

## Model shows why males have lower immunity to disease

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(PhysOrg.com) -- Researchers from the University of Cambridge in the UK have for the first time incorporated sexual reproduction in a mathematical model of the evolution of defense against disease, and found the popular myth that men are weaker when it comes to fighting disease may well be true and is the result of the male's biological urge to "live hard and die young".

Earlier studies have shown there are differences in the immune responses of males and females, with males tending to be more exposed to the risk of infection and being less able to deal with the infection. Previous studies also showed that males shed more viral particles and suffer more severe symptoms than females, although females are more susceptible to some infections.

The Cambridge scientists, Olivier Restif and William Amos, sought to understand why males and females should evolve different levels of immunity, and how natural selection is shaped by a combination of ecological and genetic considerations to produce a different immune response to disease by females and males. If males really are exposed to infection more than females it would seem logical they would evolve higher immunity rather than lower, but the opposite appears to be true.

In the <u>mathematical model</u> of a population with distinct male and female genders, birth rate is assumed to be proportional to the population density of females, and the reproductive success of the male genotypes is proportional to their relative frequency. The model is dynamic and



includes <u>sexual reproduction</u> parameters, gender-based hormonal differences, and behavioral differences (such as prevalence of risk taking), as well as changes in host-pathogen population.

The results of the adaptive dynamic model, published online in the journal <u>Proceedings of the Royal Society B</u> last week showed that if the behaviors of males led them to be more exposed to pathogens, this surprisingly also led them to have lower immunocompetence than females. Males tended to become re-infected quickly, which lowers the benefit of immunity and selects for lower resistance in males. Biologically, the most important thing for a male is to mate, whereas for females, it is more important to survive and maintain health through a strong immune response to enable them to bear offspring.

Immunity has an impact on survival, but also reproductive success, and this means the different reproductive strategies of males and females allow natural selection to produce sex differences in <u>immune response</u>.

The current model is only applicable for diseases transmitted from host to host, but it could be adapted for other types of disease transmission. It considers only natural selection, but further research could include a sexual selection component.

**More information:** Paper available online: <u>rspb.royalsocietypublishing.or</u> ... /rspb.2010.0188.full

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