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OPTIMAL PREMARITAL SCREENING RATE TO CONTROL THALASSEMIA TRANSMISSION

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Optimal control theory applies in a variety of scientific domains, especially in mathematical biology, for disease prevention and intervention. This study investigated a contextual problem of how to apply optimal control theory to identify a time-based strategy for premarital screening as a thalassemia (an inherited blood disorder) prevention method to control thalassemia transmission. Premarital screening identifies the thalassemia carrier state of parents, aiming at reducing the incidence of thalassemia in major newborns. The main objective of this study was to investigate the optimal rate of premarital screening to minimize dual-carrier marriages while minimizing the cost of implementing premarital screening in a certain population. The optimal control problem was as an age-structured two-sex population model with premarital screening as a time-dependent prevention method. The optimal control problem was derived, which includes the state equations, the adjoint equations, and the optimality condition that characterises the control. Existence and uniqueness of optimal control were established. The problem was numerically solved using an iterative procedure based on the forward-backward sweep method. The parameter values used for the simulations are referred Sri Lankan data. For the time periods $T = 1$ year, $T = 3$ years, and $T = 10$ years, numerical simulations indicate an increase in the number of thalassemia major newborns in the absence of control while in the presence of control, it decreases by 7.63%, 17.29%, and 54.68%, respectively. The effect of mandatory premarital screening program was also discussed. The results of this study will be beneficial to public health administration in disease control.

Keywords: Age-structured, Optimal control, Premarital screening, Thalassemia