



## Sow mortality is associated with meat inspection findings

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### ARTICLE INFO

#### Keywords:

Sow  
Mortality  
Meat inspection  
Condemnations

### ABSTRACT

Sow meat inspection (MI) and mortality data are important sources of information for use in herd health work. This observational study examined whether MI results of sows associate with sow mortality in Finnish sow herds. We also described some MI findings of sows to create basic references in order to encourage their use in herd health work. The project was widely advertised to farmers of sow herds and practicing veterinarians. Ten herds joined the project voluntarily and 36 other herds after they were contacted by the researchers. MI data (carcass weight, lean meat percentage, arthritis, abscesses, liver condemnations, milk spots, organ condemnations, pleuritis, pneumonia, shoulder ulcers, tail biting, whole carcass condemnations, partial carcass condemnations and kg of meat condemned) were made available by the three largest slaughterhouses in Finland, and sow mortality data were obtained from the National Swine Herd Register for 39 of the study herds for the year 2014. The mean herd size of participating herds was 529 females with a standard deviation of  $\pm 479$  and mean annual mortality  $9.0\% \pm 5.2\%$ . As much as 22.8% of the 7437 slaughtered sows had at least one MI finding. Heavy carcasses were less likely to have at least one MI finding. A median (range) of 1.8% (0–7.2) and 11.8% (0–34.6) of the sows were recorded to have a whole and partial carcass condemnation, respectively. The most common MI findings were abscesses (5.7%, 0–16.3), shoulder ulcers (3.6%, 0–22.9) and arthritis (2.1%, 0–13.3). In individual carcasses, abscesses were associated with arthritis, shoulder ulcers and pneumonia, which was indicative that these animals most likely had a systemic infection. Pneumonia findings were associated with pleuritis. At the herd level, the increase of sow mortality by 1% was associated with an increased percentage of slaughtered females with at least one MI finding 0.8% ( $P = 0.01$ ). If sow mortality increased by 1%, the odds ratio for the herd having more than a median percentage of pleuritis was 1.3 (95% confidence interval; 1.01–1.57,  $P = 0.04$ ) compared to the situation of the herd having less than a median percentage of pleuritis. Also, if sow mortality increased by 1%, the percentage of partial carcass condemnations of females increased by 0.4% ( $P = 0.08$ ). These results suggest that high mortality was associated with an increase of some MI findings. MI results of sows should be used in herd health follow-up of sow health.

### 1. Introduction

About half of the sows in modern pig production are removed from sow herds yearly (Engblom et al., 2007). These animals include culled sows and sows that were euthanized or died on-farm. Culled sows are slaughtered in slaughterhouses, their carcasses are subsequently inspected and, depending on the findings of the carcass inspection, their meat is used for human consumption. The slaughtering procedure is the same as that used for finishing-pigs. The meat inspection (MI) data

collected in the slaughterhouse have been effectively used for following-up herd health in addition to inspecting meat for the human food chain.

Originally, MI procedures were developed to reduce food-borne risks to humans (Edwards et al., 1997). Gradually these procedures are also becoming used in extensive epidemiological animal health investigations (Harley et al., 2012b). Consequently, MI recording also includes findings about conditions that are primarily a risk for the animals in addition to those that affect human health (Elbers et al., 1992)

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<https://doi.org/10.1016/j.livsci.2017.12.011>

Received 21 June 2017; Received in revised form 7 December 2017; Accepted 21 December 2017

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and there is thus an increasing need and interest in expanding these MI data to be used as a welfare surveillance tool (Harley et al., 2014). There is, therefore, a clear need to increase knowledge about sow MI findings in general.

Some studies about MI procedures and results have already been published (Harbers et al., 1999; Straw et al., 1986) and their use in herd health improvement work (Straw et al., 1986) and in disease investigations (Cleveland-Nielsen, 2002; Jirawattanapong, 2010). The association between MI findings of finishing pigs and herd parameters has been particularly studied (Cleveland-Nielsen, 2002; Fraile et al., 2010; Heinonen et al., 2001; Heinonen et al., 2007; Jäger et al., 2012; Maes et al., 2001; Martinez et al., 2009; Meriäldi et al., 2012): especially risk factors for MI findings in respiratory organs.

Several earlier studies concentrated on sow mortality, the risks associated with it and possible reasons for mortality (Abiven et al., 1998; Engblom, 2008; Jensen et al., 2012; Sanz et al., 2007; Sasaki and Koketsu, 2008). However, there are very few studies published about MI findings in sows (Cleveland-Nielsen et al., 2004a, b; Flesja and Ulvesaeter, 1979). Moreover, textbooks on meat inspection only consider fattening pigs, even though sows also produce a considerable amount of meat. A total of 41 882 sows were sent to slaughter in Finland in 2014 and about 6.8 million kg of sow meat was accepted for human consumption (Eva Kaisti, Finnish Food Safety Authority Evira national records, personal communication 2016), whereas the corresponding meat quantity from fattening pigs was about 176 million kg. Thus, the mean quantity of meat from culled sows is still a noteworthy contribution to the pig meat consumed in Finland.

At some stage of production sows inevitably become diseased or less productive and the farmer decides whether to send the animal to slaughter or to euthanize her on-farm. In addition, some sows die unexpectedly. Some farmers may be more likely than the others not to send a diseased sow to slaughter. Others may try to save disposal costs of sow carcasses and therefore also send some unfit animals to slaughter. Some sows die in the herd or are euthanized on the farm, therefore the meat inspection results may underestimate the extent of the sow health and welfare situation on-farm. We have not found studies investigating the association of mortality in the herd and meat inspection results of sows from the same herds.

The aim of this study was therefore to examine if MI results of sows were associated with sow mortality in Finnish sow herds. We hypothesized that some farms may have fewer MI findings, because they have higher mortality due to euthanasia in-herd. We also describe some MI findings of sows in order to create basic figures to encourage herd veterinarians and herd owners to use them in preventive herd health work in sow herds. We compare our sow data to those of finishing pigs and discuss them. The results concerning the herd-level risk factors for culling, mortality and meat inspection findings in these same herds are presented in another article (Munsterhjelm et al., Submitted for publication).

## 2. Materials and methods

This observational study between mortality and MI is a part of a larger sow longevity project collecting information from Finnish sow herds. The websites of the three largest slaughterhouses in the country recommend the longevity project to their client herd producers. The longevity project was also advertised on the websites of the research group, Finnish Pig Producers and Animal Health ETT and in Facebook of the advisory organization ProAgria. The research personnel also spread the information about the longevity project in farmers' meetings and in farmers' professional journals. Finally, all client farms of the three largest slaughterhouses received an invitation letter to participate in the project. A total of 46 herds participated in the sow longevity study. Ten of them informed the research group voluntarily about their willingness to join the project and allowed the researcher to visit the herd for data collection. The rest of the herds in this study consisted of a

convenience sample of herds after making telephone contact between the research personnel and the producers. Mortality and slaughterhouse data were collected from these 46 herds for the year 2014.

Sow mortality data were collected from the National Swine Herd Register maintained by the Finnish Food Safety Authority Evira. Herd owners report their monthly numbers of animals to this register: the numbers of sows and young breeding animals (hereafter females) present in the herd on the first day of each month and the numbers of females found dead or euthanized (hereafter referred to as dead) in the herd each month. Finnish legislation defines a gilt as a sexually mature female pig from mating until the first farrowing, however, we do not know exactly how the farmers in the study applied the term 'gilt'. The slaughterhouses send a report to the National Swine Herd Register the numbers of females they receive from the herds for slaughter each month. These data were obtained directly from the Register for 44 herds that participate in the longevity study for a 12-month period from January to December 2014. The 12-month mean female inventory of the herd was calculated by summing up the number of females on the first day of each month and dividing the sum by 12. The number of dead females were the sum of females reported to have been euthanized or found dead during the whole year 2014. Similarly, the number of slaughtered (culled) animals summed up the females sent to slaughter during the same year. The mortality and culling percentage were calculated as the number of dead females in the herd or slaughtered animals divided by the 12-month mean female inventory. The removal percentage included all females removed from the herds due to death, euthanasia and slaughter.

The MI data of slaughtered females from 40 out of the 46 herds that participated in the longevity study were obtained directly from three large Finnish slaughterhouses. Slaughterhouse information could not be obtained from those study herds that sent their animals to small slaughterhouses that were not able or willing to transfer these data for the research purposes. The data obtained included individual, animal level MI findings for each slaughtered animal: carcass weight, lean meat percentage of the carcass and meat inspection findings (arthritis, abscesses, liver condemnations, milk spots, organ condemnations, pleuritis, pneumonia, shoulder ulcers, tail biting, whole carcass condemnation, partial carcass condemnation, and kg of condemned meat). Detailed sow culling reasons from farm records were not available for the study. Therefore, comparisons between MI findings and the most important culling reasons, namely reproductive failures and locomotion problems, could not be carried out. In order to numerically compare the levels of MI findings in sows and finishing pigs, we also obtained data for finishers ( $n = 1\ 998\ 124$ ) from Evira Finland's Food Safety Authority's national records by collecting information from pigs slaughtered in all slaughterhouses in Finland during the same time period as for the sows investigated in this study.

When calculating the financial loss caused by carcass condemnations, the producer price of 0.8474 €/kg for sow meat was used.

The complete set of data (both Swine Herd Register data and MI findings) for this observational study investigating the association between mortality and MI findings was obtained for 39 herds.

### 2.1. Statistical analyses

#### 2.1.1. Herd level data

The unit of interest was a herd. All outcome variables were originally expressed as herd level percentages. First, descriptive statistics were calculated for all outcome variables (abscesses, arthritis, liver condemnations, milk spots, organ condemnations, pleuritis, pneumonia, tail biting, shoulder ulcers and a summary variable "condemnation due to any reason" in addition to lean meat percentage, partial or whole carcass condemnations and kg of condemnations). Because of clear differences in coding practices regarding pleuritis between different slaughterhouses (Hälli et al., 2012), descriptive statistics for pleuritis were calculated separately for each slaughterhouse.

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