*animal* journal - New recommendations for self-locking barriers to reduce skin injuries in dairy cows

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**Supplementary Figure S1**. Example side-view of a dairy cow self-locking barrier reconstructed from the data. Distances are in cm. (0, 0) corresponds to the start of the walking alley, the black point represents the top rail, the grey point represents the bottom rail, the grey rectangle represents the separation wall, and the black square represents the headlock articulation-system screw.

**Supplementary Table S1**. Final multilevel logistic regression for dairy cow skin injuries to the neck/shoulder/back due to self-locking barriers, when using only farms with one type of self-locking barrier (which correspond to 2/3 of the farms). β is the estimate, OR is odds ratio, and CI is the upper and lower limits of the 95% confidence interval. '(Ref)' signals that the level is used as reference in the model.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Neck/shoulder/back model | | | | |
| Variable | β | OR | CI | P-value† | |
| Intercept | -0.53 |  |  | <0.001 | \*\*\* |
| Presence of an injuring area on the feeding rack | | | | | |
| No (Ref) |  | |  |  |  |
| Yes | 1.71 | 5.53 | [3.66-8.35] | <0.001 | \*\*\* |
| Cow breed |  |  |  |  |  |
| Holstein (Ref) |  | |  |  |  |
| Montbéliarde | -0.82 | 0.44 | [0.36-0.55] | <0.001 | \*\*\* |
| Bottom-rail height relative to cow height (reference: feeding floor) | | | | | |
| [0.25, 0.34[ (Ref) |  | |  |  |  |
| [0.34, 0.543] | 0.32 | 1.38 | [1.08-1.76] | 0.009 | \*\* |
| [0,0.25[ | 0.93 | 2.53 | [1.62-3.95] | <0.001 | \*\*\* |
| Bottom-rail height relative to cow height (reference: walking alley) | | | | | |
| [0.39, 0.46[ (Ref) |  | |  |  |  |
| [0, 0.39[ | -0.76 | 0.47 | [0.35-0.62] | <0.001 | \*\*\* |
| [0.46, 0.553] | -0.32 | 0.73 | [0.51-1.04] | 0.08 | NS |
| Separation-wall width (cm) | | | | | |
| [15, 20[ (Ref) |  | |  |  |  |
| [4, 15] | -1.12 | 0.33 | [0.23-0.46] | <0.001 | \*\*\* |
| [20, 25] | 0.53 | 1.70 | [1.31-2.21] | <0.001 | \*\*\* |
| Body condition score | | | | | |
| Skinny (Ref) |  | |  |  |  |
| Normal | 1.06 | 2.87 | [2.17-3.8] | <0.001 | \*\*\* |
| Fat | 0.16 | 1.17 | [0.77-1.79] | 0.46 | NS |
| Missing data | 1.18 | 3.24 | [1.42-7.37] | 0.005 | \*\* |
| Relative height of the headlock articulation nut | | | | | |
| ]0.62, 0.78] (Ref) |  | |  |  |  |
| [0.49, 0.62] | 1.01 | 2.74 | [1.95-3.86] | <0.001 | \*\*\* |
| ]0.78, 0.87] | 0.41 | 1.50 | [0.99-2.28] | 0.06 | NS |
| Incline of the self-locking barrier | | | | | |
| Straight (Ref) |  |  |  |  |  |
| Inclined | -0.87 | 0.42 | [0.34-0.53] | <0.001 | \*\*\* |
| Missing data | -0.69 | 0.50 | [0.26-0.95] | 0.04 | \* |
| Step height relatively to cow height | | | | | |
| No step or less than 0.04 (Ref) |  | | | | |
| [0.04, 0.1[ | -1.07 | 0.34 | [0.17-0.68] | 0.002 | \*\*\* |
| [0.1, 0.185] | 1.07 | 2.93 | [2.13-4.02] | <0.001 | \*\*\* |
| Are the screw and nut protrusive? |  |  |  |  |  |
| No (Ref) |  |  |  |  |  |
| Yes | 1.71 | 5.53 | [3.66-8.35] | <0.001 | \*\*\* |

† NS (non-significant) P > 0.05, \* P < 0.05, \*\* P < 0.01, \*\*\* P < 0.001

**Supplementary Table S2**. Final multilevel logistic regression for dairy cow skin injuries to carpus due to self-locking barriers, when using only farms with one type of self-locking barrier (which correspond to 2/3 of the farms). β is the estimate, OR is odds ratio, and CI is the upper and lower limits of the 95% confidence interval. '(Ref)' signals that the level is used as reference in the model.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Carpus model | | | | | | | | |
| Variable | β | OR | | CI | | P-value† | | | |
| Intercept | -1.32 |  | |  | | <0.001 | | \*\*\* | |
| Presence of an injuring area on the feeding rack | | | | | | | | | |
| No (Ref) |  | | |  | |  | |  | |
| Yes | 1.36 | 3.90 | | [2.61-5.85] | | <0.001 | | \*\*\* | |
| Cow breed |  |  | |  | |  | |  | |
| Holstein (Ref) |  | | |  | |  | |  | |
| Montbéliarde | -1.02 | 0.36 | | [0.27-0.48] | | <0.001 | | \*\*\* | |
| Position of the bottom rail relative to the wall | | | | | | | | | |
| Cow side (Ref) |  | | |  | |  | |  | |
| Centred | 0.33 | 1.39 | | [1.03-1.86] | | 0.03 | | \* | |
| Food side | -0.29 | 0.75 | | [0.51-1.09] | | 0.13 | | NS | |
| Missing data | 0.00 | 1.00 | | [0.38-2.63] | | 1.00 | | NS | |
| No rail | 0.80 | 2.22 | | [1.04-4.7] | | 0.04 | | \* | |
| Height difference between feeding floor and walking alley relative to cow height | | | | | | | | | |
| [0.02, 0.1] (Ref) |  | | |  | |  | |  | |
| [0.1, 0.21[ | 0.57 | 1.76 | | [1.34-2.31] | | <0.001 | | \*\*\* | |
| [-0.05, 0.02[ | 0.38 | 1.46 | | [0.99-2.16] | | 0.06 | | NS | |
| Separation-wall height (cm) | | | | | | | | | |
| [0.28, 0.4[ (Ref) |  | | | | | | | | |
| [0.4,0.48[ | -1.84 | 0.16 | | [0.07-0.36] | | <0.001 | | \*\*\* | |
| [0.14, 0.28] | 0.48 | 1.62 | | [1.06-2.48] | | 0.03 | | \* | |
| Step length relative to cow length | | | | | | | | | |
| [0, 0.2[ (Ref) |  | | |  | |  | |  | |
| [0.2,1.05[ | 0.59 | 1.81 | | [1.21–2.7] | | 0.004 | | \*\* | |
| [1.05,1.25] | 0.76 | 2.14 | | [1.37–3.34] | | <0.001 | | \*\*\* | |
| Form of feeding table |  | |  | |  | |  | |  | |
| Feeding manger (Ref) |  | | |  | |  | |  | |
| Feeding table | -0.41 | 0.67 | | [0.49-0.91] | | 0.012 | | \* | |

† NS (non-significant) P > 0.05, \* P < 0.05, \*\* P < 0.01, \*\*\* P < 0.001

**Supplementary Table S3**. Explained variability between cows, when predicting skin injuries on farms with two types of self-locking barriers, using multi-barrier model (coefficients from weighted regressions given in Table 3 for injuries on neck/shoulder/back and in Table 4 for injuries on carpus) or single-barrier model (coefficients given in Supplementary Table S1 for injuries on neck/shoulder/back and S2 for injuries on carpus) applied to either the main type of barrier present on a farm or the second type of barrier on the farm.

|  |  |  |
| --- | --- | --- |
| Type of model | Neck/shoulder/back | Carpus |
| Multi-barrier model | 68.5% | 27.96% |
| Single barrier model applied to the main type of barrier | 21.8% | 0.21% |
| Single barrier model applied to the second type of barrier | 45.9% | 0.04% |