ABSTRAK

Penelitian ini mengkaji model matematika untuk memantau dinamika populasi penderita diabetes yang terus meningkat dan berisiko menimbulkan komplikasi ringan maupun berat. Tujuan penelitian adalah mengkonstruksi serta menganalisis model linier dan nonlinier guna mengetahui kestabilan titik ekuilibrium dan perilaku jangka panjang sistem. Model disusun dalam bentuk sistem persamaan diferensial biasa dengan tiga kompartemen, yaitu tanpa komplikasi, komplikasi ringan, dan komplikasi berat. Analisis dilakukan melalui penentuan titik ekuilibrium, pelinieran menggunakan matriks Jacobian, serta penerapan kriteria Routh–Hurwitz. Hasil menunjukkan bahwa model memiliki solusi positif dalam daerah invarian biologis dan kestabilannya dipengaruhi oleh parameter perkembangan komplikasi, pemulihan, dan kematian. Simulasi numerik menegaskan bahwa pemulihan berperan penting dalam menekan komplikasi berat dan menjaga kestabilan populasi, sehingga model ini relevan sebagai alat bantu analisis dalam pengendalian diabetes.

Kata kunci: *diabetes, model matematika, kestabilan sistem*

ABSTRACT

This study examines mathematical models for monitoring the dynamics of the growing population of diabetes patients who are at risk of developing mild to severe complications. The objective of this study is to construct and analyze linear and nonlinear models to determine the stability of equilibrium points and the long-term behavior of the system. The model is formulated as a system of ordinary differential equations with three compartments, namely no complications, mild complications, and severe complications. The analysis was conducted by determining the equilibrium point, linearization using the Jacobian matrix, and applying the Routh–Hurwitz criterion. The results show that the model has a positive solution in the biologically invariant region and its stability is influenced by the parameters of complication development, recovery, and death. Numerical simulations confirm that recovery plays an important role in suppressing severe complications and maintaining population stability, making this model relevant as an analytical tool in diabetes control.

Keywords: *diabetes, mathematical modeling, system stability*