Elucidation of the factors producing any observed differences in the epidemiological patterns of airborne infections across Europe

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One of the key measures of infectious disease transmission is the instantaneous per capita rate at which a susceptible person acquires the infection and is called the force of infection (FOI). Empirical data show that the FOI is age-dependent and can be looked upon as a reflection of the degree of contacts with transmission potential for the infection at hand. The FOI can be estimated from seroprevalence data under the endemic equilibrium assumption. For economic reasons, such serum samples are often tested for more than one antigen. These multivariate data make it possible to study the association between infections as was done by [2] using a bivariate Dale model and a baseline category logits model to study the association in acquisition of the varicella-zoster virus (VZV) and the parvovirus B19 (B19) in Belgium. If infections are spread through similar routes, as is the case for VZV and B19, one can also look at the individual heterogeneity as proposed by [1]. They used a shared gamma frailty in the context of current status data to estimate the heterogeneity. Using the gamma frailty a closed form expression is obtained for the multinomial likelihood function. In this paper we use an extended version of the heterogeneity model to assess country-specific differences in heterogeneity and serology for Belgium, England & Wales, Finland, Italy and Poland. We will explicitly address differences in heterogeneity among countries while looking at differences on the scale of the force of infection within the country-specific mixing groups. The motivation to use mixing groups according to age-enrolment ages comes from the mass action principle expressing the relation between transmission parameters and the FOI. We use the BIC-criterion to come up with the most parsimonious model and perform a sensitivity analysis on the proposed model selection routine. While England & Wales, Italy and Poland have the same seroprofile, Belgium has an overall higher FOI and Finland a lower FOI for infants. It is also observed that there is no significant difference in heterogeneity for Belgium, Finland and Italy while a higher heterogeneity is observed for England & Wales and Poland. Elucidating on these differences using demographic data on childcare, population density etc shows no consistent pattern. Additionally, using contact-surveys from these five different countries, predictive for the the transmission of airborne infections resulted in an improved estimation of the so-called 'Who Acquires Infection From Whom' matrices (WAIFW). An elaboration of the connection between these estimated WAIFW-matrices and the observed epidemiological patterns is provided.

References

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