Lifestyle Diseases and Management: Mathematical Models

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Abstract

Lifestyle diseases are those associated with the way a person or group of people live. These diseases are caused by unhealthy behavior and other factors which are either controllable or not. It is caused by a person's habit, behavior and practices. An example of lifestyle disease is Diabetes. This study presents a mathematical model for Blood Glucose Regulatory System (BGRS) which includes epinephrine as a third variable in the form, _Y = AY; and whose solution has been analyzed for equilibrium and stability to provide the blood glucose concentrations for diabetics and non-diabetics. It is established that the final model is asymptotically stable compared to the existing models, that is, the eigenvalues of the coefficient matrix are complex numbers with negative real parts. Furthermore, the resonance period for the final model, that is, T0 = 2:9847134 hours, is far less than that of the existing model, showing that the glucose concentration returns to normal level within a shorter time. The study also presents a Mathematical Model Insulin Therapy in Patients with Diabetes Mellitus which includes external rate at which blood glucose, insulin and epinephrine are being increased in the form, _Y = AY + ~r(t) and whose solution was analyzed to provide the systems natural frequency, !0, which is the basic descriptor of saturation level of the drug. It established that the resonance period for the final model, that is, T0 = 3:76912 hrs, is in the acceptable therapeutic range and agrees well with the data for the existing insulin therapy. By employing the model, it is shown that, the peak, which is the time period for insulin to be most effective in lowering blood sugar, is shorter than T0 = 5:3199 hrs, for the existing model. This model would help the medical practitioners to predict drug therapy in patients with Diabetes Mellitus, in such a way that the concentration of the drug remains in the therapeutic range.

Keywords: *Mathematical model, Linear system, Resonance period*