Assessing cubicle partitions for dairy cows with regard to animal welfare

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Key words
Lying cubicle, cattle, rising, lying down, housing, neck rail

Aim of the study
The aims of the current study were to: (i) develop an objective and automated method for detecting specific atypical rising and lying down behaviours in dairy cows using accelerometers and machine learning; (ii) investigate associations between lying cubicle design and rising and lying down behaviours of dairy cows in stables with insufficient lunge space; and (iii) assess the effect of neck strap positioning on rising and lying down behaviours of dairy cows and lying cubicle hygiene.

Material and methods
For the development of an automated method to detect atypical rising and lying down behaviours in dairy cows, posture transitions were recorded in 48 lactating dairy cows housed in a research barn of Agroscope Tänikon. Associations between lying cubicle design and rising and lying down behaviours were investigated in an observational study on commercial dairy farms throughout Switzerland. Farms with the 'permissive' cubicle type (n = 4) had open frame partitions and a flexible neck strap, and farms with the 'restrictive' cubicle type (n = 6) had partitions with more bar work in the lateral lunge space and a rigid neck rail. The influence of neck strap positioning on rising and lying down behaviours and cubicle hygiene was investigated experimentally in a research barn of Agroscope Tänikon consisting of two mirrored compartments. In two subsequent experiments, three neck strap heights (105, 120 and 135 cm) and two distances of the neck strap from the curb (155 and 170 cm) were investigated.

All cows were fitted with tri-axial accelerometers (MSR 145, MSR Electronics GmbH, Switzerland) attached to the left hind leg. For the development of the automated detection method, additional accelerometers were attached to the head and both front legs of the cows. The triact R package (Simmler and Brouwers, 2024) was used to extract timestamps of rising and lying down events and to calculate measures of general lying behaviour from the data of the accelerometer on the left hind leg. Rising and lying down movements were assessed from video recordings using an ethogram containing rising and lying down behaviours considered as atypical for dairy cows under unrestricted conditions (i.e., on the pasture). When investigating neck strap positioning, the elimination behaviour of the cows shortly before and after rising events and lying cubicle contamination at the afternoon milking were also recorded.

Results and significance
Machine learning models detected atypical rising and lying down behaviours with balanced accuracies ranging from 0.57–0.74. Although this is better than random guessing, this performance is not yet satisfactory for application in the evaluation of new dairy cow housing installations. Subsequent analyses indicated that collecting more data is unlikely to improve performance. Potentially, ethograms designed for human observers are not optimal for machine learning and adjustments with machine learnability in mind might be necessary.

Cows showed more staggered head lunges and more behaviours indicative of hesitance prior to lying down in the restrictive cubicle type compared to the permissive cubicle type. Daily lying times and frequencies were both

higher in the permissive cubicle type. These results suggest that the permissive cubicle with open partitions and a flexible neck strap may improve conditions for dairy cows to rise and lie down. A permissive cubicle design may therefore improve cow welfare in free-stalls with insufficient forward lunge space, where increasing lunge space is not feasible.

Abnormal rising and lying down were rare and generally unaffected by neck strap position, except for crawling backwards on the carpal joints, which was less prevalent at a higher neck strap relative to wither height. Lying time and frequency were not influenced by neck strap positioning. Cubicle hygiene slightly decreased with increasing neck strap height and distance from the curb. These results indicate that flexible neck straps provide a viable alternative to rigid neck rails, ensuring cubicle hygiene while limiting the hindrance of dairy cow movements during rising and lying down.

These results clarify the relationship between lying cubicle design and dairy cow welfare, and offer insight into how to improve dairy cow welfare with reasonable investments.

Publications, posters and presentations

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