Genetic susceptibility for classical scrapie should be considered when designing surveillance programs

Kitty Schulman* & Tapani Lyytikäinen

Risk Assessment Research Unit, Evira, Mustialankatu 3, FI-00790 Helsinki, FINLAND, www.evira.fi

The presence of scrapie is likely to cause clinical problems and elevate mortality, increasing the likelihood of scrapie positive animals becoming fallen stock (FS).

We evaluated the risk ratio of classical scrapie in fallen stock to the normal slaughtered population by applying two different sets of data. The first dataset was obtained from official EU TSE reports (EC 2012 & 2013) and did not contain information on genetic susceptibility for scrapie. On the contrary, the smaller UK dataset (Arnold & Ortis-Pelaez 2014) divided fallen stock and slaughtered animals according to NSP groups. The datasets only included data from over 18-month-old animals.

Risk ratio estimated from EU data

Prevalence data of classical scrapie in fallen stock and slaughtered animals from countries with a prevalence >0.1% (design prevalence of OIE definition for negligible risk) were used to estimate the risk ratio (RR). Monte Carlo simulation gave an average value of 2.8 for the RR for fallen stock (Figure 1).

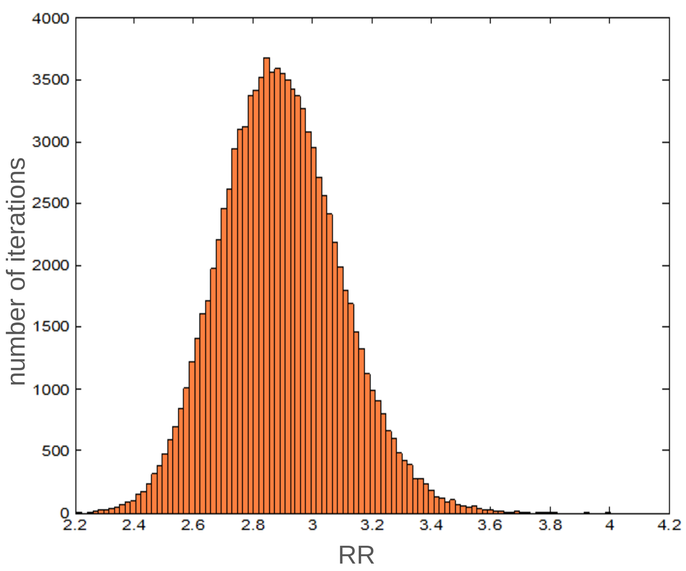

Figure 1. Estimated RR in 2011-2012 in EU Member States where the scrapie prevalence in either FS or slaughtered animals was > 0.1%. n=100 000.

Risk ratio by NSP group - UK data

In the second dataset a higher prevalence of classical scrapie was observed in fallen stock than in slaughtered animals in NSP groups 3-5 in 2005-2008. The overall prevalence of scrapie in the UK was at least 0.1 % during this period and thus only these years were taken into account in this study.

Definitions

FS (Fallen stock): over 18-month-old sheep and goats that were culled or found dead

PrP (prion protein) genotype: Genes determining the makeup of the host-encoded prion protein. Scrapie develops when the prion protein converts to an abnormal form.

NSP group (National Scrapie Plan): Sheep are divided into groups according to PrP genotype with sheep in the NSP 1 group having the lowest and NSP 5 the highest susceptibility for the disease. Generally NSP 1 and 2 sheep are resistant to scrapie infection.

RR (Risk Ratio): The ratio between the scrapie prevalence in fallen stock and in the slaughtered population p(FS)/p(slaughtered)

The RR for each NSP group in the UK sheep population was parametrized. Based on PrP genotyping data from Hautaniemi et. al. (2012), the Finnish sheep population has a higher proportion of scrapie susceptible sheep (NSP 3-5) than the UK population (Figure 2). Simulations of the RR were performed individually for NSP 3, NSP 4 and NSP 5 and then combined for a RR according to the Finnish NSP group distribution (Figure 3).

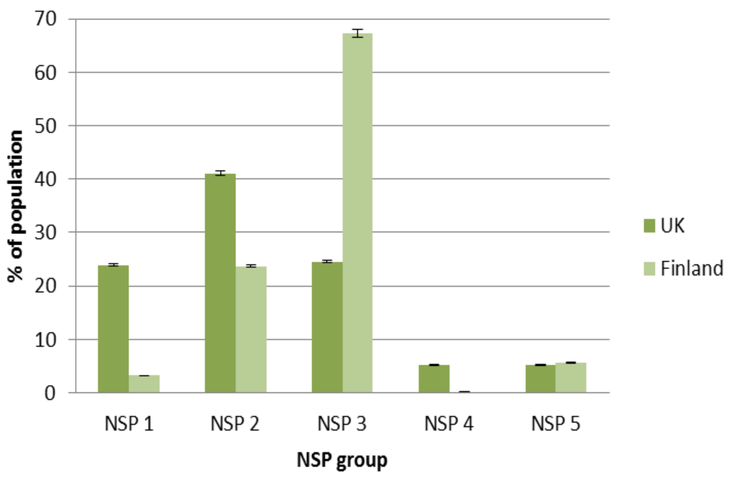

Figure 2. Proportions of NSP groups in the British (based on Arnold & Ortiz-Pelaez 2014) and Finnish (based on Hautaniemi et. al. 2012) sheep populations. Error bars represent 95% confidence intervals for the proportions.

Results

Accounting for NSP groups in the RR distribution results in a higher RR estimate than when NSP groups are ignored. The RR is significantly higher when the genetic susceptibility of the Finnish sheep population is taken into account, 17.1 vs. 2.8.

Conclusion

The results indicate that the PrP genotype distribution should be taken into account when surveillance for classical scrapie is planned. This would lead to a reduced sampling requirement in countries with a higher proportion of sheep representing scrapie sensitive genotypes. Ignoring the distribution will, on the other hand, lead to unnecessarily large surveillance plans.

References:

EC (2012 and 2013). Report on the monitoring of ruminants for the presence of Transmissible Spongiform Encephalopathies (TSEs) in the EU.

Arnold M, Ortiz-Pelaez A (2014). The evolution of the prevalence of classical scrapie in sheep in Great Britain using surveillance data between 2005 and 2012. PREVET 2014:117(1):242-50.

Hautaniemi et al. (2012). Genotyping and surveillance for scrapie in Finnish sheep. BMC Veterinary Research 8:122

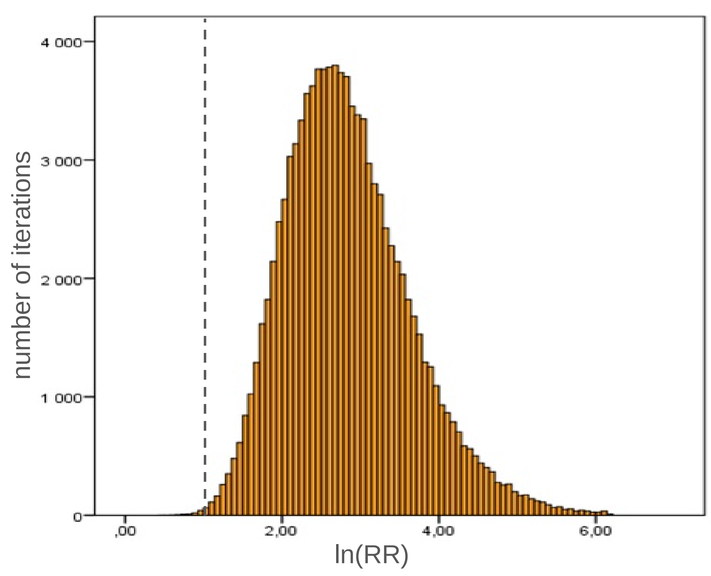

Figure 3. Estimated ln(RR) in Finland by applying the NSP specific RRs in the UK 2005-2008 and NSP distribution in Finland. For visual purposes a cut off value of 500 was introduced leading to an exclusion of 0.12% of iterations. The average value for the ln-transformed combined RR was 2.8 (95% confidence interval 1.5328-4.6885), corresponding to 17.1 on the original scale. The mean of figure 1 is indicated as a dotted line. n=100 000.

*Corresponding author: Kitty Schulman, kitty.schulman@evira.fi