mathe- maticalmodels have been formulated and studied to help in reducing the number of drinkers[17,21–25].

2. WINEBIBBER

2.1 HISTORY OF WINEBIBBER:

Alcohol consumption has a long history in India, dating back to ancient times. In traditional Indian society, the consumption of alcoholic beverages was prevalent in various forms and had cultural, social, and religious significance. Here is a brief overview of the history of alcohol drinkers in India:

Ancient Times: In ancient India, alcoholic beverages were consumed for various purposes. The Rigveda, one of the oldest sacred texts of Hinduism, mentions the use of Sura, a fermented alcoholic drink. Alcohol was used in religious rituals, social gatherings, and medicinal purposes.

Medieval Period: During the medieval period, the consumption of alcohol continued to be a common practice. Alcoholic beverages such as Toddy (palm wine), Arrack (distilled spirit), and various local brews were popular among different communities.

Colonial Era: With the arrival of European colonizers, the production and consumption of alcohol in India underwent significant changes. The British introduced Western-style distillation techniques, leading to the production of spirits like rum and whiskey. The colonial government also imposed regulations and taxes on alcohol.

2.2 METHOD OF WINEBIBBER

$$\frac{d}{dt}(S) = b - \beta_1 \frac{SM}{N} - \mu S \qquad \text{----------2.3}$$

$$\frac{d}{dt}(M) = \beta_1 \frac{SM}{N} - (\mu+\beta_2) M \qquad \text{----------2.4}$$

$$\frac{d}{dt}(H) = \beta_2 M - (\mu+\delta+\alpha_1+\alpha_2+\alpha_3) H \qquad \text{----------2.5}$$

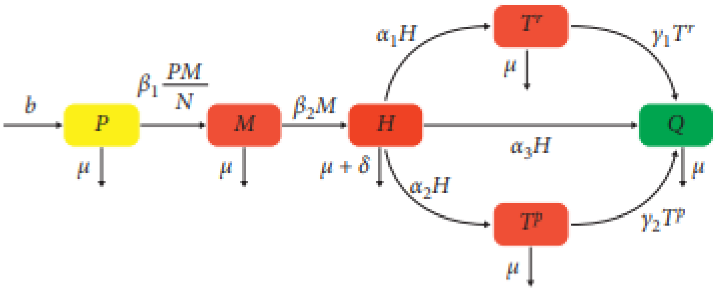
$$\frac{d}{dt}(T) = \alpha_1 H - (\gamma_1 + \mu) T \qquad \text{----------2.6}$$

$$\frac{d}{dt}(W) = \alpha_2 H - (\gamma_2+\mu) W \qquad \text{----------2.7}$$

$$\frac{d}{dt}(Q) = \gamma_1 T + \gamma_2 W + \alpha_3 H - \mu Q \qquad \text{----------2.8}$$

PARAMETERS AND THEIR DESCRIPTIONS:

- b Recruitment rate
- μ Natural death rate
- β_1 Potential drinkers increases
- β_2 Heavy drinkers increases
- α_1 Rich heavy drinkers increases
- γ_1 Rich heavy drinkers decreases
- α_2 Poor heavy drinkers increases
- γ_2 Poor heavy drinkers decreases
- α_3 Heavy drinkers decreases



2.3 Potential Drinkers S:

$$\frac{d}{dt}(S) = b - \beta_1 \frac{SM}{N} - \mu S$$

The potential drinkers P(t) represents individuals whose age is over adolescence and adulthood and may become drinkers. is compartment is increased by the recruitment rate denoted by b and decreased by an effective contact with the moderate drinkers at β1 rate and natural death μ. It is assumed that potential drinkers can acquire drinking behavior and can become moderate drinkers through effective contact with moderate drinkers in some social occasions such as weddings, celebrating graduation ceremonies, weekend parties, and end of the year celebration. In other words, it is assumed that the acquisition of a drinking behavior is analogous to acquiring disease infection

2.4 Moderate Drinkers M:

$$\frac{d}{dt}(M) = \beta_1 \frac{SM}{N} - (\mu+\beta_2) M$$

The compartment M is composed of moderate drinkers who can control their consumption during some events and occasions or in a way that is unapparent to their social environment is category of drinkers does not face any problems or negative consequences. Friends or family do not are marked by a shortage of equipment and low-quality services, especially in the developing countries, and it also contains individuals who do not have the financial capacity to join the private centers. is compartment is increased by the rate α_2 and decreased by the rates γ_2 and μ

2.5 Heavy Drinkers H:

$$\frac{d}{dt}(H) = \beta_2 M - (\mu+\delta+\alpha_1+\alpha_2+\alpha_3) H$$

The compartment H is composed of heavy drinkers suffering from addiction to alcohol. When an individual becomes an alcoholic, they face a great difficulty to control or set limits for their consumption. majority of alcoholics begin as potential drinkers and then turn to moderate drinkers. Alcohol seems to exert a control on the alcoholic's life their job, their family, social circle, and health are all endangered. Despite these negative consequences, unable to quit drinking. alcoholics may begin to disclaim that they have a problem; this disclaim can make it even more difficult for the person to get help. Alcohol addiction is considered to be a disease; it changes chemicals in the addict's brain and has made alcohol the most important thing in their life. At the time a person is an alcoholic, they will usually need to get help at a rehab to overcome their addiction. is compartment becomes larger as the number of heavy drinkers increases by the rate β_2 and decreases when some of them give up drinking at a rate α_3 as well as when they join treatment centers whether private or public at rates $\alpha 1$ and $\alpha 2$. In addition, this compartment decreases by natural death μ and due to deaths caused by diseases resulted from excessive alcohol intake at a rate δ

2.6 Rich Heavy Drinkers T:

$$\frac{d}{dt}(T) = \alpha_1 H - (\gamma_1 + \mu) T$$

The compartment T contains the number of heavy drinkers who take advantage of their financial potentials to join private treatment centers of alcohol addiction that are very often equipped and provide good and quality services compartment is increased by the rate α_1 and decreased by the rates γ_1 and μ.

2.7 Poor Drinkers W:

$$\frac{d}{dt}(W) = \alpha_2 H - (\gamma_2+\mu) W$$

The compartment W represents the number of heavy drinkers who join public treatment centers of alcohol addiction which may not provide advanced treatment and thatare marked by a shortage of equipment and low-quality services, especially in the developing countries, and it also contains individuals who do not have the financial capacity to join the private centers. is compartment is increased by the rate α_2 and decreased by the rates γ_2 and μ.

2.8 Quitters of Drinkers Q:

$$\frac{d}{dt}(Q) = \gamma_1 T+\gamma_2 W+\alpha_3 H-\mu Q$$

The compartment Q encompasses the individuals who quit drinking. It is increased with the recruitment of individuals who have been treated in treatment centers of alcohol addiction at rates α_1 and α_2. It is also increases at the rate $\alpha 3$ of those who quit alcohol without resort to treatment centers and decreases at the rate μ due to natural deaths. The total population size at time t is denoted by N(t) with N(t) = S(t) + M(t) + H(t) + T (t) + W(t) + Q(t).

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3.1 ANALYTICAL SOLUTION:

Analytical solution of a problem is essential to understand the behavior of the mathematical model under any circumstances. An analytical solution involves framing the problem in a well-understood form and calculating the exact solution. analytical solution to a problem is one that has a “proof ” : a series of logical steps that can be followed and verified as correct. Analytical solution, also called closed-form solutions, are mathematical solutions in the form of math expressions. They provide a clear view of how variables and interaction between variables affect the result. Analytical solutions are often more efficient than equivalent numeric implementations.

ANALYTICAL SOLUTION OF THE NON-LINEAR INITIAL VALUE PROBLEM USING THE HOMOTOPY PERTURBATION METHOD:

To find the solution of the equations (2.3), (2.4), (2.5), (2.6), (2.7) & (2.8) using the Homotopy Perturbation Method. The solution of the equations (2.3), (2.4), (2.5), (2.6), (2.7) & (2.8) are written as a powerseries as follows:

$S=S_0+pS_1+p^2S_2+\ldots$ (3.4)

$M=M_0+pM_1+p^2M_2+\ldots$ (3.5)

$H=H_0+pH_1+p^2H_2+\ldots$ (3.6)

$T=T_0+pT_1+p^2H_2+\ldots$ (3.7)

$W=W_0+pW_1+p^2W_2+\ldots$ (3.8)

$Q=Q_0+pQ_1+p^2Q_2+\ldots$ (3.9)

To find the solution of the equation (2.3):

$\frac{d}{dt}(S)= b - \beta_1 \frac{SM}{N} - \mu S$

Let, $\beta_1 = l$, $\mu = a$.

$\frac{dS}{dt} - b + \beta_1 \frac{SM}{N} + \mu S=0$ --------- (1)

Potential Drinkers $=\frac{\mathbf{1}}{(a)}(\boldsymbol{b}) + (S_i - \frac{\mathbf{1}}{(a)}(\boldsymbol{b}))e^{-(\mu)t} + \frac{\mathbf{-1}}{(\boldsymbol{N}a)}(lS_0M_0) + (S_i + \frac{\mathbf{1}}{(\boldsymbol{N}a)}(lS_0M_0))e^{-(\mu)t} = {}^{-}(S_0M_l l))\frac{1}{Na} -(S_1M_0 l))\frac{1}{Na} +(S_i+(S_0M_1 l)\frac{1}{Na} +(S_1M_0 l))\frac{1}{Na})e\text{-}^{at}$

Moderate Drinkers $= M_0 = M_0\ e^{-(a+m)t} + \frac{\mathbf{1}}{\boldsymbol{N(a+m)}}(lS_0M_0) + (M_i - \frac{\mathbf{1}}{\boldsymbol{N}(a+m)}(lS_0M_0))e^{-(a+m)t} + \frac{1}{N(a+m)}(S_0M_1 l)+\frac{1}{N(a+m)}(S_1M_0 l) + M_i\text{-}(\frac{1}{N(a+m)}(S_0M_1 l)+\frac{1}{N(a+m)}(S_1M_0 l))\ e^{-(a+m)t}$

Heavy Drinkers $= mM_0\frac{1}{(a+h+c+f+g)}+(H_i - \frac{1}{(a+h+c+f+g)}mM_0)\ e^{-(a+h+c+f+g)t}+\frac{1}{(a+c+h+f+g)}mM_1+(H_i\text{-}\frac{1}{(a+c+h+f+g)}mM_1)\ e^{-(a+h+c+f+g)t} + \frac{1}{e^{(a+c+h+f+g)}}mM_2+(H_i - \frac{1}{e^{(a+c+h+f+g)}}mM_2)e^{-(a+c+h+f+g)\,t}$

Rich heavy drinkers $T(t)= \frac{\mathbf{1}}{(i+a)}(\boldsymbol{c}H_0) + (T_i - \frac{\mathbf{1}}{(i+a)}(\boldsymbol{c}H_0))\ e^{-(i+a)t} + \frac{\mathbf{1}}{(i+a)}(\boldsymbol{c}H_1) + (- \frac{\mathbf{1}}{(i+a)}(\boldsymbol{c}H_1)\ e^{-(i+a)t} + \frac{\mathbf{1}}{(i+a)}(\boldsymbol{c}H_2) + - \frac{\mathbf{1}}{(i+a)}(\boldsymbol{c}H_2)\ e^{-(i+a)t}$

Poor Heavy Drinkers $=\frac{1}{(a+j)}+(W_i - \frac{1}{(a+j)} fH_0)\ e^{-(a+j)t} + \frac{1}{(a+j)}+(W_i- \frac{1}{(a+j)}fH_1)\ e^{-(a+j)t}+\frac{1}{e^{(a+j)}}+(W_i - \frac{1}{e^{(a+j)}}fH_2)e^{-(a+j)\,t}$

Quitters Of Drinking = $iT_0+jW_0+gH_0\frac{1}{(a)}+ (Q_i - \frac{1}{(a)}\ iT_0+jW_0+gH_0)e^{-(a)t}+\frac{1}{(a)}\ iT_1+jW_1+gH_1 +(Q_i- \frac{1}{(a)}\ iT_1+jW_1+gH_1)\ e^{-(a)t} + \frac{1}{e^{(a)}}\ iT_2+jW_2+gH_2+(Q_i - \frac{1}{e^{(a)}}\ iT_2+jW_2+gH_2)e^{-(a)\,t}$

4.1 NUMERICAL SIMULATION:

The numerical simulation gives us the approximate solution. A numerical simulation means making guesses at the solution and testing whether the problem is solved well enough to stop. The given system of an ordinary differential equation is compared using various numerical methods. Using Matlabsoftware we solve the initial value problems of the system of an ordinary differential equation and compare the numerical simulation with the analytical solution of the given equation.

4.2 COMPARISON BETWEEN THE ANALYTIC AND NUMERICAL SOLUTION OF THE GIVEN SYSTEM OF EQUATIONS

In all the following figures, μ=a, δ=h, β_1=l, β_2=m, γ_1=I, γ_2=j, α_1=c, α_2=f, α_3=g

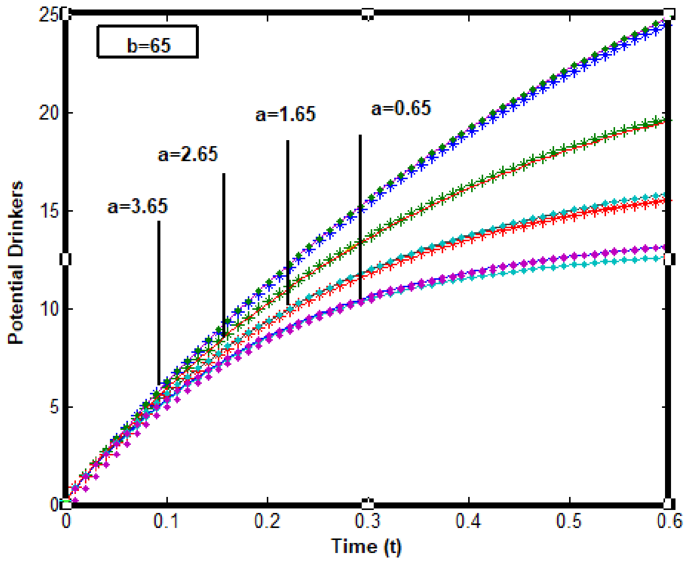

Figure 1.1

Figure (1.1): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Potential Drinkers (S) versus Time (t) of equation (2.3).

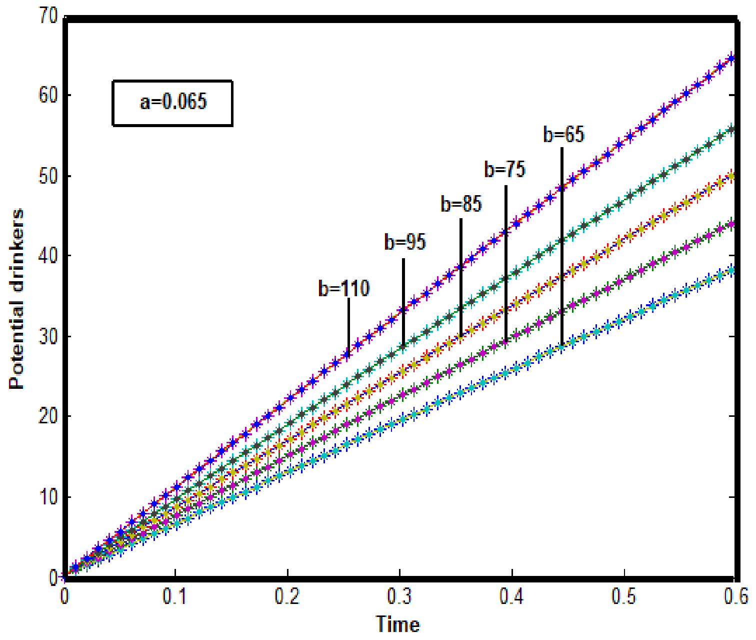

Figure 1.2

Figure (1.2): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Potential Drinkers (S) versus Time (t) of equation (2.3).

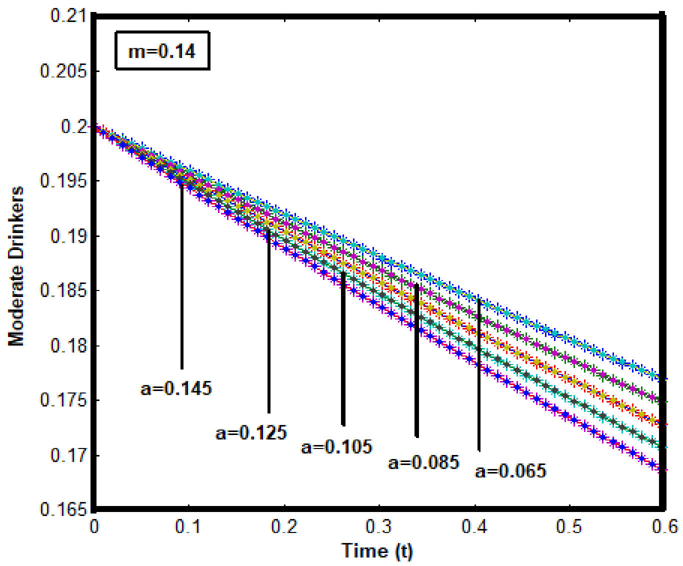

Figure 2.1

Figure (2.1): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Moderate Drinkers (M) versus Time (t) of equation (2.4).

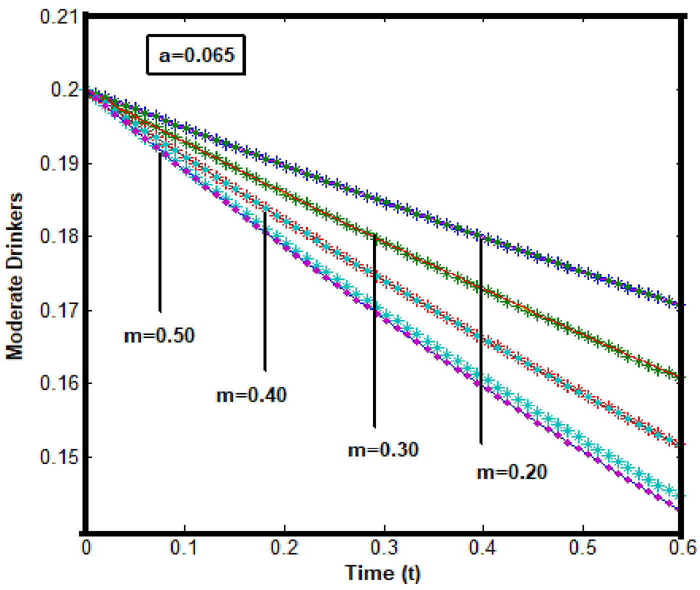

Figure 2.2

Figure (2.2): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Moderate Drinkers (M) versus Time (t) of equation (2.4).

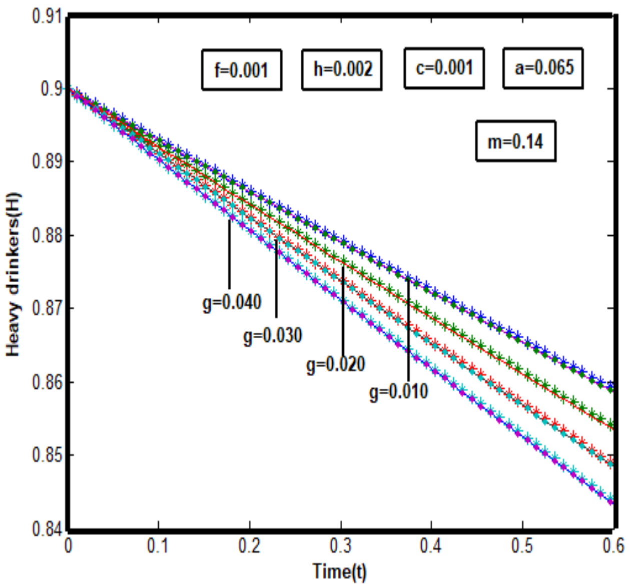

Figure 3.1

Figure (3.1): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Heavy Drinkers (H) versus Time (t) of equation (2.5).

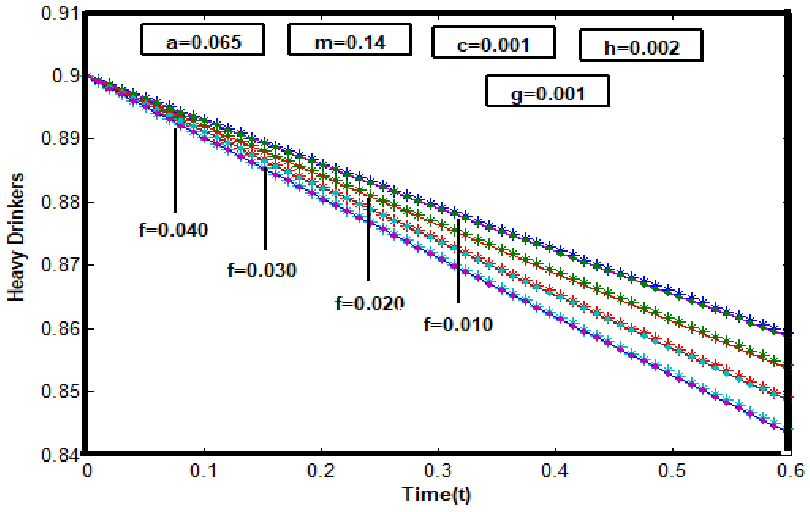

Figure 3.2

Figure (3.2): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Heavy Drinkers (H) versus Time (t) of equation (2.5).

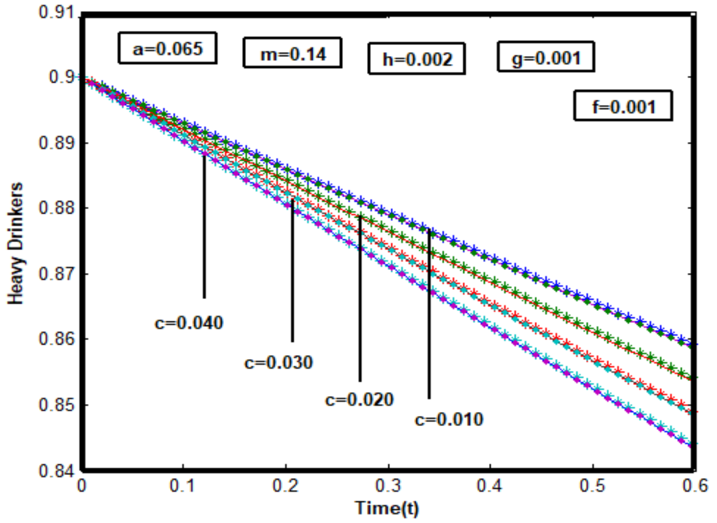

Figure 3.3

Figure (3.3): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Heavy Drinkers (H) versus Time (t) of equation (2.5).

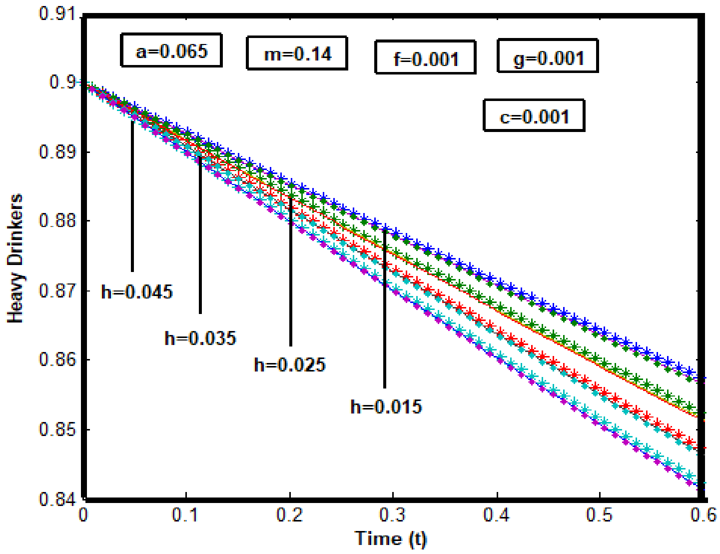

Figure 3.4

Figure (3.4): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Heavy Drinkers (H) versus Time (t) of equation (2.5).

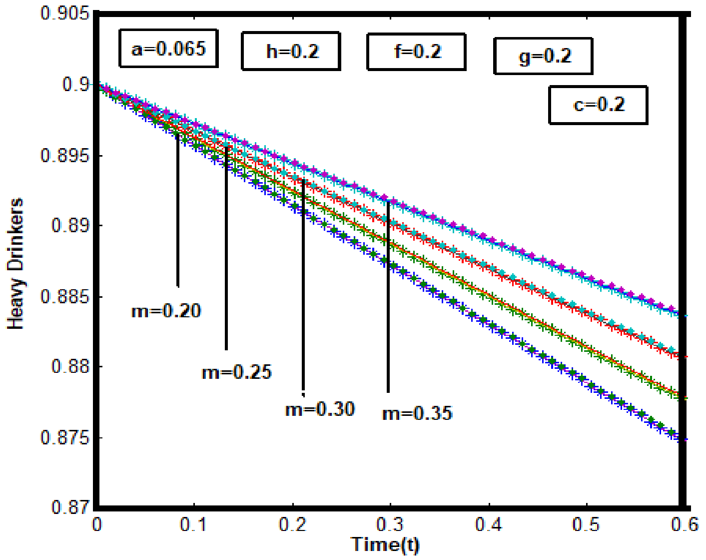

Figure 3.5

Figure (3.5): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Heavy Drinkers (H) versus Time (t) of equation (2.5).

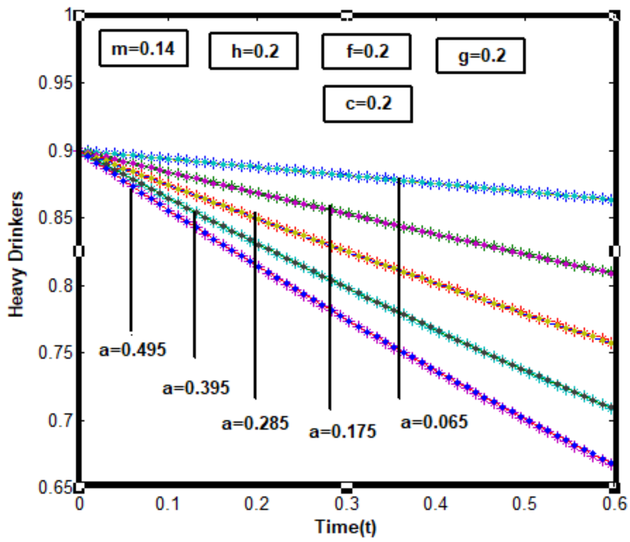

Figure 3.6

Figure (3.6): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Heavy Drinkers (H) versus Time (t) of equation (2.5).

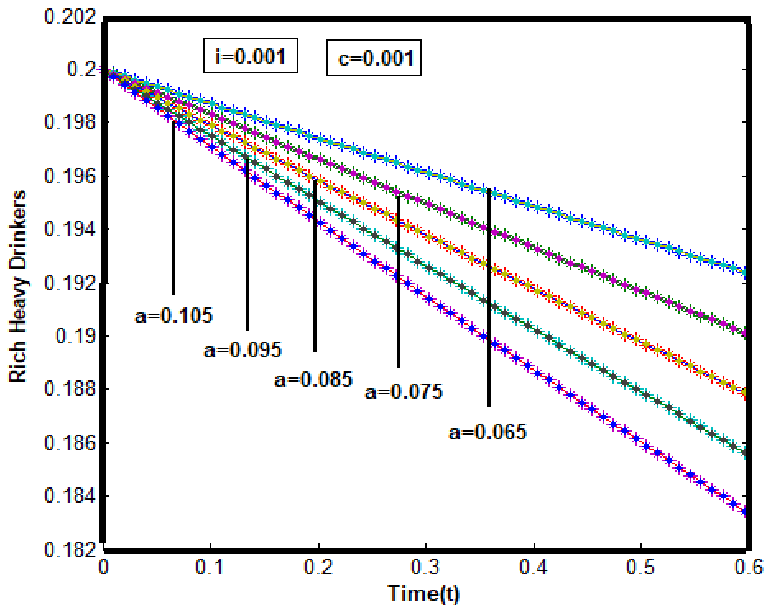

Figure 4.1

Figure (4.1): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Rich Heavy Drinkers (T) versus Time (t) of equation (2.6).

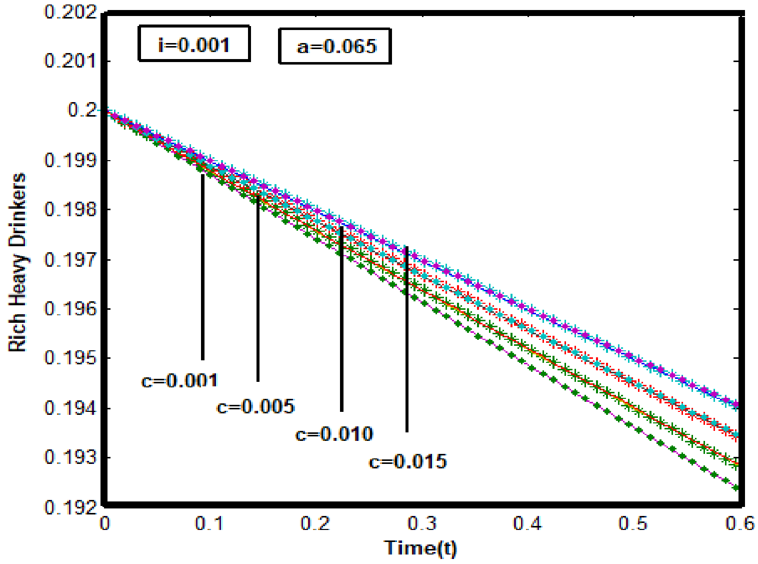

Figure 4.2

Figure (4.2): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Rich Heavy Drinkers (T) versus Time (t) of equation (2.6).

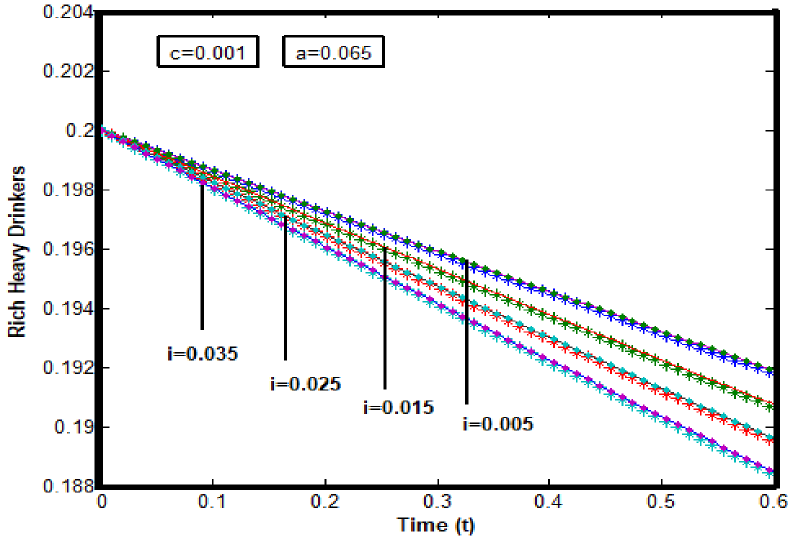

Figure 4.3

Figure (4.3): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Rich Heavy Drinkers (T) versus Time (t) of equation (2.6).

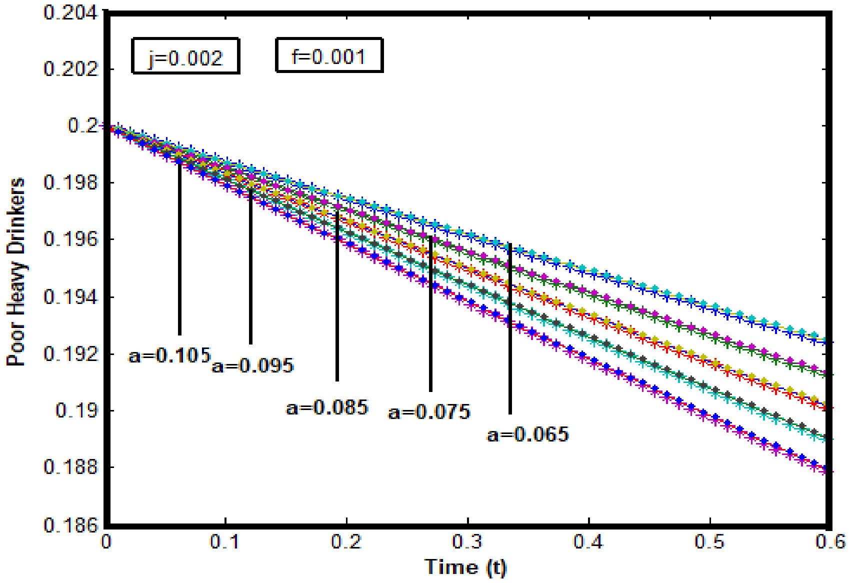

Figure 5.1

Figure (5.1): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of poor Heavy Drinkers (W) versus Time (t) of equation (2.7).

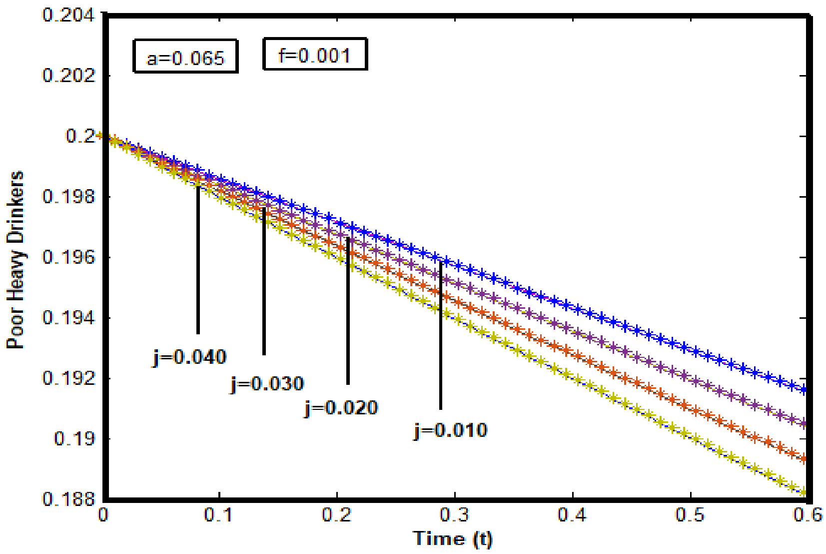

Figure 5.2

Figure (5.2): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Poor Heavy Drinkers (W) versus Time (t) of equation (2.7).

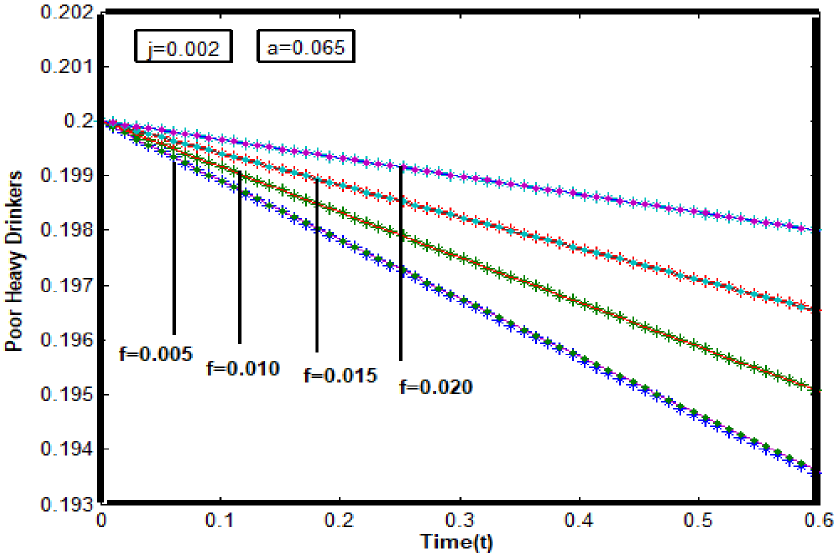

Figure 5.3

Figure (5.3): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Poor Heavy Drinkers (W) versus Time (t) of equation (2.7).

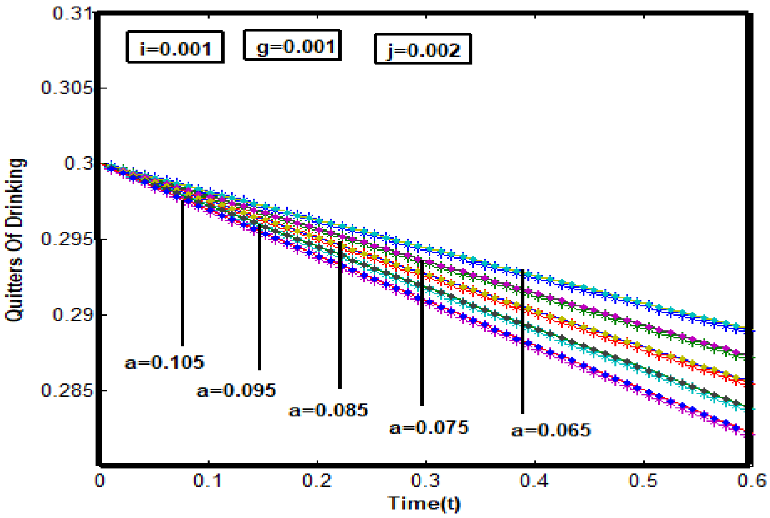

Figure 6.1

Figure (6.1): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Quitters of Drinkers (Q) versus Time (t) of equation (2.8).

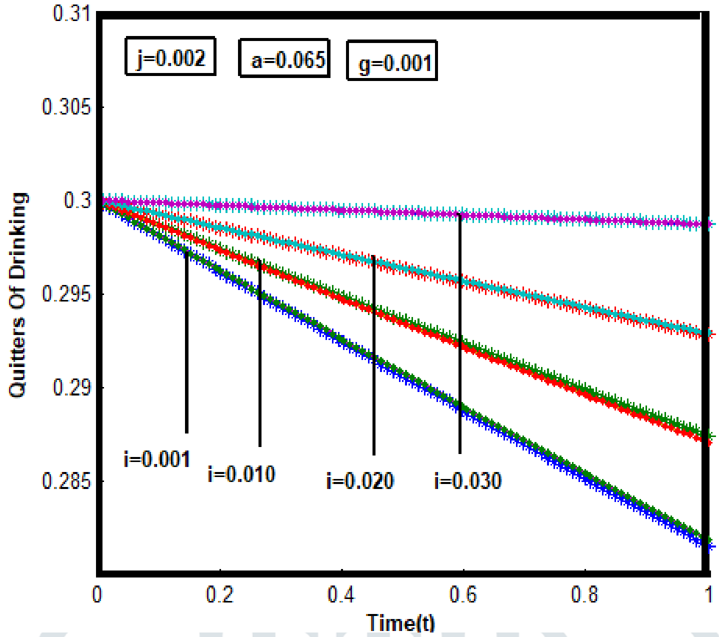

Figure 6.2

Figure (6.2): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Quitters of Drinkers (Q) versus Time (t) of equation (2.8).

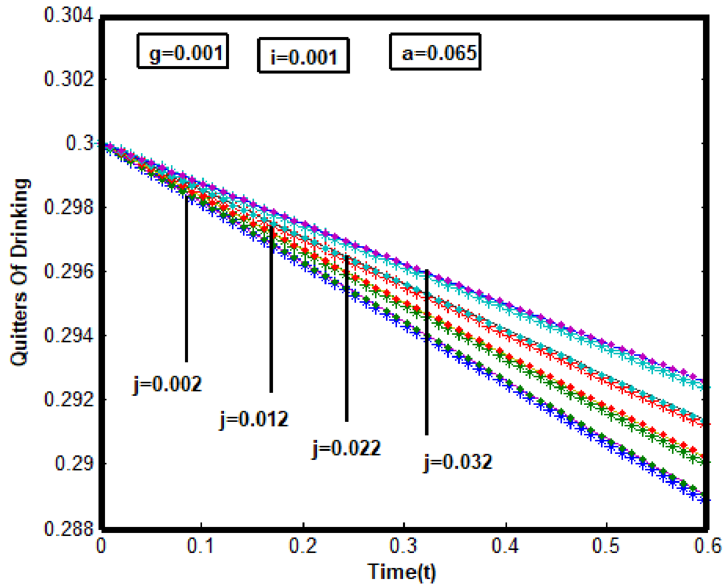

Figure 6.3

Figure (6.3): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Quitters of Drinkers (Q) versus Time (t) of equation (2.8).

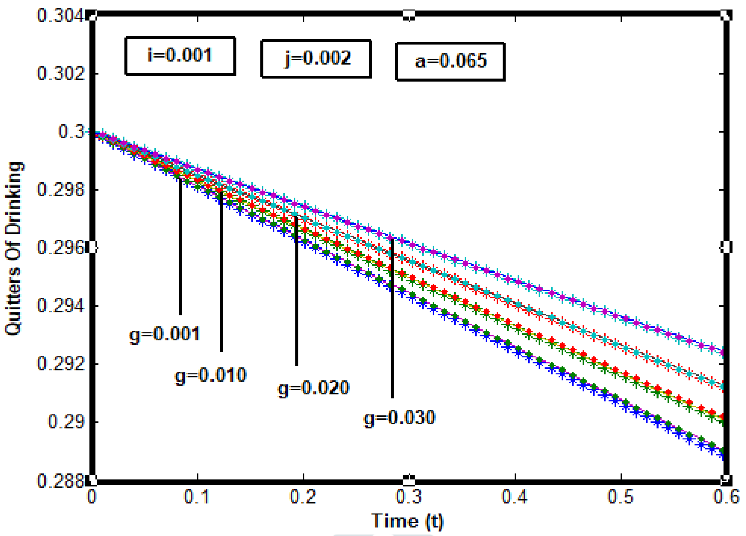

Figure 6.4

Figure (6.4): Star line (*) represents the numerical solution, the solid line (-) represents the analytical solution with HPM and the dotted line (.) represents the analytical solution with NHPM. Plot of Quitters of Drinking (Q) versus Time (t) of equation (2.8).

4.4. RESULTS AND DISCUSSIONS:

Figure 1.1 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters b=65. We observe that the ratio of the Potential Drinkers (S) gradually increases with respect to increase in Time (t).

Figure 1.2 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065. We observe that the ratio of the Potential Drinkers (S) gradually increases with respect to increase in Time (t).

Figure 2.1 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters m=0.14. We observe that the ratio of the Moderate Drinkers (M) gradually decreases with respect to increase in Time (t).

Figure 2.2 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065. We observe that the ratio of the Moderate Drinkers (M) gradually decreases with respect to increase in Time (t).

Figure 3.1 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065,h=0.002,f=0.001,m=0.14,c=0.001. We observe that the ratio of the Heavy Drinkers (H) gradually decreases with respect to increase in Time (t).

Figure 3.2 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065,h=0.002,c=0.001,m=0.14,g=0.001. We observe that the ratio of the Heavy Drinkers (H) gradually decreases with respect to increase in Time (t).

Figure 3.3 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065,h=0.002,g=0.001,f=0.001,m=0.14. We observe that the ratio of the Heavy Drinkers (H) gradually decreases with respect to increase in Time (t).

Figure 3.4 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065,c=0.001,g=0.001,f=0.001,m=0.14. We observe that the ratio of the Heavy Drinkers (H) gradually decreases with respect to increase in Time (t).

Figure 3.5 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065,h=0.002,g=0.001,f=0.001,c=0.001. We observe that the ratio of the Heavy Drinkers (H) gradually increaseswith respect to increase in Time (t).

Figure 3.6 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters c=0.001,h=0.002,g=0.001,f=0.001,m=0.14. We observe that the ratio of the Heavy Drinkers (H) gradually decreases with respect to increase in Time (t).

Figure 4.1 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters c=0.001,i=0.001. We observe that the ratio of the Rich Heavy Drinkers (T) gradually decreases with respect to increase in Time (t).

Figure 4.2 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters i=0.001,a=0.065. We observe that the ratio of the RichHeavy Drinkers (T) gradually increaseswith respect to increase in Time (t).

Figure 4.3 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065,c=0.001. We observe that the ratio of the Rich Heavy Drinkers (T) gradually decreases with respect to increase in Time (t).

Figure 5.1 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters j=0.002, f=0.001. We observe that the ratio of the Poor Heavy Drinkers (W) gradually decreases with respect to increase in Time (t).

Figure 5.2 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065,f=0.001. We observe that the ratio of the Poor Heavy Drinkers (W) gradually decreases with respect to increase in Time (t).

Figure 5.3 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters j=0.002,a=0.065. We observe that the ratio of the Poor Heavy Drinkers (W) gradually increases with respect to increase in Time (t).

Figure 6.1 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters g=0.001 j=0.002, i=0.001. We observe that the ratio of the Quitters Heavy Drinkers (Q) gradually decreases with respect to increase in Time (t).

Figure 6.2 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065 j=0.002, i=0.001. We observe that the ratio of the Quitters Heavy Drinkers (Q) gradually increases with respect to increase in Time (t).

Figure 6.3 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters g=0.001, a=0.065, i=0.001. We observe that the ratio of the Quitters Heavy Drinkers (Q) gradually increases with respect to increase in Time (t).

Figure 6.4 shows that the ratio is computed by using different values of the parameters a and some fixed values of parameters a=0.065, j=0.002, i=0.001. We observe that the ratio of the Quitters Heavy Drinkers (Q) gradually increases with respect to increase in Time (t).

Conclusion:

In conclusion, alcohol addiction is a significant public health concern with far-reaching social, economic, and health implications. The impact of alcoholism extends beyond the individual to affect families, communities, and society as a whole. Addressing alcohol addiction requires a comprehensive approach that includes prevention, treatment, and awareness programs.

Alcohol treatment centers play a crucial role in helping individuals overcome alcohol use disorders by providing detoxification services, therapy, counseling, and support. These centers offer a structured environment for individuals to address the physical, psychological, and emotional aspects of addiction and work towards achieving sobriety.

Awareness campaigns and educational initiatives are essential in raising public awareness about the risks of alcohol abuse, promoting responsible drinking behaviors, and reducing the stigma associated with seeking help for alcohol addiction. By increasing awareness and understanding of alcohol-related issues, communities can work towards preventing alcohol abuse and supporting those in need of treatment.

Overall, the collaboration between alcohol treatment centers, awareness programs, healthcare providers, policymakers, and the community is vital in addressing the challenges posed by alcohol addiction. By promoting a culture of responsible drinking, providing access to quality treatment services, and fostering a supportive environment for recovery, we can make significant strides in combating alcoholism and improving the well-being of individuals and society as a whole.”

REFERENCES:

[1] World Health Organization’s 2016 Report.

[2] K. B. Carey, “Heavy drinking contexts and indices of problem drinking among college students,” Journal of Studies on Alcohol, vol. 56, no. 3, pp. 287–292, 1995.

[3] V. M. Gonzalez, R. L. Collins, and C. M. Bradizza, “Solitary and social heavy drinking, suicidal ideation, and drinking motives in underage college drinkers,” Addictive Behaviors, vol. 34, no. 12, pp. 993–999, 2009.

[4] B. A. Reboussin, E.-Y. Song, and M. Wolfson, “Social influences on the clustering of underage risky drinking and its consequences in communities,” Journal of Studies on Alcohol and Drugs, vol. 73, no. 6, pp. 890–898, 2012.

[5] L. A. Crawford, K. B. Novak, and R. R. Jayasekare, “Volunteerism, alcohol beliefs, and first-year college students’ drinking behaviors: implications for prevention,”vol. 40, no. 4, pp. 429–448, 2019. [6] E. A. P. Poelen, R. H. J. Scholte, G. Willemsen, D. I. Boomsma, and R. C. M. E. Engels, “Drinking by parents, siblings, and friends as predictors of regular alcohol use in adolescents and young adults: a longitudinal twin-family study,” Alcohol and Alcoholism, vol. 42, no. 4, 2007.

[7] R. H. J. Scholte, E. A. P. Poelen, G. Willemsen, D. I. Boomsma, and R. C. M. E. Engels, "Relative risks of adolescent and young adult alcohol use: the role of drinking fathers, mothers, siblings, and friends," Addictive Behaviors, vol. 33, no. 1, pp. 1–14, 2008.

[8] H. Xiang, C.-C. Zhu, and H.-F. Huo, "Modelling the effect of immigration on drinking behaviour," Journal of Biological Dynamics, vol. 11, no. 1, pp. 275–298, 2017.

[9] O. Balatif, A. Labzai, and M. Rachik, "A discrete mathematical modeling and optimal control of the electoral behavior with regard to a political party," Discrete Dynamics in Nature and Society, vol. 2018, Article ID 9649014, 14 pages, 2018.

[10] H.-F. Huo, Y.-L. Chen, and H. Xiang, "Stability of a binge drinking model with delay," Journal of Biological Dynamics, vol. 11, no. 1, pp. 210–225, 2017.

[11] H.-F. Huo, S.-R. Huang, X.-Y. Wang, and H. Xiang, "Optimal control of a social epidemic model with media coverage," Journal of Biological Dynamics, vol. 11, no. 1, pp. 226–243, 2017.

[12] H. F. Huo and N. N. Song, "Global stability for a binge drinking model with two stages," Discrete Dynamics in Nature and Society, vol. 2012, Article ID 829386, 15 pages.

[13] Z. Hu, Z. Teng, and H. Jiang, "Stability analysis in a class of discrete sirs epidemic models," Nonlinear Analysis: Real World Applications, vol. 13, no. 5, pp. 2017–2033, 2012.

[14] M. Kot, Elements of Mathematical Ecology, Cambridge University Press, Cambridge, UK, 2000. [15] S. H. Ma, H. F. Huo, and X. Y. Meng, "Modelling alcoholism as a contagious disease: a mathematical model with awareness programs and time delay," Discrete Dynamics in Nature and Society, Article ID 260195, 13 pages, 2015.

[16] X. Ma, Y. Zhou, and H. Cao, "Global stability of the endemic equilibrium of a discrete sir epidemic model," Advances in Difference Equations, vol. 2013, no. 1, pp. 1–19, 2013.

[17] S. Sharma and G. P. Samanta, "Drinking as an epidemic: a mathematical model with dynamics behavior," Journal of Applied Mathematics Informatics, vol. 31, no. 1-2, pp. 1–25, 2013.

[18] X.-Y. Wang, K. Hattaf, H.-F. Huo, and H. Xiang, "Stability analysis of a delayed social epidemics model with general contact rate and its optimal control," Journal of Industrial and Management Optimization, vol. 12, no. 4, pp. 1267–1285, 2016.

[19] X. Y. Wang, H. F. Huo, Q. K. Kong, and W. X. Shi, "Optimal control strategies in an alcoholism model," Abstract and Applied Analysis, vol. 2014, Article ID 954069, 18 pages, 2014.

[20] K. C. Young-Wolff, P. Wang, C. Tuvblad, L. A. Baker, A. Raine, and C. A. Prescott, "Drinking experience uncovers genetic influences on alcohol expectancies across adolescence," Addiction, vol. 110, no. 4, pp. 610–618, 2015.

[21] I. Adu, M. Osman, and C. Yang, "Mathematical model of drinking epidemic," British Journal of Mathematics & Computer Science, vol. 22, no. 5, pp. 1–10, 2017.

[22] A. Agrawal, A. Tenguria, and G. Modi, "Role of epidemic model to control drinking problem," International Journal of Scientific Research in Mathematical and Statistical Sciences, vol. 5, no. 4, pp. 324–337, 2018.

[23] J. L. Manthey, A. Y. Aidoo, and K. Y. Ward, “Campus drinking: an epidemiological model,” Journal of Biological Dynamics, vol. 2, no. 3, pp. 346–356, 2008.

[24] S. Sharma and G. P. Samanta, “Analysis of a drinking epidemic model,” International Journal of Dynamics and Control, vol. 3, no. 3, pp. 288–305, 2015.

[25] P. V. Driessche and J. Watmough, “Reproduction numbers and sub-threshold en-demic equilibria for compartmental models of disease transmission,” Mathematical Biosciences, vol. 180, no. 1-2, pp. 29–48, 2002.