Non-Linear Fractional Polynomial for Estimates of Long-Term Persistence of Induced HPV Antibodies: A Hierarchical Bayesian Approach

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Abstract

The primary interest in infectious diseases vaccination trial is long term prediction of the patient immune status for many years after the vaccination (Fraser *et al.*, 2007). In this paper, we focus on hierarchical Bayesian models for HPV vaccination trial proposed to use the subject specific posterior probability to be above a pre-specified threshold. Since the true relationship between a covarite and an outcome is expected to be non linear, we use a model which take in to account this non-linearity behavior. Moreover, the fractional polynomial which assumed a pre specified power was extended in to a Non-Linear Fractional Polynomial; NLFP using Bayesian approach by assuming a uniform prior distribution for the power. The proposed model was applied in to a vaccine induced anti HPV-16/18. Using the NLFP with Bayesian approach, the posterior probability to stay above a threshold at any time point after vaccination was calculated. In addition, we predicted the long term persistence of vaccine induced anti-HPV antibodies. The model was compared with power-law model (Fraser *et al.*, 2007) using Deviance information criterion and found to be better than the power-law model. To evaluate the prediction performance of both models within the follow-up period, the observed proportion was compared with model based proportion. The NLFP returned estimates more similar to the observed proportion within the estimation period than the power-law model. This indicates that the NLFP behaves good in terms of prediction within the follow-up period but this doesn't mean it best fits outside the range of the observed data. It was conducted sensitivity analysis which has shown that the results doesn't depend on the prior distribution of the power.

Some Keywords: Deviance information criterion; Fractional polynomial model; Non-linear fractional polynomial; Power-law model