ISSN: 1391-8796
Proceedings of 10th Ruhuna International Science & Technology Conference
University of Ruhuna, Matara, Sri Lanka
January 18, 2023

A modified mathematical model for diabetic population dynamics with optimal control strategies

Madhushika T.D.T.*, Somathilake L.W. and Fernando M.C.S.

Department of Mathematics, University of Ruhuna, Wellamadama, Matara, Sri Lanka.

Diabetes is a chronic disease due to problems with the insulin hormone. Although diabetes cannot be cured, it can be managed with the right medications, proper exercise, and a diet low in carbohydrates and sugar. Multiple problems are exacerbated by uncontrolled diabetes. The objective of this study is to investigate the behavior of the diabetic population dynamics under control strategies, assuming that the total population grows logistically. To achieve this objective, we modify an existing mathematical model, which is a system of nonlinear ordinary differential equations for diabetic population dynamics with optimal control strategies. We derived the necessary condition for optimal control using Pontryagin's maximum principle, which is usually used to characterize the optimal control for a system of ordinary differential equations. The optimality system was solved using the forward-backward sweep iteration with the fourth order Runge-Kutta method. The results of our model demonstrate that the incidence rate could not remain constant over a long period of time. Furthermore, we can conclude that by implementing a control, the number of cases of pre-diabetes and diabetes with and without complications, can be reduced.

Keywords: Diabetes Population Dynamics, Optimal Control, Pontryagin's maximum principle, Runge-Kutta method

*Corresponding author: thilinim832@gmail.com