THE EFFECT OF ENVIRONMENTAL RISK FACTORS ON THE OCCURRENCE OF MULTIFACTORIAL DISEASES IN ESTONIAN DAIRY CATTLE

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1. ABSTRACT

The interrelationship between the health status of dairy cows and the possible risk factors arising from housing conditions and management routines were investigated. Some large high-production dairy herds with different keeping technology across Estonia were selected as focal units. 33 cowsheds with 5000 milking cows were under investigation over a period of 3 full years (1998-2000). On the basis of the data collected, specific datasets were formed and analysed using MS Excel and SAS. The panorama of multifactorial diseases was established and the generalized linear models with logit link function were used to determine the relevance of environmental risk factors on the incidence of multifactorial diseases in dairy cows.

Keywords: dairy cow, environment, multifactorial diseases, risk factor, generalized linear models.

2. INTRODUCTION

Dairy housing is and will probably remain the most essential part of Estonian agriculture. In the context of the increasing use of intensive modern keeping technologies, the environment has a very strong influence on the health, welfare and productivity of dairy cows.

Economic losses due to the increased incidence of major diseases and other health problems in dairy cattle herds are relatively high (Kossaibati and Esslemont, 1997). The ascertainment of the interrelationships among disease, milk yield, reproduction and herd management is necessary in order to develop a decision-making model for disease treatment, insemination and replacement (Gröhn and Rajala-Schultz, 2000). Multifactorial diseases are characterized by a variety of internal and external factors, none of which can itself produce the disease (Hartung, 1994). Risk factors for diseases can be classified as herd (environmental) and cow (individual) risk factors (Ekesbo and Oltenacu, 1994). Most diseases in Estonian dairy cattle have a multifactorial etiology, but there is no general system for recording and analysing them. The objective of this study was to establish the panorama of multifactorial diseases and elaborate a generalized linear model to determine the possible external risk factors for the most common diseases.

3. MATERIALS AND METHODS

The study involved 33 cowsheds with 5000 milking cows across the entire country over a period of three full years (1998-2000), the different natural conditions, the organisation of production and administrative division being taken into account.

Data concerning keeping conditions (housing system, microclimate, placement of animals, stalls, mangers etc.), management routines (feeding, manure handling and milking technologies etc.) and the technical and hygienic status of the cowsheds were registered. Exact measurements and empirical values were used in the evaluation of keeping conditions.

Production data were obtained from the Agricultural Registers and Information Centre.

The technical and hygienic status of the building and its parts (walls, ceilings, floors, windows, doors) was estimated using a scale of one to five (1- worst; 2-bad; 3-insufficient; 4-good; 5-very good). The dimensions of the stalls and mangers were measured using the metric system.

Of microclimate parameters during the indoor period (October-May), temperature, relative humidity, air velocity and ammonia concentration were registered during three seasonal visits annually.

Diseases were diagnosed and registered by local veterinarians. There were a total of 125 disease codes on the list. As the incidence rate for many of them was very low or they were not estimated, the generalisation of diagnoses was reasonable, and 9 groups of diseases were formed: 1) ovulatory dysfunction, 2) calving-related diseases (abortion, dystocia, prolapse of the uterus, retained placenta, uterine infection), 3) metabolic diseases, 4) diseases of the digestive tract (tympani, rumen acidosis, disorders of the abomasum, enteritis), 5) udder diseases, 6) foot diseases, 7) other injuries, 8) diseases of the respiratory tract and 9) skin diseases.

From the collected data, four databases were formed: 1) diseases; 2) microclimate; 3) facilities and 4) milk production. MS EXCEL and Statistical Analysis Systems (SAS) were used to analyse the distribution and dynamics of multifactorial diseases and the likelihood of their incidences resulting from keeping conditions. As the variable (disease incidence) is characterized by binomial distribution, generalized linear models are suitable tools to evaluate the effect of risk factors for multifactorial diseases. For example, the model describing the influence of some risk factors on mastitis is the following:

$$\text{logit}(\pi_{ijklm}) = \eta + K_i + M_j + A_k + L_l + bX_{ijklm} + e_{ijklm},$$

where π is the incidence of mastitis, η is the intercept, K, M, A and L are month, farm, bedding material and animal effects, respectively, X is stall length, b is regression coefficient, e represents the random error and

$$\text{logit}(\pi) = \ln(\pi/1\text{-}\pi).$$

The structure of the model for a particular case depends on the disease incidence rate, the logical choice and the pattern of risk factors.

4. RESULTS AND DISCUSSION

The panorama of diseases in Estonian dairy cows is shown in figure 1.

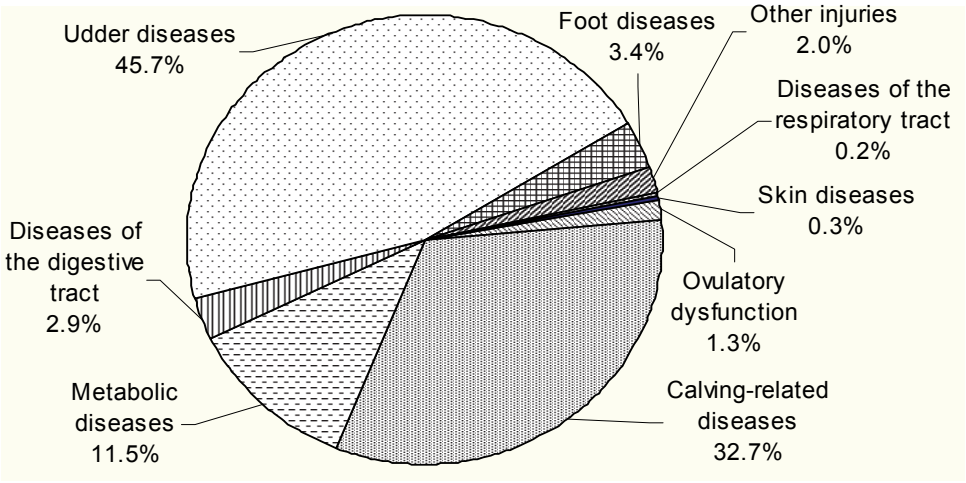

Figure 1. *Panorama of multifactorial diseases in Estonian dairy cows, based on 87332 observations over 3 full years.*

The most common diseases of dairy cows in Estonia are udder diseases (45.7 %), calving-related diseases (32.7 %), metabolic diseases (11.5 %), foot diseases (3.4 %) and diseases of the digestive tract (2.9 %). The panorama of mutlifactorial diseases generally resembles the situation in other European countries. The results of the statistical analysis of the five most frequently registered disease complexes are the following.

Udder diseases

Herd-level risk factors associated with udder diseases include the type of housing, the type and amount of bedding, the length and width of the stalls, and the average temperature and air velocity in the cowhouse. A significantly higher incidence ($p<0.001$) was registered: 1) in the case of tied housing (compared to loose housing), 2) when peat or sawdust (compared to straw) were used as bedding material, 3) when the amount of bedding was insufficient, 4) in the case of long and narrow stalls, 5) when the indoor temperature and air velocity were unfavourable. Udder diseases have been found by many investigators to be more common in tied housing systems than in loose housing (e.g. Valde, 1997; Hultgren, 2002). Schukken et al. (1991) found that the type and amount of bedding have a strong influence on the incidence of high somatic cell count in milk, trampled teat and clinical mastitis.

Calving-related diseases

Herd-level risk factors associated with uterine infection include the type of housing, the type and amount of bedding, the technical and hygienic status of the building, the length and width of the stalls and the season. A significantly higher incidence ($p<0.001$) was registered: 1) in the case of tied housing (compared to loose housing), 2) when peat or sawdust (compared to straw) was used as bedding material, 3) when the amount of bedding was insufficient, 4) when buildings were of poor technical and hygienic status, 5) in case of short and wide stalls, 6) in spring (compared to autumn and winter). We did not find much information in the literature about herd-level risk factors. Bendixen et al. (1987) found that the incidence of retained placenta was lower in loose housing.

Metabolic diseases

Environmental risk factors associated with metabolic diseases include the technical and hygienic status of the building, the season, and the temperature in the cowhouse. A significantly higher incidence ($p<0.001$) was registered: 1) in the case of buildings in poor technical and hygienic status, 2) in spring (compared to autumn or winter), 3) in high inside temperature. There is some information in the literature that the incidence risk for metabolic diseases (ketosis) is higher in tied housing herds (Valde et al., 1997).

Foot diseases

Environmental risk factors associated with foot diseases include the type of housing, the type of bedding, the presence of stall partitions, the season of the year, stall length, humidity and the air velocity in the cowhouse. A significantly higher incidence ($p<0.001$) was registered: 1) in the case of loose housing (compared to tied housing), 2) when sawdust or straw (compared to peat) was used as bedding material, 3) when there were stall partitions on both sides of the cows, 4) in autumn (compared to winter and spring), 5) in the case of long stalls, 6) in high indoor humidity and air velocity. Østerås and Leslie (1997) found that most foot diseases are connected with the housing system and the material and quality of the floor on the stalls. According to Hultgren (2002), the loose housing system promotes a higher incidence of foot diseases.

Diseases of the digestive tract

Environmental risk factors associated with diseases of the digestive tract include the technical and hygienic status of the building, the season and the temperature in the cowhouse. A significantly higher incidence ($p<0.001$) was registered: 1) in the case of buildings with poor technical and hygienic status, 2) in winter and spring (compared to autumn), 3) in high inside temperature. According to the literature (e.g. Vannier et al., 1983), the quality of the building is an important risk factor for this complex of diseases.

5. CONCLUSIONS

The main groups of multifactorial diseases of dairy herds in Estonia are udder diseases, calving-related diseases and metabolic diseases, which is similar to the panorama of diseases in other European countries.

Generalized linear models are suitable tools to evaluate the effect of risk factors for multifactorial diseases.

6. ACKNOWLEDGEMENTS

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