Turk J Vet Anim Sci
24 (2000) 465-472

Cost of Mastitis in Scottish Dairy Herds with Low and High Subclinical Mastitis Problems*

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Received: 24.12.1999

Abstract: The aim of this study was to estimate the cost of mastitis and the contribution of each cost component of mastitis to the total mastitis induced cost in herds with low and high levels of subclinical mastitis under Scottish field conditions.

It was estimated that mastitis cost £140 per cow/year to the average Scottish dairy farmer in 1996. However, this figure was as low as £69 per cow/year in herds with lower levels of subclinical mastitis, and as high as £228 cow/year in herds with high subclinical mastitis. The magnitude and proportion of the cost components in the total cost of mastitis were significantly different in herds with high subclinical mastitis and those with low levels of subclinical mastitis. However, losses due to milk yield depression were found to be the most significant cost components in both herd groups.

Key Words: Dairy cows, mastitis, costs

Düşük ve Yüksek Subklinik Mastitis Problemiyle Karşı Karşıya Olan İskoçya Süt Sığırcılık İşletmelerinde Mastitisten Kaynaklanan Finansal Kayıplar

Özet: Bu çalışmada mastitisin süt sığırcılık işletmelerine toplam maliyeti ve bu maliyet içinde her bir maliyet kaleminin katkısı düşük ve yüksek düzeyde subklinik mastitis problemiyle karşı karşıya olan İskoç süt sığırcılık işletmeleri için ayrı ayrı tahmin edilmiştir.

1996 yılı itibarıyle ortalama bir İskoç süt sığırcılık işletmesine mastitisin maliyeti inek başına yıllık £140 olarak tahmin edilmiştir. Ancak bu rakam düşük düzeyde subklinik mastitis problemiyle karşı karşıya olan işletmelerde £69'a kadar düşmesine karşın yüksek düzeyde subklinik mastitis problemiyle karşı karşıya olan işletmelerde £228'e kadar çıkabildiği tahmin edilmiştir. Maliyet kalemlerinin büyüklüğü ve toplam maliyetler içindeki payı açısından iki sürü grubu arasında önemli farklılıklar gözlenmiştir. Bununla birlikte toplam maliyet içindeki payı açısından, süt verimindeki azalmadan kaynaklanan mali kayıpların her iki işletme grubunda da en önemli maliyet kalemini oluşturduğu tespit edilmiştir.

Anathar Sözcükler: Süt sığırı, mastitis, maliyet

Introduction

Mastitis is a widespread disease in modern dairy herds. The occurrence of mastitis varies according to country, region, production system and mastitis control measures used (1). In the United Kingdom, the average incidence of clinical cases is around 50% (2) and around 10% of all quarters are subclinically infected. Individual herds deviate considerably from these average figures (3, 4).

In terms of the magnitude of financial loss caused by endemic diseases livestock, mastitis is the most significant disease in dairy cows in modern dairy herds (5, 6, 7). Kossaibati and Esslemont (4) estimated the magnitude of economic cost of the main endemic diseases in 50 dairy herds in England, and reported that the financial cost of mastitis to these herds was far greater than any other endemic diseases (Table 1).

Mastitis incurs costs for dairy farmers in several ways. These include:

1. Decreased milk yield during the remainder of lactation (mainly due to subclinical mastitis).
2. Decrease in milk fat content (mainly due to subclincal mastitis).

*This paper was presented at the International Symposium of Livestock Production 99 Held in İzmir, 21-24 Sept. 1999.

Table 1. Cost of endemic disease in 50 dairy herds in England.

Disease/problem	Total cost/case	Cases per 100 cows	Average costs (£/cow)*
Vulval discharge#	162	21.2	34
Retained foetal membranes#	289	3.6	10
Calf mortality#	310	7.8	24
Milk fever	220	7.7	17
Clinical mastitis	183	33.2	61
Subclinical mastitis &			42-84¢
Lameness	213	24.0	51
Oestrus not Observed	13	46.4	6

* Weighted according to incidence of the disease
\# Includes cost of longer calving intervals due to infertility problems
& Taken from Esslemont and Peeler (8)
¢ Depending on level of cell counts

3. Increased replacement costs due to culling of persistent clinical mastitis cases.
4. Treatment costs of clinical cases (e.g. drugs, veterinary costs, cost of extra labour, costs for treatment and nursing of mastitic cows, milk discarded due to antibiotic treatment)
5. Costs of prevention of mastitis (e.g. antibiotic cost for dry cow therapy, disinfectant for teat dipping/spraying, fees for checking milking machine, cost of culling cows as a part of mastitis control, extra labour cost for application of prevention procedures).
6. Other categories to consider are changes in feed intake and death (from clinical mastitis).

The results of several previous studies estimating the major financial cost/loss components of mastitis are shown in Table 2. As can be seen from the table, the major revenue losses from mastitis appear to be due to milk yield depression. The studies reported in Table 2 are almost in agreement in ranking cost components in terms of the magnitude of the losses they cause. However, these figures represent average herds and it is likely that these figures are considerably different in herds with high mastitis problems and those with low mastitis problems. Furthermore, since the mid 1980s the cost components and their magnitude in the total cost have changed significantly, particularly for herds with high subclinical mastitis problems, as the Milk Hygiene Regulation of western countries has imposed penalties or premiums according to bulk tank somatic cell counts (BTSCC), total bacterial counts (TBC) and antibiotic residues in the milk tank (as a result of milk from cows which have received antibiotic treatment entering milk tanks) (9). There is still a lack of studies considering these components in the literature. This study, therefore, aimed at producing a revised estimate of the contribution of each component to the total cost of mastitis to herds with low and high BTSCC separately under Scottish field conditions.

Table 2. Percentage contribution of cost components caused by mastitis estimated in several studies.

	Philpot (1976)	Blood et al, (1983)	Crist et al, (1993)
	% of Total	% of Total	% of Total
Milk yield depression	70	70	64
Premature culling	14	14	13
Milk discarded or downgraded	8	7	14
Treatment and veterinary expenses	8	8	9

Source: Pickering (10)

Materials and Methods

Materials

The Scottish Milk Recording Association's (SMRA) monthly individual cow records from 328,628 cow records of 756 herds, and the Scottish Milk Marketing Board's (SMMB) 1993 Mastitis Census including all 2187 Scottish dairy herds were used to estimate/calculate milk yield depression and the cost of BTSCC and TBC penalties, which are regarded as the most significant elements in the cost of mastitis. The other cost components included

in the study were obtained from the literature, but revised considering Scottish circumstances and the effect of inflation on the financial figures. The statistical figures related to the Scottish dairy herds were also obtained from different sources, as shown in Table 3.

Methods

All the above mentioned financial cost components of mastitis except that of antibiotic residues were taken into consideration in the study. Although the available data permitted calculation of this cost component, it was not calculated as few Scottish herds exceeded the penalty band for antibiotic residues. It was, therefore, considered negligible in the study.

The nformation and sources used in the study are presented in Table 3. In order to calculate the losses/revenues from BTSCC and TBC, the BTSCC and TBC penalty/premium bands of Scottish Milk Ltd., the main buyer of milk in Scotland, was used, and the proportion of herds paying BTSCC and TBC penalties in these bands was calculated from the SMMB's 1993 Mastitis Census including all 2187 Scottish dairy herds according to these bands.

Milk yield loss from somatic cell counts (SCC) for both low and high BTSCC herds was estimated using linear and generalised linear regression model procedures in the GENSTAT Statistical Package, Version 3.1 (21). For details of the model see Yalcin et al. (15).

Table 3. Information used in calculation of the cost of mastitis in Scotland.

Assumptions in the Calculations	Value			Source of Information
	All herds (2187 Herds)	High BTSCC* (472 Herds)	Low BTSCC** (1003 Herds)	
1) General				
No of days milk is produced in a year	305.00	305.00	305.00	
Average 305-day milk yield (litre/cow)	5166.00	5166.00	5166.00	Anon (11)
Average milk price (£/l)	0.23	0.23	0.23	SAC Farm Management Handbook (12)
Butter fat premium/penalty (ppl&)	0.03	0.03	0.03	SAC Farm Management Handbook (12)
Heifer value (£/head)	1,000.00	1,000.00	1,000.00	SAC Farm Management Handbook (12)
Cull cow value (£/head)	450.00	450.00	450.00	SAC Farm Management Handbook (12)
Price of concentrate (£/kg)	0.18	0.18	0.18	SAC Farm Management Handbook (12)
Annual culling rates (%)	20.00	22.00	18.00	Esslemont & Spincer (13) #
Proportion of culling due to insufficient production in total culling reason (%)	14.00	15.00	13.00	Young et al. (14) (+/- 1% were assumed for high and low BTSCC herds respectively)
Cost of culling	762.00	762.00	762.00	Esslemont & Spincer (13)
Cost of culling fatal clinical mastitis cases	1,999.00	1,999.00	1,999.00	Esslemont & Spincer (13)
BTSCC and TBC bands ('000/ml)		Premium/penalty (ppl)		Premium/penalty band of Scottish Milk Ltd. was used. SAC Farm Management Handbook (12)
BTSCC bands ('000/ml)				
Less than 250	0.1	0.1	0.1	
250-400	0.0	0.0	0.0	
401-500	-0.4	-0.4	-0.4	
More than 500	-1.0	-1.0	-1.0	
TBC Bands ('000/ml)				
Less than 15	0.2	0.2	0.2	
15-50	0.0	0.0	0.0	
50-100	-2.0	-2.0	-2.0	
More than 100	-5.0	-5.0	-5.0	
2) Suclinical mastitis				
Prevalence of subclinical mastitis (% udder)	10.00	15.00	5.00	Wilson and Richard (3) (+/- 5% was assumed for high and low BTSCC herds respectively)

Assumptions in the Calculations	Value			Source of Information
	All herds (2187 Herds)	High BTSCC* (472 Herds)	Low BTSCC** (1003 Herds)	
Milk yield depression (lt/cow/day)	1.57	1.89	0.64	Yalcin et al. (15)
Feed saved per 1 lt reduction in milk yield due to mastitis (kg)	0.30	0.30	0.30	McInerney et al. (16)
Average reduction in fat % due to mastitis	0.20	0.20	0.20	Beck et al. (17)
Average reduction in prot.% due to mastitis	Negligible	Negligible	Negligible	Beck et al. (17), Blowey and Edmontson (2)
BTSCC and TBC status of Scottish herds in 1993 (total 2187 herds)				SMMB Mastitis Census in 1993
% Herd with BTSCC less than 250,000 cells/ml	45.9	0.0	100.0	
% Herd with BTSCC of 250,00-400,000 cells/ml	32.6	0.0	0.0	
% Herd with BTSCC between 401,000-500,000 cells/ml	10.7	49.6	0.0	
% Herd with BTSCC greater than 500,000 cells/ml	10.9	50.4	0.0	
% Herd with TBC less than 15,000 bacteria/ml	70.4	0.0	71.9	
% Herd with TBC of 15,000 -50,000 bacteria/ml	27.4	89.8	28.1	
% Herd with TBC between 50,000-100,000 bacteria/ml	1.9	8.9	0.0	
% Herd with TBC more than 100,000 bacteria/ml	0.3	1.3	0.0	
Proportion of culling due to subclinical mastitis in culled cows due to insufficient yield (%)	2.00	3.00	1.00	Beck et al. (17) (+/- 1% was assumed for high and low BTSCC herds respectively)
3) Clinical mastitis				
% cows affected in an average herd	22.02	25.90	17.81	Esslemont & Spincer (13)#
No. of treatments per affected cow	1.56	1.61	1.41	Esslemont & Spincer (13)#
Average cost of treatment of mild and severe cases (includes milk discarded, drugs, labour and veterinary costs (£/per episode)	33.1	33.1	33.1	Stott and Eker (18)
Average cost of treatment of fatal cases	249.00	249.00	249.00	Esslemont & Spincer (13)
Proportion of culling due to clinical mastitis (%)	10.30	15.00	5.00	Young et al. (14) (+/- 5% was assumed for high and low BTSCC herds respectively)
% mild and severe clinical mastitis incidence	99.00	99.00	99.00	Blowey (19)
% fatal cases	1	1	1	Blowey (19)
4) Preventive measures (includes PMTD, DCT, MMT and UP) (£)	25.6	25.6	25.6	Yalcin (20)

* Herd average SCC 400,000-1,097,000 cells/ml
** Herd average SCC less then 148,000 cells/ml
& ppl = pence per litre
ø SAC = Scottish Agricultural College
The second and third quartiles were used for low and high BTSCC herds respectively

The mastitis preventive measures included in the survey were udder preparation (UP), post-milking teat disinfection (PMTD), dry cow therapy (DCT) and milking machine tests (MMT). The expenditures for these preventive measures were taken from McInerney et al. (16), but these figures were adjusted with the retail price index up to 1996, and the opportunity cost of labour for these procedures was also taken into account. Since almost all the herds in Scotland use these procedures, the cost of these procedures was assumed to be the same in both low and high BTSCC herd groups.

Microsoft Excel software (version 5.0) was used to calculate the total cost of mastitis and the contributions of each cost items to the total cost.

Results

The financial cost of mastitis per cow per year, and the magnitudes and proportion of each cost components in the total cost are presented in Tables 4 and 5 respectively.

As can be seen from the tables, the cost of mastitis and the contribution of each component to the total financial cost of mastitis vary considerably according to the level of subclinical mastitis in the herds.

The total financial cost of mastitis was as high as £218 per cow/year in herds with a high BTSCC problem (>400,000 cells/ml), whereas it was about £69 per cow/year in those with a low level of BTSCC (<148,000 cells/ml). The total financial cost of mastitis to the average Scottish dairy herd was estimated to be £140 per cow/year in Scotland in 1996.

In terms of the magnitude and proportions of the total cost, the losses from milk yield depression due to subclinical mastitis appeared to be the most significant cost component in all herd groups. On average, it cost £110.60 cow/year, but £25.90 of this was compensated for by a saving in the feed cost, giving a net figure of around £84.80 per cow/year (61% of the total cost) in 1996. The net financial losses from milk yield depression for high and low BTSCC herds were £102 and £34.60 respectively.

Table 4. Cost of mastitis to Scottish dairy herds (cow/year) in 1996.

Financial cost components	£*		
	All herds Financial value (£/cow/year)	High BTSCC herds Financial value (£/cow/year)	Low BTSCC herds Financial value (£/cow/year)
Revenue losses due to subclinical mastitis			
I) Net revenue losses due to milk yield depression	-84.8	-102.0	-34.6
Milk yield depression	-110.6	-133.2	-45.1
Feed cost saved	25.9	31.1	10.5
II) Milk quality			
1) Hygienic quality			
a) BTSCC premium/penalty	-5.5	-36.3	0.1
b) TBC premium/penalty	4.6	-12.6	7.4
2) Compositional quality (decrease in fat %)	-0.3	-0.3	-0.3
III) Extra replacement costs	-0.4	-0.8	-0.2
Cost due to clinical mastitis			
Treatment costs (inc. drugs, discarded milk, vet and labour)	-12.1	-14.7	-8.9
Replacement costs	-16.0	-25.6	-7.0
Cost of preventive expenditure	-25.6	-25.6	-25.6
TOTAL COST	-140.0	-217.7	-68.9

* Positive figures refer to financial gains

Table 5. Proportion of the cost components in the total cost of mastitis in Scotland in 1996.

Financial cost components	% in Total cost**		
	All herds	High BTSCC herds	Low BTSCC herds
Revenue losses due to subclinical mastitis	0.61	0.47	0.50
I) Net revenue losses due to milk yield depression	0.79	0.61	0.65
Milk yield depression	-0.18	-0.14	-0.15
Feed cost saved			
II) Milk quality			
1) Hygienic quality	0.04	0.17	0.00
a) BTSCC premium/penalty	-0.03	0.06	-0.11
b) TBC premium/penalty			
2) Compositional quality (decrease in fat %)	0.00	0.00	0.00
III) Extra replacement costs	0.00	0.00	0.00
Cost due to clinical mastitis			
Treatment costs (inc. drugs, discarded milk, vet and labour)	0.09	0.07	0.13
Replacement costs	0.11	0.12	0.10
Cost of preventive expenditure	0.18	0.12	0.37
TOTAL COST	1.00	1.00	1.00

** negative figures refer to gains

In order of importance in the total cost, the milk yield depression was followed by expenditures for preventive measures (18%), cost of culling due to clinical cases (11%), treatment cost of clinical cases (9%) and financial losses from the BTSCC penalty/premium scheme (4%). Since only 2.1% of the farmers incurred penalties due to high TBC, while over 70% received a premium from this scheme, the financial losses from the BTSCC penalty scheme were to a great extent compensated for by the premiums obtained from the TBC scheme.

However, when the calculation of the contribution of each component to the total cost was made separately for high and low BTSCC herds, quite different pictures were seen. In high BTSCC herds the financial losses from milk hygiene losses (BTSCC and TBC penalties) became the second most significant cost component (23%) after that of milk yield depression (47%). These were followed by expenditure for preventive measures and cost of culling due to clinical mastitis (both accounting for 12% of the total cost), and the cost of clinical cases (7%).

The low BTSCC herds benefited by about £7.5 per cow/year from the milk hygiene scheme. In terms of the cost of mastitis in this group, the second most significant cost of mastitis appeared to be that of preventive measures (37%) after the cost of milk yield depression (50%). These were followed by the treatment cost of clinical cases (13%) and the cost of culling due to clinical mastitis (10%).

The contribution of the cost of culling and milk fat reduction due to subclinical mastitis to the total cost were found to be negligible in all the groups studied.

Discussion

The findings of this study are in agreement with those of Blosser (5), Salsberg et al. (22) and Booth (23) in that subclinical mastitis is responsible for most of the economic losses from mastitis, and milk yield depression appears to be the main cause of the losses from mastitis.

The most interesting finding in this study is that the financial importance of mastitis varies considerably according to the level of mastitis in the herd. While mastitis does not appear to be a major concern in low BTSCC herds, for herds with high somatic cell count problems (BTSCC >400,000 cells/ml) the BTSCC penalty became the major concern. Moreover, since 1998, Scottish Milk Ltd. (the main buyer in Scotland) has stopped buying milk containing more than 500,000 cells/ml (Logue, personal

communication). It is likely that farmers whose BTSCC level exceeds this threshold will be faced with serious financial problems.

Despite the fact that almost all the herds underwent the main mastitis prevention procedures, considerably high BTSCC levels observed in one-third of the herds may be explained by the quality of the applications of these methods and farmers' conscientiousness in fulfilling general hygiene requirements.

In the literature, information about the reasons for culling and the incidence of clinical mastitis is not presented for low and high BTSCC herds separately. Therefore, figures for the former were based on questimates, and for the latter the second and third quartiles of herds in the study of Esslemont and Spincer (13) were used for low and high BTSCC herds respectively. As these components appear to be significant contributions to the total cost more reliable figures are needed for future research of this kind.

This study highlighted several important points about mastitis and its control in Scottish dairy herds.

1. The cost of mastitis mainly depends on the level of subclinical mastitis in the herd. There is considerable cost to herds whose BTSCC level is higher than the desired level. However, in low BTSCC herds it is unlikely to be the most significant disease.

2. Although the financial losses from milk yield depression appears to be the most significant cost components, the losses from BTSCC penalties have becoming increasingly significant for herds in which the BTSCC level is still around 400,000 cells/ml.

3. From the above finding one can deduce that it is unlikely that marginal returns from mastitis prevention procedures in low and high BTSCC herds are the same. Therefore, it is recommended that cost-benefit analyses of mastitis control procedures be carried out separately for these two groups.

References

1. Blood, D.C. and Rodostits, O.M.: Veterinary Medicine. 7th Edition. London. Bailliere Tindall. 1989.
2. Blowey, R. and Edmondson, P.: Mastitis Control in Dairy Herds: An Illustrated and Practical Guide. Farming Press Books Miller Freeman Professional Ltd. 1995.
3. Wilson, C.D. and Richards, M.S.: A Survey of Mastitis in the British Dairy Herds. The Veterinary Record. 1980; 106: 431-435.
4. Kossaibati, M.A. and Esslemont, R.J.: Wastage in Dairy Herds. Report No.4. Daisy - The Information System.1995.
5. Blosser, T.H.: Economic Losses from and the National Research Program on Mastitis in the United States. Symposium: Bovine Mastitis. Journal of Dairy Science. 1977; 62: 119-127.
6. Gill, R., Howard, W.H, Leslie K.E. and Lissemore, K.: Economics of Mastitis. Journal of Dairy Science. 1990; 73: 3340-3348.
7. Miller, G.Y.: The Economic Impact of Management Strategies to Control Somatic Cell Counts in Dairy Herds (Mastitis). PhD Thesis. Ohio State University. 1991.
8. Esslemont, R.J., and Peeler, E.J.: The Scope for Raising Margins in Dairy Herds by Improving Fertility and Health. British Veterinary Journal. 1993; 149: 537-547.
9. Logue, D.N., Gunn, J. and Fenlon, D.: Results of Our Approach to Mastitis Control in Scotland. Proceedings British Mastitis Conference. 1993; 33-49.
10. Pickering, K.E.: Decision Analysis as an Aid for Monitoring Mastitis. MSc Thesis. University of Aberdeen, Department of Agriculture. 1995.
11. Anon: Great Britain House of Commons Parliamentary Papers. 1993-94; 4
12. SAC Farm Management Handbook, 1995/1996.
13. Esslemont, R.J. and Spincer, I. The Incidence and Costs of Diseases in Dairy Herds. DAISY Report No 2, University of Reading. 1993; pp58.
14. Young, G.B., Lee, G.J., Waddington, D., Sales, D.I. and Bradley, J.S.: Culling and Wastage in Dairy Cows in East Anglia. Veterinary Record. 1983; 113: 107-111.
15. Yalcin, C., Stott, A. W., Gunn, J., Logue, D.N.: The Economic Impact of Mastitis-Control Procedures Used in Scottish Dairy Herds With High Bulk-Tank Somatic Cell Counts. Preventive Veterinary Medicine. 1999; 41, (2-3): 135-149.
16. McInerney, J.P., Howe, K.S. and Schepers, J.A.: A Framework for the Economic Analysis of Disease in Farm Livestock. Report of A Research Project (Ref. CSA 873) Funded by the MAFF, The University of Exeter, Agricultural Economics Unit. 1990; pp87.
17. Beck, H.S., Wise, W.S. and Dodd, F.H.: Cost Benefit Analysis of Bovine Mastitis in the UK. Journal of Dairy Research. 1992; 59: 449-460.

18. Stott, A.W. and Eker, M.M.: Predicting the Cost of Clinical Mastitis in the Dairy Cow as An Aid to Mastitis Control. Scottish Agricultural Economics Review. 1993;.63-72.

19. Blowey, R.: An Assessment of the Economic Benefits of a Mastitis Control Scheme. Veterinary Record. 1986; 119: 551-553.

20. Yalcin, C.: The Economic Impact of Mastitis Control Procedures in Scottish Dairy Herds. PhD Thesis. Aberdeen University. 1996.

21. Payne, R.W.: Genstat 5 Release 3. Clarendon Press, Oxford. 1993.

22. Salsberg, E., Meek, A.H. and Martin, S.W.: Somatic Cell Counts: Associated Factors and Relationship to Production. Canadian Journal of Comparative Medicine. 1984; 48: 251-257.

23. Booth, J.M.: Lameness and Mastitis Losses. Veterinary Record. 1989; 125: 161.