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An intercontinental survey of commercial abattoirs: Preliminary data on the prevalence of advanced pre-slaughter health and welfare conditions in mature cows

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Abstract

A survey was conducted to describe the distribution of 10 advanced health and welfare conditions in cows destined for slaughter within a large, multinational beef supply chain. The survey included 4,211 groups of cows (N = 76,886) from 13 countries in 3 areas of the world (Europe, Brazil, and the United States). Thirty-four commercial abattoirs participated in Europe, 9 in the United States, and 7 in Brazil. The survey was conducted in July, August, and September 2014. The conditions were non-ambulatory (NA), severe lameness (SL), ocular neoplasia (ON), wounds (W), malaise (M), nervous system disorders (NSD), poor udder condition (PUC), active parturition (AP), uterine prolapse (UP), and low body condition score (LBCS). Of all animals evaluated, 2.98% displayed at least 1 condition. The 3 most common conditions were LBCS (45.6% of conditions observed), PUC (20.3% of conditions observed), and SL (16.3% of conditions observed). The combination of "Dairy" and "Mixed Beef and Dairy" groups of cows accounted for 69.6% of the total population, and 82.3% of all conditions observed. The most common conditions observed in Europe and the United States were LBCS, PUC, and SL, while LBCS, NA, and AP were the 3 most common conditions in Brazil.

Key words: bovine, cow, cull, market, slaughter, welfare

Résumé

Une enquête a été menée pour décrire la distribution de 10 conditions avancées de santé et de bien-être chez des vaches destinées à l'abattoir dans une grande chaîne multinationale de distribution du bœuf. L'enquête a impliqué 4 211 groupes de vaches (N = 76 886) provenant de 13 pays dans 3 régions du monde (Europe, Brésil et États-Unis). Trente-quatre abattoirs commerciaux ont participé en Europe, 9 aux États-Unis et 7 au Brésil. L'enquête a été menée en juillet, août et septembre 2014. Les conditions étaient les suivantes : non ambulatoire (NA), boiterie sévère (BS), néoplasie oculaire (NO), blessures (B), malaise (M), troubles du système nerveux (TSN), mauvais état du pis (MEP), mise bas active (MBA), prolapsus de l'utérus (PU) et mauvaise condition corporelle (MCC). Un total de 2.98% des animaux évalués montraient au moins une des conditions. Les trois conditions les plus fréquentes étaient MCC (45.6% des conditions observées), MEP (20.3 % des conditions observées) et BS (16.3% des conditions observées). Les groupes de vaches laitières ou de vaches laitières et de boucherie représentaient 69.6% de la population et montraient 82.3% de toutes les conditions observées. Les conditions les plus fréquemment observées aux États-Unis et en Europe étaient MCC, MEP et BS alors que les trois conditions les plus fréquentes au Brésil étaient MCC, NA et MBA.

Introduction

The health, welfare, and quality of beef and dairy cows removed from the breeding herd, or "culled," and entering the beef supply chain is an important consideration for many end users. In the US, 3 national surveys have been conducted since 1994 to quantify, document, and assess the occurrence of quality defects in beef and dairy cows and bulls destined

for slaughter.[19,22,24] The primary emphasis of the 3 US surveys was identification of opportunities to capture lost economic value. An international survey of cow health and welfare conditions, particularly with an emphasis on severe conditions, has not been published. Therefore, the primary purpose of this survey was to establish a benchmark for assessing cull cow health and welfare at the time of slaughter within a specific multinational supply chain. The objective of this benchmark survey was to determine the period prevalence of 10 advanced, severe cattle health and welfare conditions (i.e. severe lameness, body condition score, udder condition, prolapse, cancer eye, malaise, wounds, pregnancy, etc.) in 3 areas of the world, Europe, the United States, and Brazil.

Materials and Methods

Ethics statement

Institutional Animal Care and Use Committee approval was not sought for this study because the animals in this study were farm animals intended for food production. In addition, the study was purely observational with no deviation from standard animal handling and care procedures. The definition of 'animal' in the Animal Welfare Act (7 U.S.C. 2132(g)) clearly exempts the cattle in this study. Per the Act, "Animal means any live or dead dog, cat, nonhuman primate, guinea pig, hamster, rabbit, or any other warm-blooded animal, which is being used or is intended for use for research, teaching, testing, experimentation, or exhibition purposes, or as a pet. This term excludes birds, rats of the genus *Rattus* and mice of the genus *Mus*, bred for use in research; horses not used for research purposes; and other farm animals, such as, but not limited to, livestock or poultry used or intended for use as food or fiber, or livestock or poultry used or intended for use for improving animal nutrition, breeding, management, or production efficiency, or for improving the quality of food or fiber." Although IACUC approval was not sought for this study, the guidelines set forth in the *Guide for the Care and Use of Agricultural Animals in Research and Teaching*[13] were followed during this project. The methods were completely observational, with no deviation from normal animal handling procedures at the abattoirs. Although the method of sacrifice was not of direct relevance to the current study, all animals were either slaughtered in accordance with the laws governing the country in which the abattoir was located or euthanized following procedures outlined by the AABP if unfit for human consumption.[1]

Survey development

A survey instrument to capture the period prevalence of 10 health and welfare conditions in the cow population at slaughter was developed based on an existing document that provided recommendations regarding the fitness of cows for transport to slaughter establishments.[20] Ten specific health conditions were identified for inclusion in the survey: non-ambulatory (NA), severe lameness (SL), ocular neoplasia (ON), wounds (W), malaise (M), nervous system disorders (NSD), poor udder condition (PUC), active parturition (AP), uterine prolapse (UP), and low body condition score (LBCS). Training and data collection materials, which included a definition card (Figure 1), prescribed sampling time, guidance regarding sampling cattle that arrived in different sized transport containers (Table 1), and a data collection sheet were developed to facilitate consistency in data collection. After the training and data collection materials were developed, they were pilot tested by members of the survey team and quality-assurance personnel at a commercial abattoir in the US during the initial training of key personnel.

Definitions

A series of definitions were developed to facilitate the identification of cows that displayed 1 or more of the 10 health and welfare conditions. The emphasis of the definitions was to facilitate the identification of cows that experienced reduced quality of health and welfare due to the advanced stages of the conditions they displayed. The assessment of each condition was treated as a discrete variable (yes or no outcome only) by data collection personnel. The specific conditions and associated definitions that were used to train assessment personnel can be observed in Figure 1. The 10 conditions and definitions were: non-ambulatory (NA) – any animal unable to rise from a down position, walk, or remain standing without assistance; severe lameness (SL) – any animal capable of walking (animals incapable of walking were identified as non-ambulatory), but with significant impairment – almost unable to bear weight on the affected limb, or while standing on a level surface is not bearing weight on 1 of 4 legs, analogous to a score of 5 in the 5-point scoring system validated by Thomsen et al;[26] ocular neoplasia (ON) – any animal that presents with advanced stages of the disease (Stage 4) characterized by a lesion obliterating the eye, with the affected area extending outside the orbit region of the eye; wounds (W) – any animal with a puncture wound or other laceration resulting in profuse bleeding and obvious signs of pain and discomfort; malaise (M) – any animal that displays general body weakness, discomfort, or lethargy, including animals that appear to be exhausted, in a physically depressed state, and have a delayed response or no response to external stimuli; nervous system disorders (NSD) – any animal that displays paralysis, incoordination such as high-stepping or over-extended gait or other abnormal behaviors such as circling, head pressing, tremors, and hyperexcitability; poor udder condition (PUC) – any animal that displays a severely engorged udder that is interfering with the animal's ability to walk; active parturition (AP) – any animal that is in the process of giving birth, defined as stage 2 of parturition or beyond; uterine prolapse (UP) – any animal that displays a large, elongated mass, deep red in color, covered with 'buttons' on which the placenta was attached; and low body condition score (LBCS) – any animal that appears as extremely

thin or emaciated. These animals would be described as 'very thin' with no fat on the rib or in the brisket and easily visible backbone, with some muscle depletion evident through the hindquarter, analogous to a BCS < 2 in the 5-point dairy BCS system developed by Edmonson et al[12] and the 9-point beef BCS system cited by Richards et al.[21]

Cow class was defined as: 1) dairy, which included all lots of animals that exclusively displayed characteristics,

This job aid is provided to help you complete the cull cow health and welfare survey. It's important that the observations you record on this survey are those that are "obvious" to you - not observations that you have to ask yourself "is she or isn't she?". For example, if the animal is having significant trouble walking and cannot bear weight on the affected limb, she is severely lame. If her udder is so large it alters her ability to walk she has an udder problem. If you have any questions about this survey, please refer to the definitions and pictures provided below, and then consult with your supervisor.

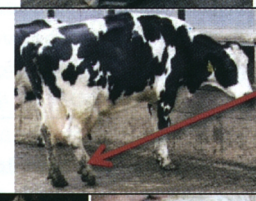
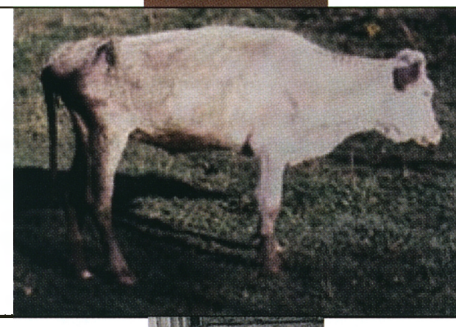
Non-ambulatory Animals (Sometimes referred to as "downers") Any animal unable to rise from a down position, walk, or remain standing without assistance. Note: dead on arrival should be counted in this category	
Severe Lameness Any animal capable of walking (animals incapable of walking were identified as non-ambulatory), but with significant impairment – almost unable to bear weight on the affected limb, or while standing on a level surface is not bearing weight on 1 of 4 legs	
Cancer Eye Any animal that presents advanced stages of the disease characterized by the lesion obliterating the eye and the affected area extends outside the orbit region of the eye.	
Wounds Any animal with a puncture wound or other laceration resulting in profuse bleeding and obvious signs of pain	
Malaise Any animal that displays general body weakness, discomfort, or lethargy, including animals that appear to be exhausted, in a physically depressed state, and have a delayed response or no response to external stimuli	
Nervous System Disorder Any animal that displays paralysis, incoordination such as a high stepping or over-extended gait or other abnormal behaviors such as circling, head pressing, tremors or hyperexcitability.	 http://www.vetmed.wsu.edu/announcements/images/bse5sm.jpg

Figure 1. Cull cow health and welfare survey definitions.

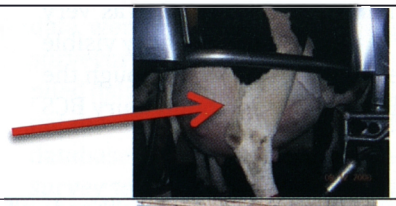
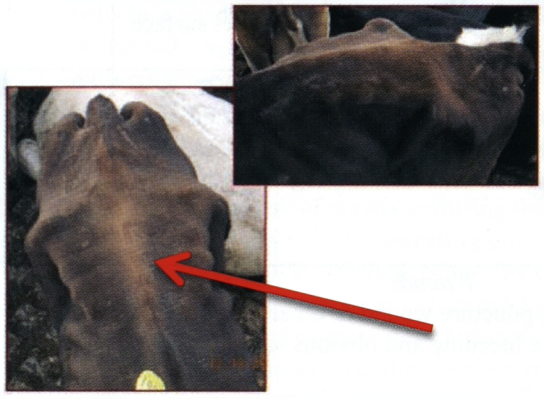
Udder Condition Any animal that displays a severely engorged udder that is interfering with the animal's ability to walk	
Active Parturition Any animal that is in the process of giving birth, defined as stage 2 of parturition or beyond	
Uterine Prolapse Any animal that displays uterine prolapse; large, elongated mass, deep red in color, covered with "buttons" on which the placenta was attached.	
Low Body Condition Score Any animal that appears as extremely thin or emaciated – these animals would be described as 'very thin' with no fat on the rib or in the brisket and easily visible backbone, with some muscle depletion evident through the hindquarter, analogous to a BCS < 2 in the 5-point dairy BCS system developed by Edmonson et al (1989) and the 9-point beef BCS system cited by Richards et al (1986).	

Figure 1 (continued). Cull cow health and welfare survey definitions.

Table 1. Prescribed daily sampling distribution based on percent of daily slaughter population transported by small truck and trailer.

Percent of daily slaughter population transported by small truck and trailer	Small trucks and trailers to sample	Large, semi-mounted trucks and trailers to sample
0%	0	2
10%	1	2
20%	2	2
30%	3	2
40%	4	2
50%	5	1
60%	6	1
70%	7	1
80%	8	1

including markings, body type, and udder characteristics, of dairy cattle commonly found within the continent in which the survey was conducted; 2) beef, which included all lots of animals that exclusively displayed characteristics, including markings, body type, and udder characteristics, of beef cattle but not dairy cattle commonly found within the continent in which the survey was conducted; and 3) mixed beef and dairy, which included all lots of animals that displayed a blend of animals that belonged to the dairy and beef classes.

Survey population

A total of 4,211 groups, which contained 76,886 cows, were surveyed during the 8-week sampling period at 50 abattoirs Target sample size for each sampling day was based on the transport container in which the animals arrived at the abattoir. Maximum anticipated sample size per day, based on the typical capacities of transport containers and trends in stocking density, was 70 to 100 cows distributed across 2 to 6 groups when greater than 50% of the cows arrived at an individual abattoir in large semi-mounted trailers. If less than 50% of the cows arrived on large semi-mounted trailers, the anticipated sample size was 30 to 40 cows per day distributed across 6 to 9 groups. All abattoirs included in this study were suppliers to a single large, multinational quick-service restaurant company. The abattoirs were distributed across 13 countries in 3 areas of the world: Brazil, Europe, and the United States. The ownership of the abattoirs varied from single-site ownership to ownership and corporate management of multiple sites.

Surveyor training

All animals in the survey were individually assessed by 1 or 2 trained evaluators at each abattoir. During any single survey data collection activity, 1 evaluator performed the assessment. Due to the size of the survey population, a set of survey materials consisting of a simple set of written definitions, surveyor instructions, and data collection sheets were provided to each abattoir by a trained representative of the multinational quick-service restaurant company. An initial training and pilot data collection session was held at 1 commercial abattoir in the US prior to survey commencement. Key personnel in the investigator team, quality and supply chain personnel from the quick-service restaurant company, and quality assurance personnel from the abattoir at the training site were present at the training and pilot session. Following the training and pilot session, the trained quality and supply chain personnel from the quick-service restaurant company trained the regional representatives from their company in the 3 geographic regions of this survey. The trained personnel from the quick-service restaurant company distributed the survey materials to the participating abattoirs and served as the primary contacts for questions regarding survey conduct and logistics. The surveyors at each site were abattoir employees who were informed to follow the written instructions provided within the survey materials. All survey data were entered into a central electronic database. The surveyors had the option of collecting written data on a supplied data collection sheet and entering the data in the central database at a later time or directly entering the data into the database during the survey through the use of an electronic survey tool with direct linkage to the electronic database.

Sampling regimen

Survey data were collected by designated personnel employed by each abattoir during each production day for a period of 8 weeks. Specific instructions were developed to control sampling bias within the convenience samples available at each abattoir as much as practically possible. The same surveyor or surveyors collected data on each sampling day. The same location within facility was used for data collection. The location for data collection had to meet the following criteria: a relatively level flooring surface with adequate space to allow animals to walk, not immediately after the animals were unloaded from the transportation vehicle, and located before the entrance to lairage. If a group of animals, such as a trailer load of cows, was selected for data collection, all animals within the group were included in the data set.

Surveyors were instructed to alternate data collection activities between AM and PM time periods each day, such that data collection did not occur during the same time period on consecutive days. The separating times between AM and PM were 12:00 and 24:00 local time. The number of loads of animals to survey was prescribed according to the proportion of the total facility slaughter population that arrived by large, semi-mounted trailers versus smaller trucks and trailers (Table 1). The objective of the prescribed sampling by trailer size was to develop an accurate representation of the cow population at each slaughter facility through the prevention of transport container-related bias in cow condition In some regions of the US, a greater proportion of the cows that arrive on small trailers display severe health and welfare problems because smaller trailers are more conducive to the safe and humane transport of compromised animals.[a] In addition, some cattle suppliers send shipments of cattle to slaughter at approximately the same time of day on multiple days per week. To avoid bias in sampling toward such groups of cattle, the sampling regimen was developed.

Survey period and location

Survey data were collected during the months of July, August, and September 2014 in Europe, the US, and Brazil. The particular countries and regions included in the survey were: the US, Brazil, Portugal, Spain, France, Italy, Ireland, United Kingdom, Netherlands, Germany, Poland, Ukraine, and Eastern Russia. Control for seasonality as well as differences in production, trade, and culture was not possible with such a broad survey. As a result, statistical comparisons between areas of the world or class of cattle were not made.

Survey quality control

Due to the method of localized data reporting for this survey, interobserver reliability was not tested. This may be viewed as a limitation to this study. However, 95% confidence intervals were calculated for all period prevalence means to allow the reader to interpret the magnitude of mean variation. In general, the 95% confidence intervals associated with the data from the survey indicate minimal variation in surveyor interpretation of the definitions of the 10 health and welfare conditions that were quantified in this study. In future iterations of this survey, additional quality control methods should be implemented.

Statistical analysis

At the conclusion of the survey, data were transferred from the collection database to an electronic spreadsheet.[b] Mean estimates and 95% confidence intervals for the period prevalence rates of defects for each area of the world (Brazil, Europe, and the US) and each class of cows (beef, dairy, and mixed dairy and beef) were calculated using the same electronic spreadsheet. Data are reported as mean period prevalence followed by 95% confidence interval in Tables 4 thru 7. Statistical comparisons were not made between areas of the world due to the potential for confounding.

Results and Discussion

There were 4,211 surveys completed (Table 2), and 76,886 cattle were observed. Of these, 37,108 (48.26%) were observed in Europe, 21,760 (28.30%) in Brazil, and 18,018 (23.43%) in the US. Observers described each group of cattle as "beef", "dairy", or "mixed beef and dairy" based primarily on appearance to identify the likely production system (dairy, beef, or mixed dairy and beef) within each group (Table 3). Conditions were observed in 2,295 cattle, or 2.98% of all animals included in the survey. It is possible that individual animals may have had more than 1 condition; a potential limitation of the current survey is that it was not possible to isolate animals with multiple conditions within the dataset. As a result, the period prevalence of each condition must be considered individually. Total period prevalence of conditions observed per area of the world was 1.72% in Europe, 0.46% in Brazil, and 8.44% in the United States (Table 4). The 3 most common conditions observed in both Europe and the United States were LBCS, PUC, and SL (Table 4). The 3 most common conditions observed in Brazil were LBCS, AP, and NA (Table 4). The prevalence of conditions in the US was less than that estimated by Nicholson et al[19] in which they reported that 30.8% of approximately 5,407 mature cattle had visible defects at the time of presentation for slaughter at 23 slaughter establishments. A likely explanation for the difference in prevalence between this study and Nicholson et al[19] can be attributed to the focus on a limited number of severe conditions in the current study versus the inclusion of more conditions scored on scales that included scoring options that were less severe in their study.

One or more of the 10 health and welfare conditions were detected in 3.92% of cows classified as dairy, 1.78% of cows in the beef class, and 2.87% of cows in the mixed beef and dairy class. The dairy and mixed beef and dairy classes accounted for 69.6% of all animals observed, yet they accounted for 82.3% of all conditions observed. These data suggest that the health and welfare conditions we quantified may be more common in dairy cattle. Further investigation is warranted to understand if a difference in the occurrence of the health and welfare conditions truly exists between cattle types. In addition, the causative factors of such a difference must be investigated.

In beef cows (Table 5), the 3 most prevalent conditions observed in Europe were SL, LBCS, and PUC (0.57%, 0.39%, and 0.30%, respectively). The 3 most prevalent conditions in Brazilian beef cows were AP, W, and ON (0.07%, 0.04%, and 0.03%, respectively). In the United States, the 3 most prevalent conditions in beef cows were LBCS, SL, and PUC (5.24%, 1.01%, and 0.28%, respectively). Ahola et al[3] reported 10.4% of culled beef cows from the western US had body condition scores less than or equal to 2.0. Nicholson et al[19] identified 0.2% of beef cows at US slaughter facilities as severely lame.

In dairy cows (Table 6), the 3 most common conditions observed in Europe were PUC, LBCS, and SL (0.69%, 0.54%,

Table 2. Surveys completed by class of cows and area of the world (N = 4,211).

Class*	Europe	Brazil	United States
Beef	552	199	137
Dairy	1990	37	340
Mixed beef and dairy	716	81	130
Not classified†	12	15	2

*Cow class was defined as: 1) dairy, which included all lots of cows that exclusively displayed characteristics, including markings, body type, and udder characteristics, of dairy cows commonly found within the continent in which the survey was conducted; 2) beef, which included all lots of cows that exclusively displayed characteristics, including markings, body type, and udder characteristics, of beef cows but not dairy cows commonly found within the continent in which the survey was conducted; and 3) mixed beef and dairy, which included all lots of cows that displayed a blend of cows that belonged to the dairy and beef classes.

†Surveys in the "not classified" category were surveys which were completed, but no description of the animals was provided.

Table 3. Description of cows observed within area of the world (N = 76,886).

Class*	Europe	Brazil	United States	Total
Beef	4,381	13,826	4,355	22,562
Dairy	20,821	1,551	8,601	30,973
Mixed beef and dairy	11,777	5,442	5,061	22,280
Not classified†	129	941	1	1,071
Total	37,108	21,760	18,018	76,886

*Cow class was defined as: 1) dairy, which included all lots of female animals that exclusively displayed characteristics, including markings, body type, and udder characteristics, of dairy cows commonly found within the continent in which the survey was conducted; 2) beef, which included all lots of cows that exclusively displayed characteristics, including markings, body type, and udder characteristics, of beef cows but not dairy cows commonly found within the continent in which the survey was conducted; and 3) mixed beef and dairy, which included all lots of cows that displayed a blend of cows that belonged to the dairy and beef classes.

†Surveys in the "not classified" category were surveys which were completed, but no description of the animals was provided.

Table 4. Period prevalence* of conditions within area of the world across all classes of cattle (N = 76,886).

Condition†	Europe (n = 37,108) Period prevalence (95% CI)	Brazil (n = 21,760) Period prevalence (95% CI)	United States (n = 18,018) Period prevalence (95% CI)
Non-ambulatory (NA)	0.20% (0.14%, 0.29%)	0.06% (0.02%, 0.14%)	0.38% (0.26%, 0.56%)
Severe lameness (SL)	0.31% (0.23%, 0.42%)	0.02% (0.01%, 0.10%)	1.42% (1.15%, 1.74%)
Ocular neoplasia (ON)	0.06% (0.03%, 0.11%)	0.02% (0.01%, 0.08%)	0.12% (0.07%, 0.22%)
Wounds (W)	0.06% (0.03%, 0.10%)	0.04%, (0.01%, 0.09%)	0.49% (0.38%, 0.63%)
Malaise (M)	0.11% (0.06%, 0.21%)	0.00% (0.00%, 0.00%)	0.33% (0.23%, 0.46%)
Nervous system disorder (NSD)	0.01% (0.00%, 0.06%)	0.00% (0.00%, 0.00%)	0.02% (0.00%, 0.13%)
Poor udder condition (PUC)	0.56% (0.45%, 0.70%)	0.01% (0.00%, 0.09%)	1.42% (1.16%, 1.74%)
Active parturition (AP)	0.00% (0.00%, 0.00%)	0.11% (0.08%, 0.16%)	0.04% (0.02%, 0.08%)
Uterine prolapse (UP)	0.02% (0.00%, 0.06%)	0.00% (0.00%, 0.00%)	0.02% (0.00%, 0.12%)
Low body condition score (LBCS)	0.47% (0.35%, 0.62%)	0.20% (0.12%, 0.35%)	4.60% (4.04%, 5.24%)

*Period prevalence is expressed as number of cows in that area of the world, with that condition/total number of cows observed in that area of the world.

†For condition definitions, see Figure 1.

Table 5. Period prevalence* of conditions within area of the world for all beef cows observed (N = 22,562).

Condition†	Europe (n = 4,381) Period prevalence (95% CI)	Brazil (n= 13,826) Period prevalence (95% CI)	United States (n = 4,355) Period prevalence (95% CI)
Non-ambulatory (NA)	0.07% (0.01%, 0.40%)	0.01% (0.00%, 0.15%)	0.11% (0.03%, 0.45%)
Severe lameness (SL)	0.57% (0.32%, 1.02%)	0.00% (0.00%, 0.00%)	1.01% (0.65%, 1.56%)
Ocular neoplasia (ON)	0.09% (0.03%, 0.24%)	0.03% (0.01%, 0.08%)	0.23% (0.12%, 0.42%)
Wounds (W)	0.07% (0.02%, 0.25%)	0.04% (0.01%, 0.10%)	0.09% (0.03%, 0.28%)
Malaise (M)	0.09% (0.02%, 0.54%)	0.00% (0.00%, 0.00%)	0.02% (0.00%, 0.82%)
Nervous system disorder (NSD)	0.00% (0.00%, 0.00%)	0.00% (0.00%, 0.00%)	0.00% (0.00%, 0.00%)
Poor udder condition (PUC)	0.30% (0.13%, 0.68%)	0.00% (0.00%, 0.00%)	0.28% (0.12%, 0.65%)
Active parturition (AP)	0.00% (0.00%, 0.00%)	0.07% (0.04%, 0.14%)	0.02% (0.00%, 0.18%)
Uterine prolapse (UP)	0.09% (0.03%, 0.30%)	0.00% (0.00%, 0.00%)	0.05% (0.01%, 0.25%)
Low body condition score (LBCS)	0.39% (0.15%, 0.98%)	0.02% (0.00%, 0.19%)	5.24% (4.07%, 6.73%)

*Period prevalence is expressed as number of beef cows in that area of the world, with that condition/total number of beef cows observed in that area of the world.

†For condition definitions, see Figure 1.

Table 6. Period prevalence* of conditions within continent for all dairy cows observed (N = 30,973).

Condition†	Europe (n = (20,821) Period prevalence (95% CI)	Brazil(n = 1,551) Period prevalence (95% CI)	United States(n = 8,601) Period prevalence (95% CI)
Non-ambulatory (NA)	0.28% (0.18%, 0.43%)	0.06% (0.00%, 1.72%)	0.66% (0.43%, 1.02%)
Severe lameness (SL)	0.36% (0.24%, 0.52%)	0.00% (0.00%, 0.00%)	1.65% (1.25%, 2.18%)
Ocular neoplasia (ON)	0.07% (0.03%, 0.16%)	0.00% (0.00%, 0.00%)	0.13% (0.05%, 0.33%)
Wounds (W)	0.05% (0.02%, 0.13%)	0.00% (0.00%, 0.00%)	0.42% (0.26%, 0.68%)
Malaise (M)	0.15% (0.07%, 0.31%)	0.00% (0.00%, 0.00%)	0.31% (0.14%, 0.68%)
Nervous system disorder (NSD)	0.01% (0.00%, 0.11%)	0.00% (0.00%, 0.00%)	0.00% (0.00%, 0.00%)
Poor udder condition (PUC)	0.69% (0.52%, 0.90%)	0.00% (0.00%, 0.00%)	1.64% (1.24%, 2.16%)
Active parturition (AP)	0.00% (0.00%, 0.00%)	0.71% (0.43%, 1.17%)	0.02% (0.01%, 0.07%)
Uterine prolapse (UP)	0.00% (0.00%, 0.06%)	0.00% (0.00%, 0.00%)	0.02% (0.00%, 0.14%)
Low body condition score (LBCS)	0.54% (0.39%, 0.76%)	0.77% (0.28%, 2.14%)	4.15% (3.44%, 5.00%)

*Period prevalence is expressed as number of dairy cows in that area of the world, with that condition/total number of dairy cows observed in that area of the world.

†For condition definitions, see Figure 1.

and 0.36%, respectively). Ahlman et al[2] identified udder health, low fertility, low production, and leg problems as the most common causes for culling in Swedish dairy herds. In the present study, it was not possible to collect farm-level data regarding factors such as production or fertility. Minchin et al[18] recognized a seasonal influence on reduced body condition in Irish Holstein-Friesian cows in which 6% more cows were presented for slaughter with reduced body condition between September and December than throughout the rest of the year. In Brazil, LBCS, AP, and NA were the most prevalent conditions observed in the dairy class (0.77%, 0.71%, and 0.06%, respectively). Dairy cows in the United States had the most conditions reported as LBCS, SL, and PUC (4.15%, 1.65%, and 1.64%, respectively). Ahola et al[3] reported that 34.8% of culled dairy cows in the western US displayed body condition less than or equal to 2.0. The SL prevalence in the current study is greater than the 0.2 ± 0.05% prevalence reported by Ahola et al,[3] but less than the 2.7% prevalence reported by Nicholson et al.[19]

The 3 most prevalent conditions reported in mixed beef and dairy cows (Table 7) in Europe were PUC, LBCS, and SL (0.44%, 0.36%, and 0.13%, respectively). Bazzoli et al[8] documented greater total carcass value in dual-purpose dairy breeds due to heavier muscling and greater body condition score than exclusive dairy breeds. In the Brazilian mixed beef and dairy class, the most prevalent conditions were LBCS,

Table 7. Period prevalence* of conditions within continent for all mixed beef and dairy cows observed (N = 22,280).

Condition†	Europe (n = 11,777) Period prevalence (95% CI)	Brazil (n = 5,442) Period prevalence (95% CI)	United States (n = 5,061) Period prevalence (95% CI)
Non-ambulatory (NA)	0.10% (0.06%, 0.17%)	0.18% (0.10%, 0.33%)	0.12% (0.06%, 0.25%)
Severe lameness (SL)	0.13% (0.06%, 0.27%)	0.09% (0.03%, 0.33%)	1.36% (0.96%, 1.93%)
Ocular neoplasia (ON)	0.04% (0.02%, 0.11%)	0.02% (0.00%, 0.15%)	0.02% (0.00%, 0.16%)
Wounds (W)	0.06% (0.02%, 0.15%)	0.06% (0.01%, 0.23%)	0.38% (0.21%, 0.66%)
Malaise (M)	0.05% (0.02%, 0.11%)	0.00% (0.00%, 0.00%)	0.02% (0.00%, 0.09%)
Nervous system disorder (NSD)	0.00% (0.00%, 0.00%)	0.00% (0.00%, 0.00%)	0.06% (0.04%, 0.09%)
Poor udder condition (PUC)	0.44% (0.28%, 0.69%)	0.04% (0.00%, 0.36%)	2.02% (1.46%, 2.77%)
Active parturition (AP)	0.00% (0.00%, 0.00%)	0.06% (0.02%, 0.13%)	0.10% (0.05%, 0.19%)
Uterine prolapse (UP)	0.01% (0.00%, 9.37%)	0.00% (0.00%, 0.00%)	0.00% (0.00%, 0.00%)
Low body condition score (LBCS)	0.36% (0.20%, 0.63%)	0.53% (0.27%, 1.06%)	4.82% (3.80%, 6.12%)

*Period prevalence is expressed as number of mixed beef and dairy cows in that area of the world with that condition/total number of mixed beef and dairy cows observed in that area of the world.

†For condition definitions, see Figure 1.

NA, and SL (0.53%, 0.18%, and 0.09%, respectively). Finally, in the US, the 3 most prevalent conditions in the mixed beef and dairy class were LBCS, PUC, and SL (4.82%, 2.02%, and 1.36%, respectively).

Low body condition score (LBCS) was a common cow condition issue across all areas of the world included in this study. Focus on selection for appropriate body condition maintenance during lactation may have additional benefits to dairy cow health. Berry et al[10] documented the negative impact of predominant selection for milk production on fertility in dairy cattle. The authors suggested that indirect selection for fertility through selection for body condition score at specific stages of lactation may be an effective strategy for improving dairy cow fertility. Gallo et al[14] identified body condition as a genetic trait with greater heritability than milk production, and a potential trait to include in selection indices for dairy cattle. Shemeis et al[23] documented improvement in carcass conformation from Danish Friesian cows as body condition increased. Apple reported a relationship between beef cow body condition score and ultimate cow carcass value for cattle producers and slaughter establishments that favored animals with average to moderate body condition.[5] The purpose of specific breeds and the differentiation between exclusive beef and dairy production systems varies between areas of the world. In the United States, adult dairy cows accounted for 44% of the annual cow slaughter during 2006/07.[27] In other areas of the world, dual-purpose breeds are more prevalent. Improved body condition is a substantial contributor to overall carcass value.[8] However, it appears that modification of the diet of mature cows may have a greater effect on body condition and subsequent carcass yield than quality grade. Minchin et al documented that the diet used to increase the body condition of non-lactating Holstein-Friesian cows prior to slaughter did not have a direct impact on carcass quality attributes, but dietary concentrate inclusion reduced the number of days required to reach a body condition score of 3.5.[18]

Although this study has identified the most common acute cow health and welfare conditions across 3 areas of the world, it is important to emphasize that inherent variation in season, predominant breed, production system, and management practices exist and cannot be controlled. As a result, comparisons between areas of the world should be avoided due to those confounding factors. Reasons for culling cows from their respective herds vary considerably and depend to some extent on the type of production and management systems on the farm.[2,4,7,8] However, the presence of some health disorders, such as dystocia and mastitis, appear to be greater risk factors for culling than production system alone.[9] Dohoo and Martin[11] reported a positive association of cow survival in the production herd and milk production. In a survey of New York dairies, the most common reasons for dairy cow culling included reproductive problems, udder problems, and low production.[17] In addition to milk production and disease state, Garcia Peniche et al[15] identified inherent differences in the longevity of dairy cows based on breed type. Breed influence on longevity was also described in beef cattle by Arthur et al.[6] Greer et al[16] reported that beef heifers bred for the first time at 2 years of age were more likely to be culled from their herd than heifers bred at 3 years of age. The greatest occurrence of beef cattle culling appears to happen during the first breeding and calving interval due to reproductive problems.[6] Beaudeau et al[9] also identified several previous studies that documented variation in the occurrence of health disorders in cows on a seasonal basis.

Conclusions

Data from this survey suggest that congruencies exist across different areas of the world with regard to the most common health and welfare issues in mature cows. Europe and the United States shared the 3 most common mature cow health and welfare conditions, namely, low body condition score (LBCS), severe lameness (SL), and poor udder condition (PUC). The 3 most common cow health and welfare issues at the Brazilian abattoirs included in this study were low body condition score (LBCS), active parturition (AP), and non-ambulatory (NA). Although statistical comparisons were not made in this study due to the presence of several confounding factors between areas of the world, variation in the period prevalence of the health and welfare conditions assessed in this survey appeared to exist between classes of cows and were likely resultant of differences in genetic susceptibility in combination with management and environmental factors specific to the respective production systems in which the cows lived. Additional investigations focused on the existence, magnitude, and etiologies of differences between cow classes are warranted and necessary. Additional iterations of this survey will help to develop understanding of the seasonal effects on cow condition at slaughter on an international scale. Although the relative prevalence of the most common conditions in each area of the world was not extensive, the total number of animals affected by the conditions observed in this study on an annual basis was substantial. The data presented in this survey was collected with the intent of guiding producer education efforts to specifically address the most common severe cow health and welfare issues within the areas of the world that were surveyed.

Endnotes

[a] K. D. Vogel, unpublished data
[b] Microsoft Excel® software, version 15, Spokane, WA

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