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Analysis of schistosomiasis global dynamics with general incidence functions and two delays

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Abstract/Résumé:
As most communicable diseases, schistosomiasis transmission mechanism involves some delay due to the incubation period. In this study, we seek to investigate the impact of incubation period on schistosomiasis global transmission dynamics. For that, starting from our previous work and using delay differential equations, we have proposed a more sophisticated model in which the new feature we accounted is the latency period in both human and snail hosts. Then, under some suitable assumptions, the mathematical analysis of the model has been done. Specifically, we calculated the basic reproduction number and showed its dependence on the delays in both humans and snails as follows: when the delays in humans and snails increase, R_0 decreases. We also proved that when $R_0 > 1$, the no-disease point is globally asymptotically stable and when $R_0 < 1$, the system is uniformly persistent and admits a unique endemic equilibrium. Besides, by formulating a suitable Lyapunov function, we established that the unique endemic steady state of the model is globally asymptotically stable when the threshold parameter R_0 exceeds 1. Furthermore, sensitivity analysis has been carried out to show how parameters variations affect the model global behaviour. We finished by illustrating some numerical results that are well in keeping with our theoretical findings.

Mots clés: Schistosomiasis transmission mechanism, incubation period, basic reproduction number, global transmission dynamics, delay differential equations, numerical simulation.
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