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Mortality in Farmed Mink: Systematic Collection versus Arbitrary Submissions for Diagnostic Investigation

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Rattenborg E, Dietz HH, Andersen TH, Møller SH: Mortality in farmed mink: systematic collection versus arbitrary rubmissions for diagnostic investigation. Acta vet. scand. 1999, 40, 307-314. – The distribution of diagnoses of mortality in mink submitted to the Danish Veterinary Laboratory (DVL) for diagnostic investigation in the calendar year 1997 was compared with the diagnoses of mortality in all dead mink collected at 4 selected farms (project farms) during the same period. A total of 1,015 submitted mink and 1,149 mink from the 4 project farms were subjected to post mortem investigation. The average size (breeding stock) of the project farms was larger than Danish farms on average. However, the distribution of colour types of the mink was comparable. The seasonal distribution of the material from project farms and that of the submissions were approximately the same. Differences in the distribution of diagnoses as well as recovered microorganisms were found, however, mainly related to the proportion of gastro-intestinal disorders and *E. coli* respectively. These proportions were negatively correlated. Overall the results showed that extrapolating diagnostic results of laboratory submissions to the population of farmed mink may be problematic, and more reliable methods for disease surveillance must be considered.

fur animals; epidemiology; mortality rate; proportional mortality; bias; pathology; microbiology.

Introduction

Good reasons for obtaining precise knowledge about occurrence of diseases in populations of animals are numerous. However, the expenses of getting even tolerable estimates mostly make this impossible, not to mention keeping records updated. During the procedure of data collection loss of information and increase of bias take place for each level passed. If it is left to the farmer and his staff to record diagnoses, the estimates may be imprecise depending on types of diseases and animal populations. As an example *Vaillancourt et al.* (1990), *Vaillancourt et al.* (1992) and *Christensen & Svensmark* (1997) have shown that sensitivity of producer-recorded mortality among piglets was low. Even when trained veterinary practitioners record diagnoses, information bias may occur. These circumstances make it preferable to diagnose causes of mortality at a laboratory, where a large range of diagnostic facilities are available. However, usually laboratory data are collected for other purposes than disease surveillance, and furthermore knowledge about the underlying population is often lacking, e.g. proportional mortality data. There are plenty of caveats for using these secondary data in research. Furthermore, the use of proportional mortality data are generally considered unsuitable, even if they in some cases can serve as a substitution for population mortality data (see e.g. *Park et al.* 1991, *Miettinen & Wang* 1981, *Kupper et al.* 1977). However, in many cases these kinds of data are the only available.

In this study we had the opportunity to investigate whether diagnoses collected from post-mortem examinations of carcasses submitted by practising veterinarians to the Danish Veterinary Laboratory (DVL) from farms with disease problems (usual laboratory data) were comparable to causes of mortality on 4 mink farms during a calendar year. If the possible differences could be quantified and the bias related to these could be identified, the former material could be used for extrapolation. A full year was chosen because of the distinct seasonal production period of the mink. Almost all kits were born within 2 weeks around the first of May, thus giving rise to a distinct seasonal distribution of disease and mortality. The results and potential biasses are discussed.

Materials and methods

One part of the material consisted of mink carcasses submitted for post mortem investigation to the DVL during the period from 1 January 1997 through 31 December 1997. These were submitted by veterinary practitioners as a supplement to diagnosing causes of disease problems on mink farms (submission farms). For comparison all dead mink from 4 selected mink farms (project farms) in 1997 were subjected to similar post mortem investigation. The pathological diagnoses were based on gross pathology, microbiological and histological examination, and analyses for specific virus infections if indicated, i.e. Mink Virus Enteritis (ELISA), distemper (indirect immunofluorescence) or Aleutian disease (histology). The same pathologist, with 2 pathologists as relieves at rare occasions, performed the gross pathology of carcasses from both categories. The microbiological supplemental investigations carried out if indicated were performed according to standard laboratory directions. The same histopathologist carried out all histological examinations.

The 4 project farms were chosen because of their participation in a pilot project about health

Table 1. Farm size and composition of colour types for project farms and all Danish farms.

Characteristics	Project farms	All Danish farms
Average number of breeding females	3,613	863
Colour types - brown types	83 %	77 %
- black	15 %	16 %
- other types	1 %	6 %

Table 2. Descriptive statistics for farm size (number of breeding females) for submission and project farms. Specific submissions concern a number of specific diseases (see text), ordinary submissions concern other diseases.

	No. farms	Mean size	95% CI	Std. error	Min. size	Max. size
Ordinary subm.	190	1,268	1,101-1,435	85	40	8,500
Specific subm.	154	1,113	999-1,226	58	185	3,600
Project farms	4	3,613	-	-	2,500	5,450

CI = confidence interval.

Table 3. Distribution (%) of post mortem diagnoses among submission and project farms.

Diagnosis	Subm.%	Project%
Mink Virus Enteritis	3.0	0.0
Enteritis, bact. infections	10.6	31.2
Intestines, other diseases	0.1	0.1
Respiratory system, virus inf.	0.4	0.0
Respiratory system, bact. inf.	4.2	1.5
Pneumonia, Ps. aeruginosa inf.	10.3	0.0
Respiratory system, other diseases	0.1	0.2
Urinary tract infections / Urolithiasis	4.7	13.1
Liver, bact. inf.	0.1	0.0
Hepatitis, chronical	1.8	4.6
Liver, other diseases	0.3	0.0
Neural System, virus inf.	0.1	0.0
Neural System, bact. inf.	0.1	0.0
Nutritional Muscular Dystrophy	1.9	0.1
Nursing Sickness	0.3	1.9
Sticky Kits	9.3	4.1
Trauma	0.0	0.4
Starvation, Dehydration	1.6	6.2
Septicaemia	5.2	4.7
Plasmacytosis	4.1	0.0
Distemper	20.7	0.1
Unknown, Other	21.3	31.8
Total %	100.2	100.0

No of animals: Submission 1,015
Project 1,149

management in mink farms. The characteristics of the project farms, and Danish farms in general (*Clausen* 1997a, *Clausen* 1997b) concerning farm size and composition of colour types are shown in Table 1. The crude mortality rates per 1,000 mink months were calculated.

The reason for submission of carcasses by the veterinary practitioner could be either voluntary as an aid to the diagnosis of a disease problem on the farm, or compulsory due to suspicion of a notifiable disease. These and a few other specific diseases were excluded from the analyses before further comparisons were made in order to minimise selection bias . They concerned distemper, mink virus enteritis, Aleutian disease and haemorrhagic pneumonia. Furthermore animals for which a diagnosis could not be made were excluded. Concerning the project farms the latter was mainly a large number of stillborn or neonatal deaths of which only a fraction were subjected to examination for practical reasons. Concerning the submission group a major part was carcasess solely examined for a specific disease and found negative. The exclusions were made for comparison of diagnoses as well as the distribution of pathogenic agents.

The project farms were compared to the submission farms with respect to farm size (Table 2). In this table the separation into voluntary (ordinary) and compulsory (specific) submissions has been made. See later for further justification of separation (Table 3).

The single diagnoses were joined into the major categories 'gastro-intestinal disorders' and 'other' for illustration of seasonal distributions (Fig. 4). The homogeneity of the distributions was tested by a Poisson model, ie.

$$\ln(E(x_{tdq})) = a_t + b_d + x_q ,$$

where $\ln(E(x_{tdq}))$ is the natural logarithm of the expected number of cases according to submission type, t, (submission vs. project farms), diagnosis category, d, and quarter of the year, q. a, b, and x are unknown parameters. Furthermore the interactions between submission type and disease category, t x d, as well as submission type and quarter, t x q, were tested in a model controlling for the interaction between disease category and quarter, d x q. The latter initiative was carried out in order to detect the location of potential differences. The analyses were performed using the GENMOD procedure of the statistical computer program SAS (*SAS Institute Inc.* 1993).

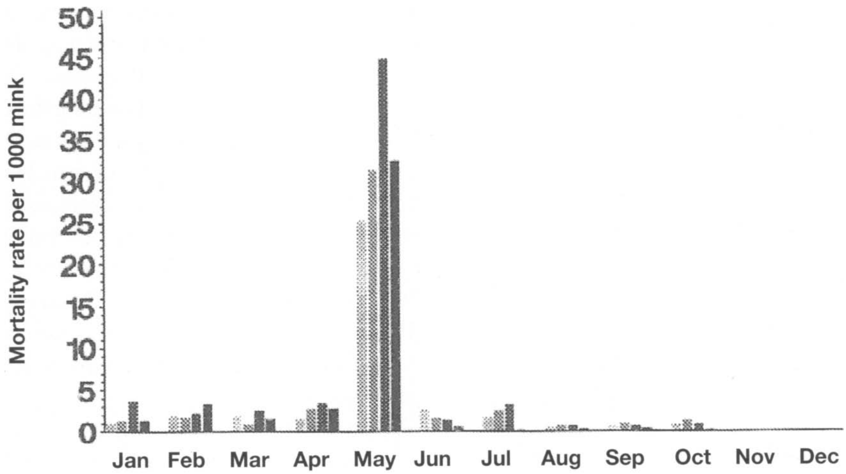

Figure 1. Crude mortality rate per 1,000 mink months on each of the 4 project farms. Rates for November and December are not included (pelting season).

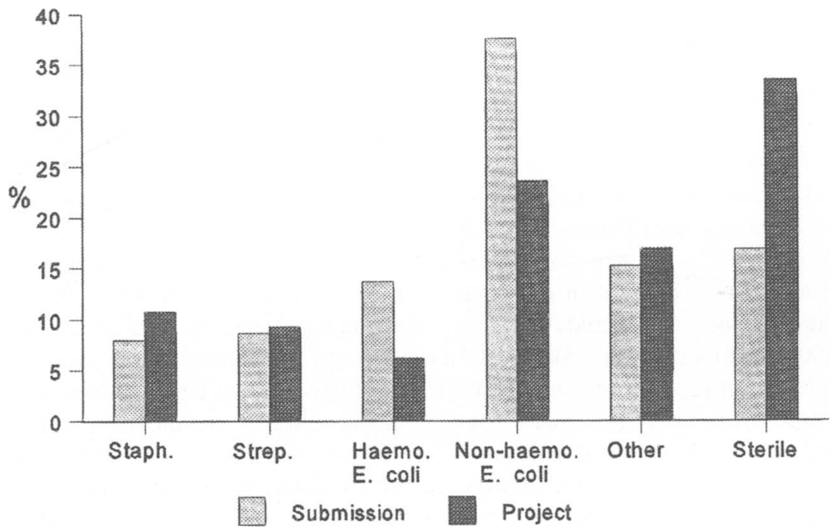

Figure 2. Distribution of recovered microorganisms from submission and project farms.

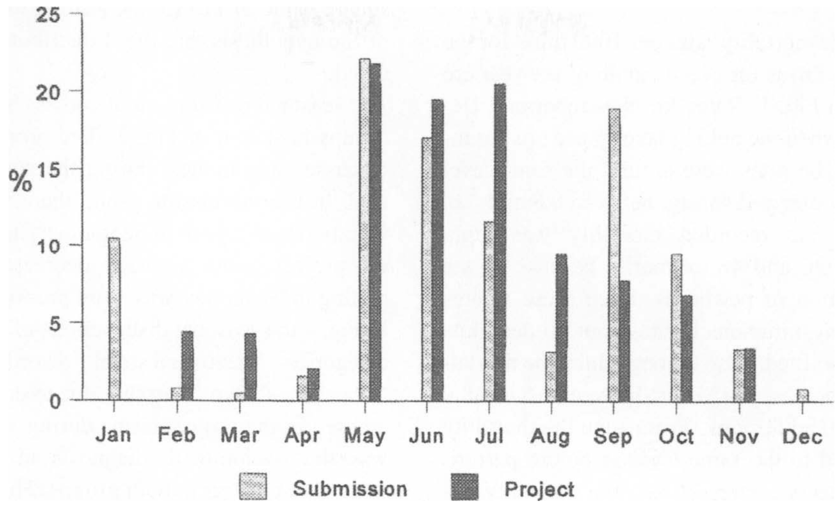

Figure 3. Seasonal distribution of the proportion of carcasses.

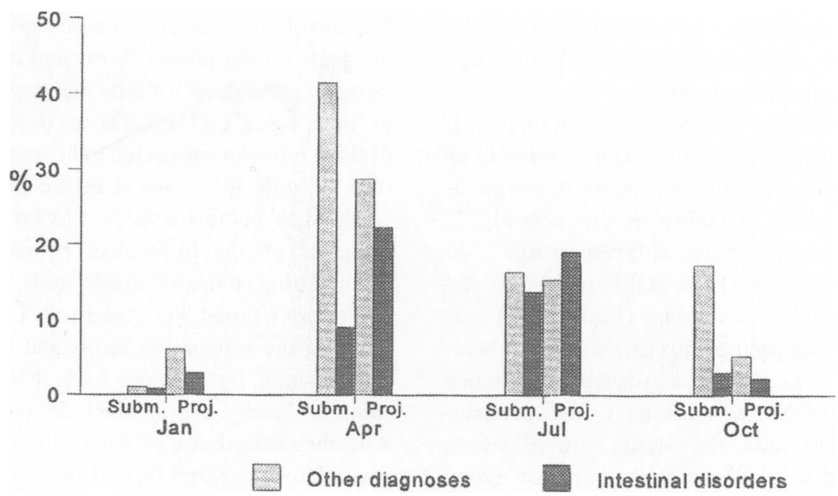

Figure 4. Quarterly distribution of the proportion of intestinal disorders and other diagnoses. The submission group and the project group each add to 100 percent.

Results

The crude mortality rates per 1000 mink for the 4 project farms for every month of the year are shown in Fig. 1. Rates for November and December when the pelting takes place are not included. The rates were around the same level during winter and spring, between 0.8 and 3.6. In May the recorded mortality was high, between 26 and 46, primarily because of the contribution of newborns. Even these figures are underestimations because not all dead kits were submitted. Also among adults the mortality rate increased in May to between 2.8 and 8.0 per 1,000 adult mink. From June the mortality decreased to the same level as before parturition. After weaning in July the mortality decreased further and stayed between 0.1 and 1.2 per 1,000 mink months.

In Table 3 the 'gross' proportions of the different diagnoses for both groups (submissions and project) are shown. A major diagnosis in both groups was enteritis with 13.6% and 31.2% respectively. Furthermore, the amount of carcasses for which a diagnosis could not be found was 21.3% and 31.8%, cf. above. In the submission group distemper amounted to 20.7% of the diagnosed mink compared with 0.1% (one animal) in the project group.

The distribution of recovered microbiological agents after exclusion of distemper, mink virus enteritis, Aleutian disease, haemorrhagic pneumonia, and the 'unknown' is shown in Fig. 2. The distributions differ with respect to *E. coli* that amounted to 51.3% in the submission and 29.7% in the project group. The difference was found among haemolytic (13.7% and 6.14% respectively) as well as non-haemolytic strains (37.6% and 23.5% respectively). The compensating part was the sterile group, which amounted to 16.8% in the submission group and 33.4% in the project group. A test for homogeneity assuming a product-multinominal distribution revealed a highly significant Chi-square value of 115 (5 df), leading to rejection of the hypothesis that the 2 distributions were equal.

The seasonal distribution of carcasses for the 2 groups is shown in Fig. 3. The proportion of carcasses was highest during the summer period. In the submission group there was some variation with a peak in September; however, in the project group a steady decrease towards pelting in November was more pronounced.

In Fig. 4 the seasonal distributions of the major categories 'gastro-intestinal disorders' and 'other' are shown. Mortality due to enteritis increased in the project farms during spring and was the predominant diagnosis in the third quarter of the year in both groups. This was the case in the submission as well as the project group. The result of the test for homogeniety was significant, the deviance was 155 (10 df). Also the interactions between submission type and disease category, $t \times d$, and submission type and quarter, $t \times q$, were significant (p-values < 0.001).

Discussion

The distributions of colour types were almost the same on the project farms and on Danish farms in general, with a little higher proportion of 'other types' on Danish farms overall. Some of these types are suspected to be more susceptible towards infections than the brown and black types, but this is thought to have a minor influence on the differences between the 2 groups being compared in this study.

The project farms were relatively large compared to the submission farms and to Danish farms overall. It is not known which bias are introduced hereby, and in which direction. Likewise the average size of the submission farms was relatively greater than Danish farms overall. This might be due to the fact that larger farms tend to have owners, which are more willing to pay the costs of a laboratory investigation. Although not significant the average size of farms from which material was submitted for ordinary investigation was larger than the average size of farms from which material was submitted for specific investigation.

As mentioned above the difference between the 'unknown' among the submission group and the project group was mainly due to the great number of stillborn and neonatal deaths. These also account for a part of the carcasses starved and dehydrated. Together with other more obvious diagnoses like traumatic causes of mortality, these are unlikely to be submitted for diagnostic investigation. The difference between the proportion of animals with diagnoses related to the urinary system (4.7% and 13.1% respectively) relates to the sporadic occurrence of these diseases. It is unlikely that farmers call the veterinarian in case of the death of one or a few animals.

The difference between the distributions of the recovered bacteria detected during the study is mainly related to the relatively higher occurrence of *E. coli* in the submission group and of sterile samples from the project farms (Fig. 2). *E. coli* is thought mainly to be found in cases of intestinal disorders, which leads to the results shown in Fig. 4. The significant results of the disease category are apparently related to a relatively lower number of gastrointestinal disorders among the submission group in the quarters of April and October. The carcasses in the project group might have been subjected to a relatively fast preservation due to deep-freezing in the summer period, whereas the carcasses in the submission group have been mailed to the DVL causing some growth of bacteria into the internal organs including *E. coli.* This discrepancy in the results indicates the need for further study of *E. coli* with respect to a more detailed classification of the pathogenicity of this microorganism in mink.

The minor difference in the seasonal distributions related to the relatively great number of submissions in September is not obvious.

In this study the selection of farms for comparison (project farms) was carried out without paying attention to the formalities necessary for making statistical inferences (random sampling). This was a possible source of bias, which cannot be assessed. The fact that the farms participated in a health management project is not thought to have influenced the estimates, mainly because these were relative rather than absolute measures. However, the number of comparison farms was small, which gives rise to large variation of the estimates. The use of proportional mortality or morbidity data is always questionable and if used, it demands additional knowledge of true rates or risks in the population. The conclusion of this study is that extrapolating results of laboratory diagnostic investigations to the population of farmed mink is problematic, especially concerning certain diseases. In addition the drawbacks of using proportional mortality data where changes in one disease affects the proportions of the others must be mentioned. This means that there is a definite requirement for development of methods, which in a realistic way can provide information about disease and mortality in the population of farmed mink.

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Sammendrag

Dødelighed hos farmede mink: systematisk indsamling versus vilkårlig indsendelse til diagnostisk undersøgelse.

Kan materiale (kadavere af mink) indsendt til diagnostisk undersøgelse ved Statens Veterinære Serumlaboratorium anses for repræsentativt for dødeligheden i minkbesætninger generelt, hvad angår årstidsvariation, diagnosefordeling og fund af isolerede mikroorganismer? Dette blev undersøgt for kalenderåret 1997 ved sammenlignelig undersøgelse af alle døde mink fra 4 udvalgte farme (projektfarme) med materialet indsendt til diagnostisk undersøgelse (indsendelser). I alt 1237 døde indsendte mink og 1149 mink fra projektfarme blev obduceret. Størrelsen af projektfarmene var i gennemsnit større end gennemsnittet af danske minkfarme, men farvetypesammensætningen var nogenlunde ens. Der fandtes kun mindre forskel på fordelingen af den månedlige mortalitetsrate på projektfarmene og antallet af indsendelser til diagnostisk undersøgelse. Der fandtes derimod signifikant forskel på diagnosefordelingen samt fordelingen af isolerede mikroorganismer. Disse forskelle, der hovedsageligt var relateret til gastrointestinale lidelser og forekomsten af *E. coli,* var modsat rettede, idet der fandtes hyppigere forekomst af gastrointestinale lidelser blandt projektminkene, mens andelen af *E. coli* var højere blandt de indsendte mink. Resultaterne viser, at materiale indsendt til diagnostisk undersøgelse fra farmmink er mindre anvendeligt til sygdomsovervågning, hvor diagnosefordeling er formålet. Andre metoder til indsamling af data er nødvendige.

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