

**A MATHEMATICAL MODEL TO DESCRIBE THE BEHAVIOUR OF MITE
POPULATION IN SCABIES**

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Scabies is a highly contagious skin disease caused by the microscopic mite *Sarcoptes scabiei*. The female mite burrows into the skin to lay eggs, leading to intense itching, and rashes with pimple-like bumps or burrow tracks. While Nodular Scabies involves fewer mites, Crusted Scabies is a severe form characterized by thick crusts and thousands of mites. This study develops a mathematical model to examine the population dynamics of mites and the spread of rashes due to human scabies infestation. The model captures the four developmental stages of the mite: egg, larva, nymph and adult, and considers male and female mites separately. Mite mortality is influenced by natural lifespan, immune response, and medications, particularly with permethrin 5%. The model consists of sixteen parameters, where values of eleven parameters were obtained from existing literature, and the values of the other five parameters were assumed based on biological reasoning. In this model, four key assumptions are made: individuals get infectious when carrying fertilized female mites, permethrin 5% exhibits equal effectiveness against both larval and nymph stages, a uniform immune response with a constant effectiveness rate of 5% is applied across all developmental stages of the mites, and adult mites emerge in equal proportions of males and females. The model is solved both analytically and numerically, using Python, and the results were validated by comparing with the existing literature. Simulation results show that without treatment, mite populations grow rapidly, leading to Crusted Scabies. A 7-day treatment reduces mites, but does not eliminate them, while a 14- to 20-day treatment ensures complete clearance. Early and continuous treatment is crucial, as delays or early discontinuation leads to rapid regrowth. These findings are consistent with medical observations, supporting the validity of the proposed model.

Keywords: Life cycle, Mathematical model, Mite population, *Sarcoptes scabiei*, Scabies