

Predicting pre-weaned dairy calf weight from morphometric measurements

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- Regular weighing of calves is an essential management practice for dairy farmers:
 - **feeding management practices** (e.g., feeding colostrum per BW instead of a standardized volume);
 - **calculating medication dosages** (e.g., calculating anesthetic and analgesic dosages for disbudding or reducing underdosing caused by incorrect visual weight estimation);
 - **sell animals based on BW**, especially for male calves;
 - to test **changes in the environment or management practices** (e.g., changes in housing system),
 - to set **weight gain targets** and assess the rearing period efficiency.

Weighing calves may not be always practical due to **logistical or economic constraints**



Survey of calf management practices in the UK¹ :

55.6% (120/216) farmers weighed their calves	31.7% used a scale (i.e., birth, weaning)	10% weighed weekly basis
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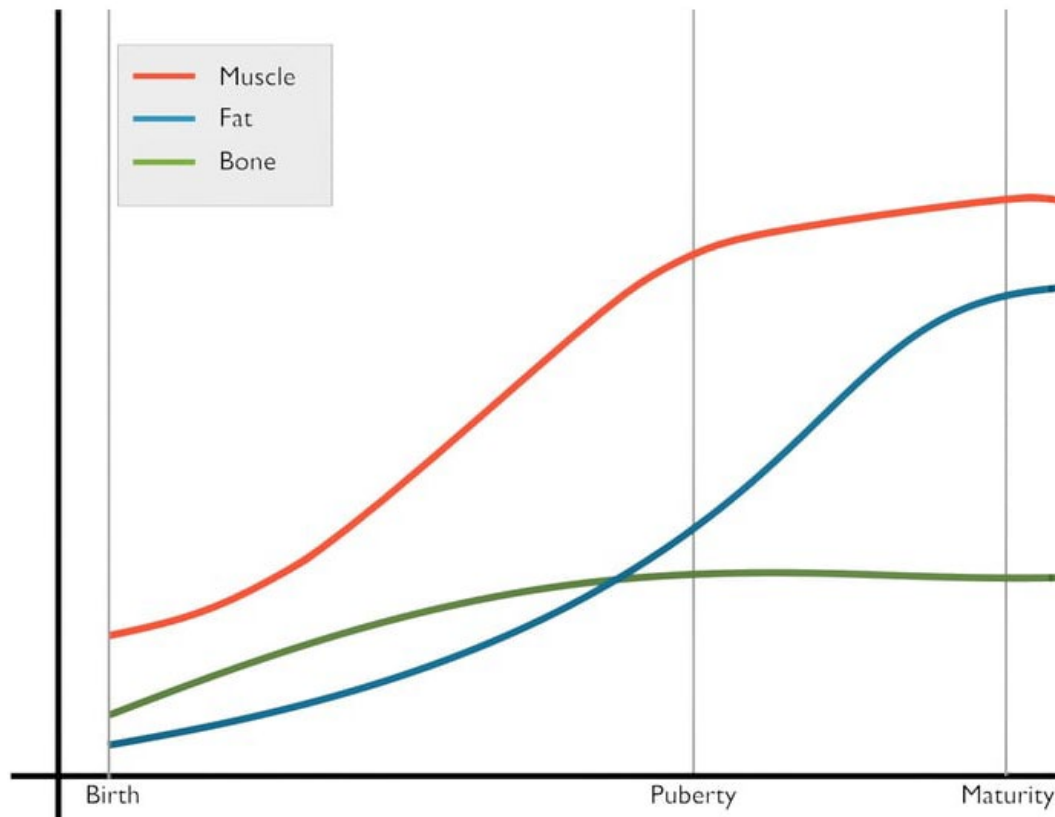


¹Mahendran et al. A survey of calf management practices and farmer perceptions of calf housing in UK dairy herds. *J. Dairy Sci.* **2022**, *105*, 409–423.

Alternative

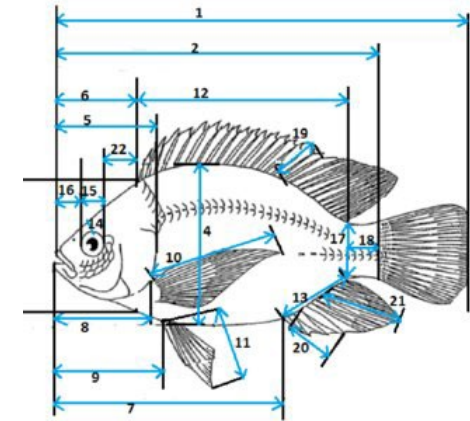
Morphometric measurements (MS)

- Animal growth
- Predict weight



<https://ruminants.ceva.pro/cattle-feed>

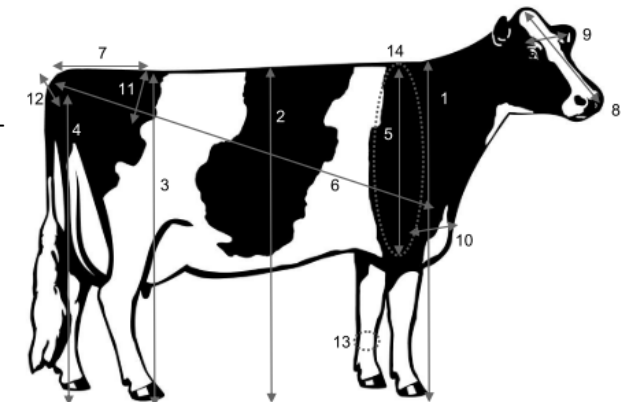
Makeche et al. *A. Sci. Res. J. Eng., Tech., and Sci.*, 2020. 74(1), 31–40



Urbanek and Zebeli. *Vet. Sci.* 2023, 10(8), 515.



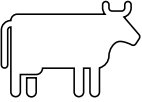
Cerqueira et al. *Int. J. Morph.* 2013, 31(1), 55-63.

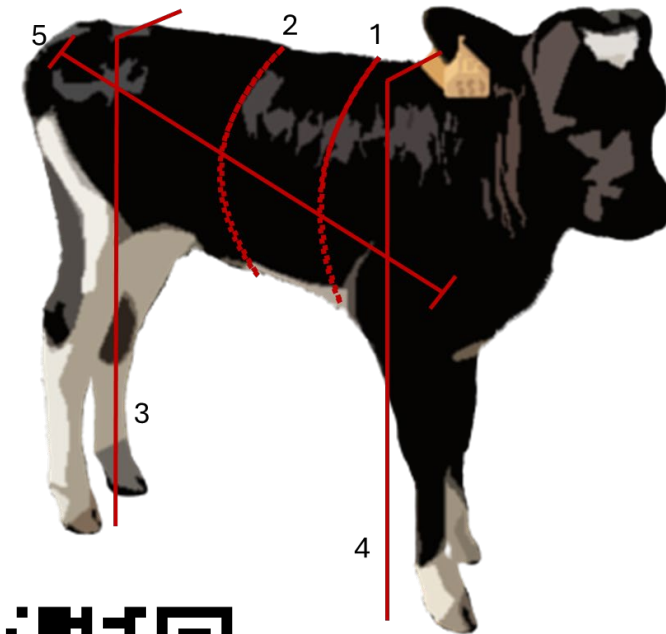


Objective

- The aim of this study was to develop a **BW predictive equation** based on **MS** for **pre-weaned Holstein–Friesian dairy calves**
 - Develop a user-friendly web application

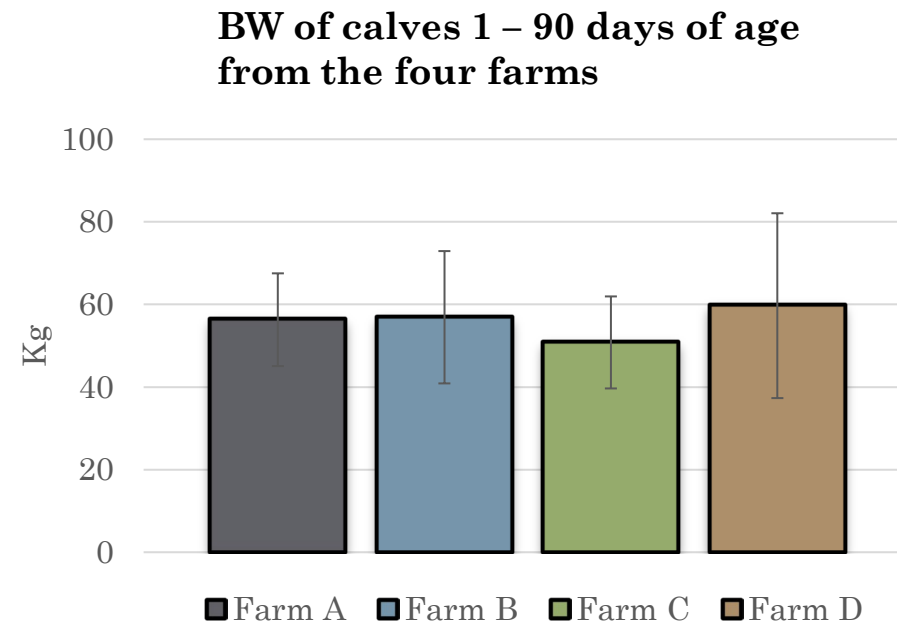
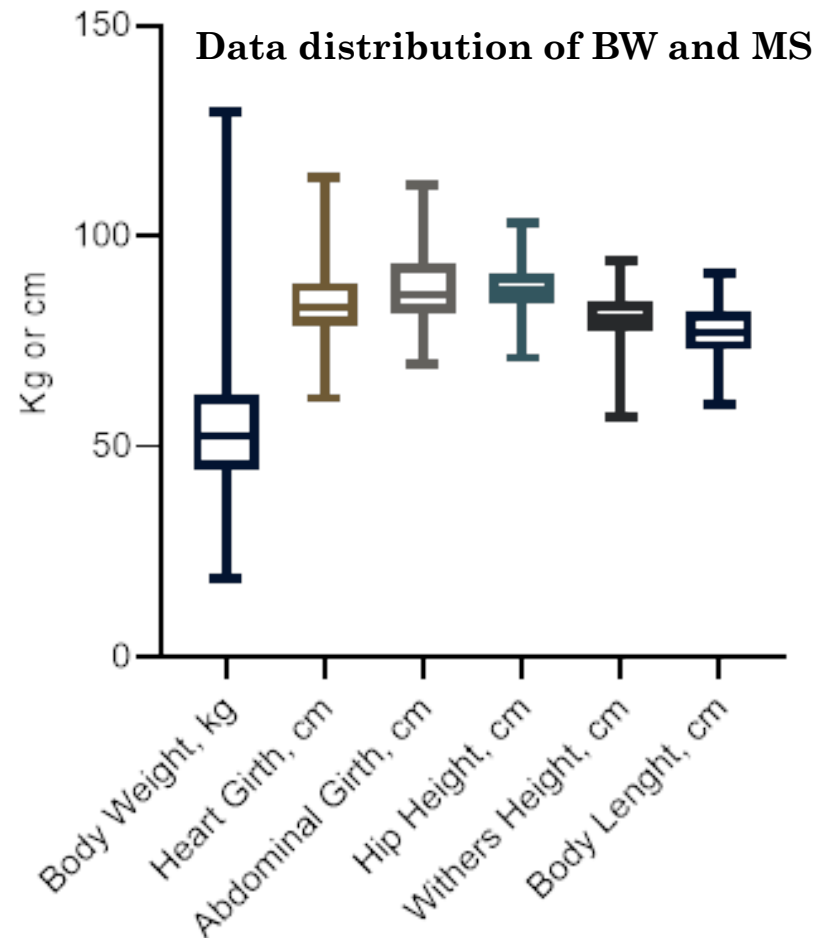


-  • Four dairy farms
-  • Holstein–Friesian ♀ (n = 188) and ♂ (n = 53) calves;
-  • 1 – 90 days of age
-  • Measurements of body weight (n = 237), heart girth¹, abdominal girth², hip height³, withers height⁴, and body length⁵
-  • Linear and nonlinear regression analysis → test the relationship between BW and MS, with age, sex, and farm as possible explanatory variables
- Models were compared with goodness of fit and agreement tests
-  • Web application: HTML, CSS, and JavaScript programming languages; storage of source code on GitHub



Again at the end of the presentation.
Prepare your phones!

Descriptive statistics



Effects of sex, age, and farm on the predictive models

- Effect of **sex** on BW prediction ($P = 0.141$)
- **Age** was correlated with BW ($r = 0.81$, $p < 0.001$)
- Effect of **farm** on BW prediction ($P < 0.001$)



Multiple linear regression models for pre-weaned Holstein–Friesian calves BW estimated from MS for each farm.

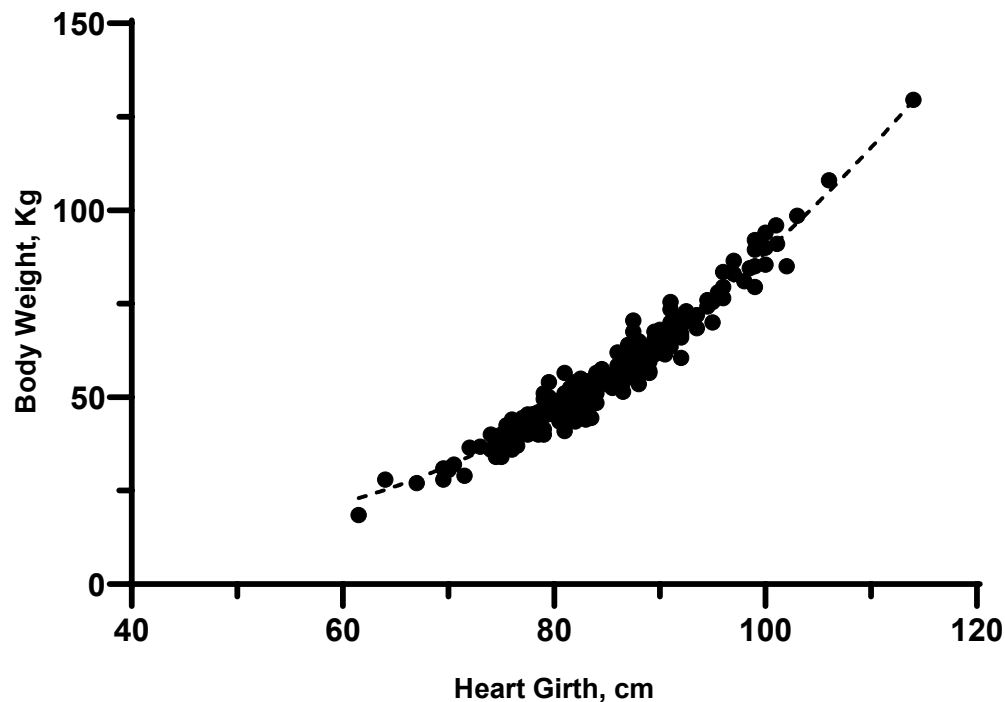
β Coefficient	N	Intercept	HG	AG	WH	HH	BL	r	R^2
Farm A	42	−112.739	1.472 ***		0.524 *			0.96	0.95
Farm B	28	−197.34	1.115 ***	0.207 *	1.701 ***			0.99	0.97
Farm C	90	−94.214	1.209 ***	0.283 ***		0.253 *		0.97	0.95
Farm D	43	−141.146	1.842 ***			0.485 **		0.99	0.97

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. BW – Body weight; MS – Morphometric measurements; HG—Hearth girth; AG—abdominal girth; HH—hip height; WH—wither height; BL—body length; r —correlation coefficient; R^2 —coefficient of determination; N—number of measurements.

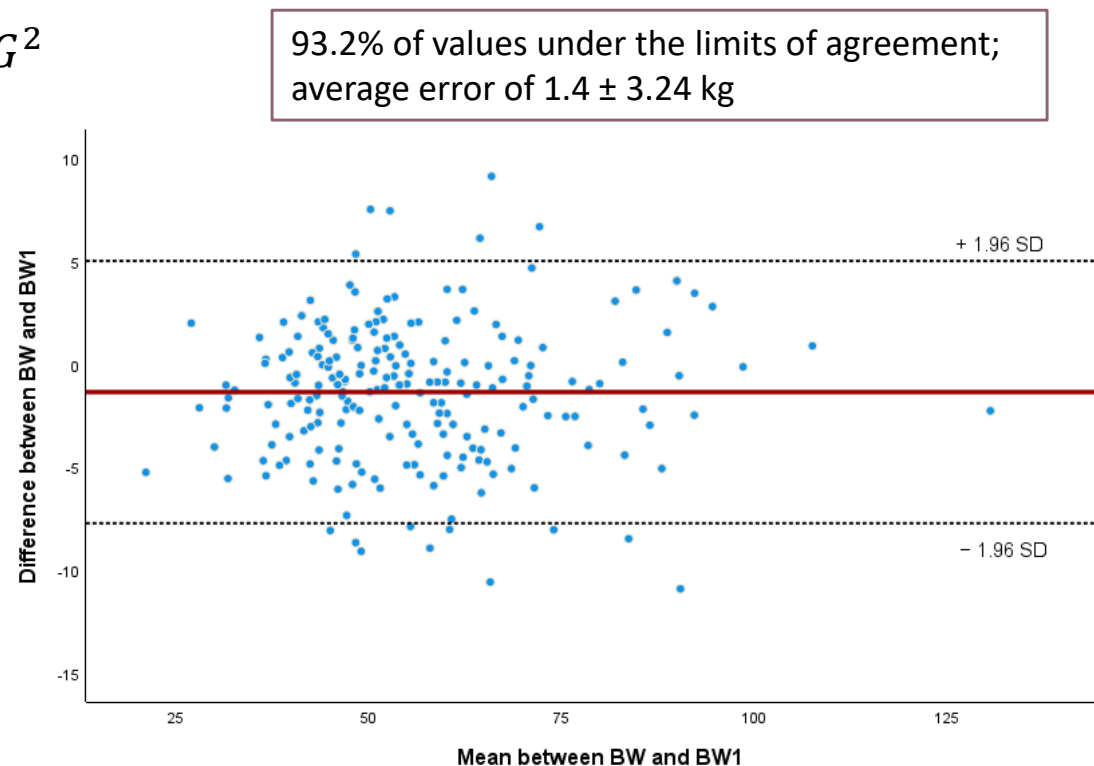
Predictive model for BW

Using data from all farms, the best predictive model:

$$BW1 = 58.459 - 1.979 \times HG + 0.023 \times HG^2$$



Scatter plot of model BW1, with heart girth (cm) and body weight (kg), and its respective equation, $R^2 = 0.96$



Bland-Altman's plot of estimated weight (BW1) against measured body weight (BW). Red line represents the mean difference between BW and BW1 and dotted lines the upper and lower limits of agreement.

How much does my calf weigh?



This website allows you to estimate the weight of Holstein-Friesian calves.

The model is validated for calves (male and female) aged between 1 and 90 days old, with an average error of 1.4kg.

The model can be applied to other calves (crossbred or of different ages), but the error may increase.

Enter Heart Girth*:

cm

*Enter value between: 61 to 114 cm

Weight:
40.9 kg

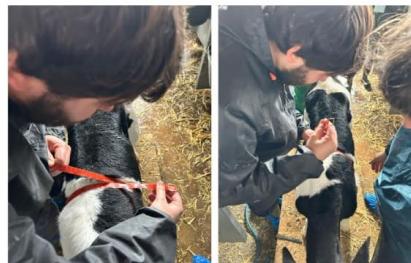
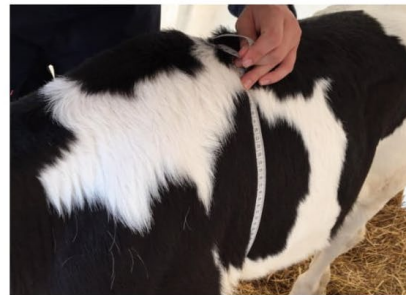
How to measure Heart Girth

The calf should be facing forward with its head parallel to its body.

Place an ordinary measuring tape measure around the calf's chest, just behind the scapula.

Apply enough pressure to pass through the hair coat, but no more. You want to get it around the skin, but don't want to squeeze it.

See images below.



- We proposed a model for estimating body weight from morphometric measurements in pre-weaned Holstein–Friesian calves aged 1 to 90 days.
- Body weight (i.e., female and male) of pre-weaned calves can be reliably estimated using heart girth measurement.
- The feasibility of this process could be improved with Web app developed.
- Further studies to validate this model in different farms would be beneficial to increase its robustness.



Conclusions

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Thank you!

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