Lameness in dairy cows: farmer perceptions and automated detection technology

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SUPPLEMENTARY FILE

Table S1: The location of lesions causing lameness in dairy cows

Author (year)	Country	Unit of analysis	No. of units	Lesions identified in the foot (%)[1]	Lesions identified in the hind feet (%)[2]	Lesions identified in the hind lateral claw (%)[3]
Prentice and Neal (1972)	UK	Clinical lameness cases	369	92	82.5	NR
Russell and Rowlands (1982)	UK	Total lesions	9,178	88.3	84	85
McLennan (1988)	Australia	Total lesions	214	83	65	63
Jubb and Malmo (1991)	Australia	Total lesions	783	91	79	NR
Murray et al. (1996)	UK	Total lesions	8,645	NR	92	65
Chesterton et al. (2008)	NZ	Total lesions	2,388	85	71	74
Somers and O'Grady (2015)	Ireland	Lame cows	134	100	90	98
Dutton-Regester 2018	Australia	Lameness event	73	100[4]	97	NR

NR: Not reported, UK: United Kingdom, NZ: New Zealand, [1]Percentage of number of units, [2]percentage of lesions identified in the foot, [3]percentage of lesions identified in the hind feet, [4]This study was focused on foot lesions only.

Table S2: Frequency of the three most commonly identified foot lesions causing lameness in dairy cows from a selection of studies

Author (year)	Country	Lesion 1	Frequency (%)	Lesion 2	Frequency (%)	Lesion 3	Frequency (%)	Unit of analysis	No. of units	Housing system
McLennan (1988)	Australia	Foot-rot	15	Deep sepsis	9	Axial groove fissure & white line disease	8 & 8	Total lesions	214	NR[1]
Jubb and Malmo (1991)	Australia	Axial wall cracks	22	Under-run sole	15	Foot & sole injury	9 & 9	Total lesions	783	NR[1]
Murray et al. (1996)	UK	Sole ulcer	28	White line disease	22	Digital dermatitis & sole bruising	8 & 8	Total lesions	8,645	NR
Warnick et al. (2001)	USA	Sole ulcer	20	Digital dermatitis	13	Abscess	11	Lame cows	925	Free-stall barn
Warnick et al. (2001)		Foot wart	51	Sole ulcer	17	Foot-rot	14	Lame cows	287	Free-stall barn
Cook (2004)[2]	USA	Digital dermatitis	57	Sole ulcer	18	White line disease	10	Total lesions	1,155	Free-stall and tie-stall barns
Sogstad et al. (2005)	Norway	Heel horn erosion	38	Haemorrhage of sole	20	Haemorrhage of white line	14	Lame cows	1114	Tie-stall barn
Sogstad et al. (2005)	Norway	Haemorrhage of sole	12	Heel horn erosion	8	Haemorrhage of white line	7	Lame cows	537	Free-stall barn
Hernandez et al. (2005)	USA	Laminitis	54	Imbalanced claws	11	Thin soles	8	Lame cows	131	Dirt lots
Bicalho et al. (2007)	USA	Sole ulcer	52	Digital dermatitis	20	White line abscess	15	Lame cows	459	Free-stall barns
Bicalho et al. (2007)	USA	White line abscess	38	Sole ulcer	31	Digital dermatitis	9	Lame cows	528	Free-stall barns
Chesterton et al. (2008)	NZ	White line disease	42	Sole injury	29	Axial wall lesions	13	Total lesions	2,388	Pasture

Katsoulis and Christodoulopoulos (2009)	Greece	Abnormal claw shape	75	Dermatitis	30	Claw horn disruption	30	Total lesions	NR	Concrete or soil, restricted access to pasture
De Frain et al. (2013)	USA	Digital dermatitis	48	Sole ulcer	21	White line disease	17	Total lesions	10,818	Free-stall barn

USA: United States of America, NZ: New Zealand, [1]Assumption that Australian based cows are pasture based, [2]conference proceeding.

Table S3: Studies demonstrating an increased calving to conception interval in cows with lameness

Author, year	Difference in calving to conception interval between lame and non-lame cows (days)	No. cows	Housing type	DIM	Lameness threshold value	Lesion type
Collick et al. (1989)	14	854	Cubicles	≤ 120	NR	Overall
Collick et al. (1989)	40	854	Cubicles	70 – 120	NR	Sole ulcer
Hernandez et al. (2005)	36	499	Indoor dirt lots	NR	≥4[1]	Overall
Bicalho et al. (2007)	30	1,762	Free-stall	≤ 70	≥3[2]	Overall
Bicalho et al. (2007)	31	1,762	Free-stall	≤ 70	≥4[2]	Overall
Alawneh et al. (2011)	12	452	Pasture	NR	NR	Overall

DIM: days in milk, NR: Not reported; [1]Using Sprecher et al. 1997 locomotion scoring system; [2]Using a locomotion scoring system where: 1 = normal, 2 = presence of a slightly asymmetric gait, 3 = the cow clearly favoured 1 or more limb (moderately lame), 4 = severely lame, to 5 = extremely lame (non-weight-bearing lame).

Table S4: Variables and values considered in different studies to estimate cost per case of lameness and foot lesions

Author, year	Country	Reduced milk production	Labour	Treatment	Veterinarian consultation	Calving interval	Culling	Discarded milk	Extra service	Pregnancy rate	Carcass weight	Other	Lameness or foot lesion	Total cost/case of lameness
Enting et al. (1997)	Netherlands	✓	✓	✓	✓	✓	X	X	X	X	✓	✓	Lameness	fl104[1]
Kossaibati and Esslemont (1997)	UK	✓	✓	✓	✓	✓	X	✓	✓	X	X	X	Lameness	£113
Irwin and Malmo (1998)	Australia	✓	X	✓	X	✓	✓	X	X	X	X	X	Lameness	$200-300AUD
Willshire and Bell (2009)	UK	X	✓	✓	✓	X	X	X	X	X	X	X	Lameness	£154
Bruijnis et al. (2010)	USA	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	Lameness	$75USD
Cha et al. (2010)	USA	✓	X	✓	X	X	X	X	X	✓	X	X	Lameness	$178USD
Kossaibati and Esslemont (1997)	UK	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	Digital dermatitis	£213
Willshire and Bell (2009)	UK	✓	✓	✓	✓	✓	X	X	X	X	X	X	Digital dermatitis	£76
Cha et al. (2010)	USA	✓	X	✓	X	X	X	X	X	✓	X	X	Digital dermatitis	$133USD
Kossaibati and Esslemont (1997)	UK	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	Sole ulcer	£392
Willshire and Bell (2009)	UK	✓	✓	✓	✓	✓	✓	X	X	X	X	X	Sole ulcer	£519
Cha et al. (2010)	USA	✓	X	✓	X	X	X	X	X	✓	X	X	Sole ulcer	$216USD
Cha et al. (2010)	USA	✓	X	✓	X	X	X	X	X	✓	X	X	Foot rot	$120USD
Willshire and Bell (2009)	UK	✓	✓	✓	✓	✓	✓	X	X	X	X	X	White line disease	£300

UK: United Kingdom; USA: United States of America; AUD: Australian dollar; USD: United States dollar; [1]fl: the Dutch guilder (this was the currency of the Netherlands until 2002. After 2002, the euro was the local currency.

Table S5: Farmer estimates of lameness prevalence compared to the prevalence estimates obtained from controlled research studies

Author, year	No. of herds	No of cows	Research prevalence (%)[1]	Research definition of lameness	No. observers (concordance)	Farmer prevalence (%)[1]	Farmer definition of lameness
Wells et al. (1993)	17	1.654	13.7[2]	0-4 scoring system, where: 0: gait abnormality not visible, 1: mild variation from normal gait, 2: moderate and consistent gait asymmetry, 3: marked gait asymmetry, 4: recumbent	2[4] (0.60)	5.6	NR
Wells et al. (1993)	17	1,654	16.7[3]	0-4 scoring system, where: 0: gait abnormality not visible, 1: mild variation from normal gait, 2: moderate and consistent gait asymmetry, 3: marked gait asymmetry, 4: recumbent	2[4] (0.60)	6.4	NR
Espejo et al. (2006)	40	5,626	24.6	1-5 scoring system, where: 1: normal locomotion, 2: imperfect locomotion, 3: lame; 4: moderately to severely lame, 5: severely lame	2[5] (0.77)	8.3	NR
Leach et al. (2010)	22	NR	36	0-3 scoring system, where: 0: sound, 1: imperfect locomotion, 2: lame, 3: severely lame	4[6] (NA)	6.9	NR
Šárová et al. (2011)	14	807	31	0-2 scoring system, where: 0: not lame, 1: moderately lame, 2: severely lame	1 (NA)	6	NR

[1]Pooled prevalence; [2]Summer; [3]spring; NA: not applicable; [4]the researchers visited the farm together; [5]all but three farms used one observer, the remaining three farms used two observers; [6]one of 4 researchers visited each farm.