Economics of Mastitis and Somatic Cell Score in Holstein Population of Iran

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Introduction

Mastitis is the most common and most costly disease of dairy cattle. Most breeding programs use somatic cell count (SCC) as an indicator for mastitis susceptibility (Mark et al. 2002). Inclusion of SCC in a national economic index is expected to bring extra revenue by reducing the incidence of clinical mastitis (CM) and related costs, improving milk price, quality, hygiene and welfare issues (Veerkamp et al. 1998). In Iran, only one national genetic index is currently available for dairy farmers and breeding organizations to use. This Lifetime Net income Index (LNI) includes milk production traits and longevity as a national selection objective (Sadeghi-Sefidmazgi et al. 2009). No health attributes are directly included. The objectives of this study were, therefore, to estimate the direct costs due to CM and SCS and to calculate the economic values of CM incidence and SCS for incorporating these traits in the national economic index.

Material and methods

Estimation of somatic cell score costs and economic values. A total of 2,182,366 test day SCC records were obtained from the Animal Breeding Center of Iran from lactations of Holstein cows that were initiated between 2003 and 2009. The somatic cell score (SCS) was calculated from the SCC, which was defined as the average number of somatic cells per milliliter of milk: $SCS = \log_2(SCC/100000) + 3.$

Costs associated with the level of somatic cell score results from the penalty applied in the milk price paid to Iranian farmers based on daily bulk tank somatic cell count levels. The actual payment system provides a discontinuous penalty to the price of milk for four classes of somatic cell count level. The SCS class frequency was calculated as the arithmetic mean of total test day records. Table1 gives frequencies and amount of penalty of each SCS class. Descriptive statistics were used to estimate SCS costs and economic value summarized in table 2.

SCS costs were modeled using a threshold model, as described by Meijering (1986) to derive economic values of dystocia. SCS economic value was defined by determining the effect of an increase in the SCS herd level on the proportion of cows producing milk in each SCS class.

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Table 1: Frequency distribution of somatic cell score (SCS) classes and penalties applied for each class of somatic cell count (SCC).

SCC range	SCS class	Frequency	Penalty (US$. kg^{-1})
< 300000	< 4.59	68.7	0.000
300000- 500000	4.59 -5.32	12.3	0.010
500000- 1000000	5.32- 6.32	9.5	0.025
>1000000	> 6.32	9.6	0.040

Table 2: Descriptive statistics

N	Mean (score)	SD	305-MY (kg)	CI (days)
2,182,366	3.41	2.11	7750	395

SD = standard deviation, MY = milk yield and CI = calving interval

Calculation of the costs due to CM and the economic value for incidence of clinical mastitis. A model to calculate mastitis costs and derive economic value for clinical mastitis was developed. Calculation of the costs due to CM and the economic value for incidence of clinical mastitis is as following:

Mastitis costs ($ per cow per year) = the losses of revenues for discarded milk during illness of cows ($ per cow per year) + the cost for drugs and veterinary service ($ per cow per year)) + the labor cost for herdsman's time dealing with clinical mastitis ($ per cow per year)) + the other costs connected with clinical mastitis ($ per cow per year).

Reductions in milk price due to high SCC, the economic consequences of increased culling rate and occurrence of other diseases, lost income caused by permanently reduced yield following mastitis in the rest of the lactation and in coming lactations (as reported, e.g. by Schepers and Dijkhuizen, 1991 or Houben et al. 1993) were explicitly excluded from the estimation mastitis costs. To include them would have caused double counting, because SCS, productive life and milk production, are already included in the breeding goal.

The economic value of clinical mastitis is calculated as the first partial derivative of the Mastitis costs with respect to the averaged incidence of clinical mastitis. The averaged incidence of clinical mastitis cases (YMI) defined as number of clinical mastitis occurrence in a herd per year divided by total number of cows. The economic value calculated in this way gives the change in the direct financial losses per cow per year which is equal to the negative change in profit per cow per year when increasing the average number of clinical mastitis cases per cow per year by one case.

Results and discussion

Costs and economic values for Somatic cell score. Table 3 gives the costs and economic values of SCS for a base situation for the whole population of Iranian Holstein. Costs and economic values for SCS were expressed in three ways. The first was per score per kg of milk yield and the second was per cow per lactation defined as 305-day milk yield multiplied by SCS costs or economic values per score per kg of milk yield and the third was per cow per year defined as SCS costs or economic values per lactation multiplied by 365/calving interval.

If we assume SCS is normally distributed with an average of 3.41 and a standard deviation of 2.11, SCS costs were found to be US$ 0.004 per score per kg MY, US$ 30.83 per cow per

lactation and US$ 28.49 per cow per year. Economic values for SCS would be US$ -0.005 per score per kg MY, US$ -38.75 per cow per lactation and US$ -35.81per cow per year.
In the USA, the value of PTA SCS per lactation was set at –US $62, which includes a lost premium of $44 plus $18 for labor, drugs, discarded milk, and milk shipments lost due to antibiotic residue (Cole et al. 2010). In the Spanish population, economic values of SCS estimated to be US$ -0.004 per score per kg of milk at basic situation for free market considering threshold method (Charfeddine et al. 1996). This is not surprising because of differences in model, trait definition and assumptions about management system.

Table 3: Somatic cell score costs and economic values for Iranian Holstein

Units	SCS costs (US $)	SCS economic values (US $)
Per score per kg milk	0.004	-0.005
Per cow per lactation	30.83	-38.75
Per cow per year	28.49	-35.81

Direct losses due to CM and economic value of CM incidence. The data used for calculating the individual components of mastitis costs for 5 different farms are given in Table 4. Losses of revenues for discarded milk during illness of cows and costs for drugs and veterinary service per cow per year differed among farms.
Differences among farms in CM incidence, the length of treatment and daily milk yield level resulted in large variation in revenue losses for discarded milk. Milk losses accounted for 68–78% of the total costs. Veterinary expenses were the next most important cost, accounting for 19–27% of total costs. Among the individual farms, mastitis costs ranged from $ 23.06 to 70.15 with a mean of $ 53.15 per cow per year. The economic values for increasing the average CM incidence by one case per cow per year varied between farms from US$ -64.55 to -93.32 per cow per year with an average of US$ -80.09.
The objective of the present study was to estimate the economic value of mastitis incidence in line with the breeding goal or the aggregate genotype. To avoid double counting of effects, the impact of mastitis on the level of other traits commonly included in the aggregate genotype (milk production traits, reproductive traits, cow survival, somatic cell count) were not considered when calculating financial losses from clinical mastitis. Therefore, economic losses from CM in the present and other studies targeting development of a breeding objective are not directly comparable to those attempting to quantify all cost.
The economic values for increasing the average CM incidence by one case per cow per year found to be US $ -91.40 per CM case per cow per year in the Czech Republic (Wolfova et al. 2006). In the UK, the EV of mastitis was estimated at US$ 1.35 per percent incidence, giving an index weight for SCC PTA of US$ 0.33 (Stott et al. 2005).

Conclusion

Mastitis and somatic cell score economic values have been estimated to be approximately US$ -80.09 and US$ -35.81 per cow per year, respectively. Having substantial economic importance justifies the incorporation of these traits into the breeding goal for dairy cattle in Iran.

Table 4: Cost components applied in the model for the calculation of financial losses due to clinical mastitis (CM) and the economic value of CM per cow per year

Variable	Farm					
	1	2	3	4	5	Mean
Losses of revenues for discarded milk during illness of cows ($ per cow per year)	37.49	16.03	37.65	54.38	47.84	39.17
Cost for drugs and veterinary service ($ per cow per year)	10.22	5.28	10.22	13.03	18.85	11.45
Labor cost for herdsman's time dealing with clinical mastitis ($ per cow per year)	1.29	0.67	1.29	1.64	2.38	1.44
Other costs connected with clinical mastitis ($ per cow per year)	1.09	1.09	1.09	1.09	1.09	1.09
Mastitis costs ($ per cow per year)	50.08	23.06	50.24	70.14	70.15	53.15
Economic value of CM $ per cow per year	-84.47	-73.26	-84.74	-93.32	-64.55	-80.09

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