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Evaluating the Validity of Dairy Calf Death Data and its Implications for Global Animal Welfare Initiatives

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Abstract

The dairy business is vital to the world's agriculture since it produces goods that are necessary for people to eat. But worries about the well-being of animals have grown in importance, especially in light of the death of dairy calves. The purpose of this research is to evaluate the reliability of dairy calf fatality data and investigate how it can affect international animal welfare schemes. The major drawback is the lack of agreement on the definition of perinatal mortality, which results in a range of figures. Of the 20 investigations, 10 clearly excluded abortion, while one broke out on the proportions of abortion and stillbirth. Interpretations are further complicated by differences in research designs as well as reporting timelines. While 12 researches were retrospective, it is difficult to ensure accuracy, particularly when included herds without information on perinatal death, seven investigations were prospective and allowed for better control over the quality of the data. Because of this aspect, retrospective studies might understate mortality. Even with an empty mean death statistic of 6.2%, significant methodological variances make caution necessary when examining nations or ways of farming. For comparisons between farms, regions, or nations to be valid, study methods must be carefully examined.

Keywords: Dairy business, well-being of animals, calves, agriculture, perinatal death.

INTRODUCTION

The issue of dairy calf (DC) mortality is a significant concern in the field of agricultural practices and global animal welfare efforts, necessitating careful attention and thorough investigation. Mortality data associated with DC not only serves as a clear indicator of challenges in the dairy business but also carries substantial implications for worldwide efforts to improve animal welfare. As we explore the numerous causes influencing DC mortality rates, it is crucial to understand the delicate relationship among various aspects, including management methods, nutrition, illness prevention and larger socio-economic issues. The mortality of DC is a complex issue that encompasses ethical and economic dimensions. The moral aspect underscores the responsibility of the dairy industry and society at large to ensure compassionate care for animals throughout their entire lifespan. As we commemorate the one-year milestone of heightened attention to this situation, it is essential to recognize the progress made in acknowledging the significance of calf welfare and the measures taken to address the underlying factors contributing to calf mortality.

Nevertheless, it is necessary to evaluate the existing deficiencies and ongoing obstacles that hinder the realization of tangible improvements (1). The consequences of DC mortality extend well beyond the confines of the barns and meadows where these animals are kept. Within the broader context of global animal welfare efforts, information about calf mortality serves as a benchmark to assess the effectiveness of existing norms and laws (2). The stark reality of elevated death rates raises questions about the adequacy of current methods in safeguarding the welfare of these vulnerable creatures. It compels us to contemplate whether the existing standards align with the ethical obligations established by a community that is progressively aware of the importance of compassion in our treatment of animals (3). Understanding the intricate network of causal elements requires a comprehensive assessment of dairy management techniques. Each aspect, from colostrum management to housing circumstances and nutritional guidelines, plays a crucial role in determining the fate of a DC. Scientific knowledge and technological developments present potential opportunities for improving these

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practices, but implementing such changes remains a challenge. As we approach the one-year mark, it is critical to scrutinize the industry's adoption of new solutions and identify opportunities for bridging the gap between research findings and on-the-ground reality.

Furthermore, given the global structure of the dairy sector, calf mortality must be considered from a transboundary perspective (4). Varied outcomes in different regions are exacerbated by disparities in resources, education and regulatory frameworks, necessitating a collaborative and inclusive approach to address this shared problem. The interconnectedness of the dairy supply chain underscores the need for a global effort to shape standards that prioritize calves' well-being regardless of geographical location (5).

Aim of the paper is to assess the accuracy of dairy calf mortality data to enhance global animal welfare efforts, addressing potential implications and fostering data-driven improvements in the industry.

Estimations of mortality during the perinatal period

Perinatal mortality (PM) was defined across two time periods: one day (9 studies) and 2 day (8 studies).

Prospective study (2000–2023)

Study (6) was a prospective investigation that centered on 30 dairy cultivation (DC) establishments located in "New Zealand." Enrolled dairy practitioners were obligated to document the daily count of bovines giving birth, the gender of the newborn "calves" and any "calves" that were stillborn or died before transferred to the rearing sheds for about 24 hours. Before the commencement of the research, a conference was held to discuss and establish the technique of data recording for each farm. Technicians conducted weekly visits to the herds, during which they either photocopied printed documents or collected data from computerized records. The postnatal mortality estimations of the calves were monitored and the data were cross-checked with all the transitions into and out of the rearing sheds to ensure their accuracy. That concentrated strategy reduced the insufficient recording of prenatal death, but it restricted the count of farms that can be documented.

The study (7) investigated PM rates across 205 Dairy Farming (DF) establishments in the western region of France over three years. It was discovered that the underestimation of incidents posed a noteworthy challenge. Out of the initial 265 agricultural plots, 9 (3.4%) were omitted since farmers found the information gathering excessively burdensome to continue and 49 (18%) were eliminated due to inadequate recording.

Study (8) conducted research on 463 dairy cattle at a DF location in "Saxony, Germany." The study's data quality was excellent, with two experienced investigators closely monitoring the cows from the moment they reached the calving zone up to the conclusion of childbirth. The "Institute of Veterinary Pathology at the University of Leipzig" conducted post-mortem examinations on any calves that were stillborn or died within 24 hours of birth. The primary limitation of that study lies in the generalizability of the prevalence of mortality in other agricultural establishments.

Study (9) relied on observations and it was conducted on 19 DF establishments in South England, known for their exceptional record-keeping. The study included 18 commercially operated farms and one experimental research farm, analyzing the outcomes of 1,097 birthing events. The study team collected monthly data on the death of young cattle from birth until their initial calving, as reported by farmers. Although data collection occurred monthly for the herds, additional data validation procedures were documented after the initial farm selection process.

Study (10) examined a total of 7380 instances of cows giving birth at three dairy farming (DF) locations in Colorado. The farm crew collected data on mortality using forms provided by the investigators. The study needed to provide more information on the validation process for these records. Moreover, a single farm accounted for almost seventy-five percent of the "calves" considered in the research. As a result, the generalizability of that study, which revealed a higher rate of PM compared to other research, was likely to be limited.

Study (11) was a prospective investigation that concentrated on four dairy herds kept in housing. The total number of cows included in the study was 1257 and the data were collected over one specific season in Poland, the research aimed to examine unrelated genetic risk factor variables associated with stillbirth during a 24-hour timeframe. While the statistical examination methodologies are explained, there needs to be more information on the collection process of the records, including the individual’s responsibility and the methods are used to ensure correctness.

In study (12), the morbidity and vitality up to the point of nursing and fertility prior to the initial birthing of dairy "calves" were studied using different Total Protein Index (TPI) categories. On commercial dairy farming

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(DF) in Michigan, records from 4,336 dairy calves born between JAN-2014 and APR-2017 were examined. The study found that optimum TPI positively impacted post-weaning reproductive efficiency and calf pre-weaning health. The summary of research (1 to 6) that evaluated PM is shown in Table (1).

Table (1). Summary of prospective studies. (Source: Author)

Prospective Study						
Reference	**1**	**2**	**3**	**4**	**5**	**6**
Mother's breed	"Mixed"	Holstein-"Friesian"	"German Holstein"	"Holstein-Friesian"	"Holstein-Friesian"	"Mixed"
calvings used in the analysis	Not reported (205 farms)	7380/7380	463/463	1097/1097	1257/1257	19,395/18,437
Explanation of Calf Mortality	Death or stillbirth during a day after the calving	Death or stillbirth during a day after the calving	Death or stillbirth during a day after the calving	Death or stillbirth during a day after the calving	Death or stillbirth during a day after the calving	Death or stillbirth during a day after the calving
Operational System	"Housed and pasture"	"Housed"	"Housed"	"Mixed"	"Housed"	"pasture"
Percentage of Mortality Rate	7.4%	8.2%	9.7%	7.9%	6.7%	5.7%

Retrospective study (2000–2023)

The study (13) was conducted on seventy specifically chosen DF in "southern Ethiopia" to assess the rates of illness and death among calves, identify the variables that contributed to those rates and determine if the mortality rate exceeded economically acceptable limits. To achieve that objective, a comprehensive study was conducted on a sample of 274 calves from 70 different farms. These calves were monitored every two weeks, starting from birth and continuing until they reached six months of age. The monitoring aimed to identify any significant clinical health issues or instances of mortality. Among the vulnerable calves under study, the research found a mortality rate was 13.2 models with a fatality incidence of 3.8 instances for each 100 calf-months.

The study (14) utilized a retrospective dataset that included information on the death of 1231 calves during the first 48 hours of delivery. The dataset contained data on other risk variables, including weight at birth, breed and the count of calves delivered per dam. Data were gathered from a single farm over a span of 9 calving seasons, starting from 2003 and ending in 2011. The identity of the data recorder and the method used to verify the data were not provided.

The study (15) analyzed almost "5.8 million" individuals birthing documents obtained via the French "National Bovine Identification Database" for the years "2005 & 2006". Annually, 27% and 26% of farming operations, respectively, reported no PM. The study aimed to examine the impact of that factor by analyzing the outcomes exclusively from farming establishments that reported death rates greater than 0% and comparing these findings to the entire dataset. The mortality rates were much higher, ranging from 0.5 to 4 times, when estimated for farms with at least one fatality, compared to the entire population, including those with no deaths. Only a small number of retrospective studies, particularly the ones that are extensive in scope acknowledge the omission of farms with no mortality.

Consequently, the article provides a certain level of assurance that the majority of datasets are undervaluing PM. While the report offers statistics on farms with no mortality, it does not provide the entire number of calves involved. Therefore, around 26-27% of the overall number of calves is removed from the dataset.

The research (16) investigation analyzed data from 14,920 instances of cows giving birth in 53 groups of animals in Thuringia, Germany. Out of 523, farms that are eligible for enrollment in the dairy herd enhancement

program opted to participate, participants were obliged to record animal migrations while keeping track of calves and the fate of calves remained optional. A representative sample was created by selecting a subset comprising 10% of farming operations from the eligible pool.

An extensive and well-organized investigation into calf mortality examined historical data involving two hundred eighty-nine thousand and thirty-eight calves in 14,474 Cattle groups enrolled in the "Norwegian Dairy Herd Recording System (NDHRS) (17). The writers noted that terminations and fetal deaths were documented as components of the dam's medical background, ensuring their accuracy across all herds in the NDHRS. Additionally, the requirement to record deceased farm animals for tax purposes suggest that the provided approximate of PM, although lower than other reported rates, was likely to be reliable. Nevertheless, like many studies examining prenatal mortality, there needed to be more information about data validation post-collection.

The study (18) conducted an analysis of perinatal death values by obtaining information from the "Irish Cattle Breeding Federation (ICBF)" for the years 2002-2005. Initially, there were three million, five hundred sixty-three thousand, six hundred forty-four entries; out of that two million, one hundred fifty-two thousand, two hundred forty-five (60%) contained information about survival rates of calves during the first 24 hours. Nevertheless, due to a substantial quantity of exclusion criteria, their ultimate examination was based on 182,026 data entries. The researchers employed five distinct categories to establish the exclusion criteria. (1) The first issue was related to the definition of calving that are considered full term. (2) The second issue was the absence of specific data, such as the parity of some animals that were not recorded. (3) The third issue involves animals that are not representative of the population, where recording their calving could be problematic. For example, animals that are recorded have calved at less than 660 days of age. (4) The fourth issue pertains to the quality of the data, specifically the exclusion of farms that have less than 20 calving records per year. (5) The final issue was the criteria used to standardize the dataset, such as requiring at least 50% of the dams to be Holstein-Friesian and their parity to be known. From that study, it is not feasible to determine the exact percentage of records that were lost owing to insufficient documentation, except for the 40% that were lost due to the failure to record the condition of the calf. The stringent exclusion criteria raise concerns about the representativeness of the data, while they are expected to enhance the quality of the data.

Study (19) attempted to calculate the hereditary characteristics of "stillbirth" (specified as demise occurring within 1 Day) in "Swedish Red cattle from 1985 to 2000" using data "from the Swedish milk recording network." The ultimate dataset, including 246,741 data entries (88 percent of the initial dataset), removed herd-year subcategories that had a single instance. Unsexed stillborn calves were designated to a gender by a random process. More supplementary details about the evaluation of the records were needed, including their validity and the extent of any missing entries. Hence, there needs to be evidence about the veracity of these records.

Study (20) utilized information from a Livestock enhancements scheme for sire proving that was gathered between 1987 and 2004. Out of the original dataset of 861,346 calving, 58,251 records (6.8%) were excluded due to missing information on calf sex or destiny, gestation duration less than two hundred and seventy-one days, or belonging to a raise distinct from "Holstein-Friesian, Jersey", or crossbreed. Information collected from farming establishments that documented every calving in a particular season categorized as live births accounted for Twenty-seven thousand and nine data or 3.4% of the remaining documentation. Nevertheless, that exclusion was carried out for statistical use rather than for the aim of ensuring data quality. No additional data checks were performed to verify the accuracy of the recordings.

Study (21) analyzed a dataset consisting of 94,250 records from 53,158 cows. The data was gathered from "1997 & 2002" and the source of "The Canadian Dairy Network". Over half of the documents (54.4%) were obtained via bovine that had given birth once. The data was primarily utilized for studying genetic factors and relationships. To be included in the analysis, animals needed to have complete records for several reproductive indicators, such as the number of times they were bred and the identity of their father. The original data collection does not provide information regarding the specific number of records and cows that were eliminated, nor does it specify the definition used for stillbirth. Due to the need for precise data for analytical purposes, it is plausible that a certain method has yielded a satisfactory level of precision in measuring PM. It could have restricted the extent to which that estimate accurately reflects the situation in Canada as a whole.

Study (22) analyzed information through the "national cattle database" spanning between "1985 & 2002", focusing on heifers that gave birth for the first time. The complete dataset, comprising over "1.8 million" entries, included documents concerning calves delivered singly, with a documented gender, acknowledged

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artificial insemination father and maternal grandfather, a mother's age 21 months or older and a Pregnancy duration period exceeding 240 days. The incidence of "stillbirth" ranged from 7.1% to 9.0% over that period. Like any study that retrieved data from a database, the records are documented by farmers. While the exclusion criteria are described, the number of data eliminated based on these criteria is not specified, making it difficult to evaluate the relevance of these findings to the Danish cattle population.

Study (23) conducted an analysis on 4528 records of calves that were born singly and appropriately presented. These calves were born from 1968 to 1999 and they were from the dairy research farm at Iowa State University in Ankeny. The text does not include any information on the handling of incomplete records or the methods used for data validation, despite the fact that the data originated from a single study farm.

Study (24) collected information from farms situated in seven mid western U.S. states that contributed data submitted to the "Dairy Records Processing Center". In order to enhance the grade of the data, they included herds that had almost complete documentation by farm staff, meaning that over 90% of the newborn calves had recorded information regarding their survival or death during the first 48 hours. That criterion of inclusion resulted in the analysis utilizing less than 15% of the herds included in the database. The analysis did not include twin births due to incomplete recording. No data comparison was conducted either across herds or within a herd to assess the quality of the data. "Calving" occurring beyond the range of 265-295 days following the estimated conception were not taken into consideration. Despite a significant number of exclusions, the dataset used to calculate death rates was extensive, consisting of 666,341 birth records spanning a period of 11 years.

Study (25) utilized information sourced from the national database of the Netherlands, specifically from 1993 to an unspecified period prior to 2000. In the "Netherlands", cultivators were obligated to document deceased livestock, but they were not obliged to label them for inclusion in the national database. Hence, the data pertaining to deceased calves were retrieved from cows that had recorded birthing date but lacked any related calf information in the database. That includes calves that came into existence but were taken off the farm during a day. The data used for genetic examination consisted of information from Holsteins registered in the Herd book with an age at first parity ranging from 640 - 1075 days and pregnancy duration among 260&300 days. Several instances of multiple instances of giving birth were deleted. The primary dataset comprised 12.9 million entries. Following an unspecified data editing process, 3.8 million records were utilized for the research. The study's methodology for checking and manipulating documents needs to be revised, making it challenging to ascertain the impact of these activities on the results. The overview of research (8 to 16) that examined PM is shown in Table (2).

Table (2). Summary of retrospective studies. (Source: Author)

Retrospective study												
Reference	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Mother's breed	"Holstein-Friesian"	"Holstein-Friesian"	"Holstein-Friesian"	"Holstein-Friesian"	"Holstein-Friesian"	"Jersey and Friesian"	"Multiple breeds"	"Holstein-Friesian and HF Blackpied Dairy Cow"	"Dairy Breeds"	"Holstein-Friesian and HF Blackpied Dairy Cow"	"Dairy Breeds"	"Holstein, Jersey and crosses of these breeds"

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calvings used in the analysis	~12,900,000/3,827,440	~4,440,000/666,341	4,528	1,781,694	94,250	861,346/776,086	309,361/289,038	Unknown/14,920	5,778,090/~4,275,800	14,920	5,778,090/~4,275,800	Unknown/1231
Explanation of Calf Mortality	Dead during one day calving	Dead during 48 hours of calving	Dead during 48 hours of calving	Dead during 48 hours of calving	Dead during 48 hours of calving	Dead during 48 hours of calving	"Stillbirths"	Stillbirth or death during one day of birth	Stillbirth or death during 48 hours of birth	Stillbirth or death during one day of birth	Stillbirth or death during 48 hours of birth	Stillbirth or death during 48 hours of birth
Operational System	"Not reported"	"Housed"	"Not reported"	"Housed"	"Not reported"	"Pasture"	"Mixed"	"Mixed"	"Not reported"	"Mixed"	"Not reported"	"Pasture"
Percentage of Mortality Rate	6.9%	5.7%	7.1%	9.0%	9.6%	7.2%	3.4%	9.5%	7.4%	9.5%	7.4%	6.6%

CONCLUSION

Reducing PM on dairy farms was crucial for global consumer trust and overall welfare. Most of the publications included for this study were retrospective assessments of sizable data sets, with records gathered by farmers as the primary source of information. Lack of knowledge about (i) the way that the data were altered after they were collected and (ii) how they were verified or checked were the most noted problems in these situations. Achieving effective change requires a reliable baseline, highlighting the necessity for a standardized approach to data collection. Many existing studies need more clarity on data manipulation and validation, impeding the determination of representativeness. The challenge lies in distinguishing whether the data reflects the general population or a specific subset. Large-scale retrospective analyses, standard in identified studies, can lack representativeness due to exclusion criteria or validation issues. The review underscores the importance of transparent reporting, as studies excluding significant data portions or lacking validation compromise reliability. The discrepancy between unweighted means of prospective and retrospective studies raises concerns about data losses and unreliability in retrospective records. To address these challenges, future research should prioritize prospective studies with standardized definitions and rigorous data accuracy validation, breaking the cycle of insufficient reporting and encouraging farmers towards better recording practices for accurate estimates.

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