

monoguthealth

Optimal gut function in monogastric livestock

Validated machine-learning model to detect IUGR piglets

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Introduction



1. Increased **litter size**



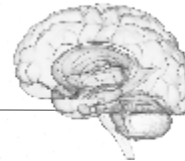
2. Increased exposition to **intrauterine growth restriction (IUGR)**



4. Inaccurate **diagnosis** due to the **absence of specific symptoms** and reliable **biomarkers**



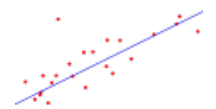
7. Gold standard to assess the degree of IUGR is the ratio between **the weight of the brain** and the **weight of other organs**



3. Low neonatal **survival rates** and long-term **growth** limitations

5. Altered **blood flow distribution** to **preserve** cerebral functionality

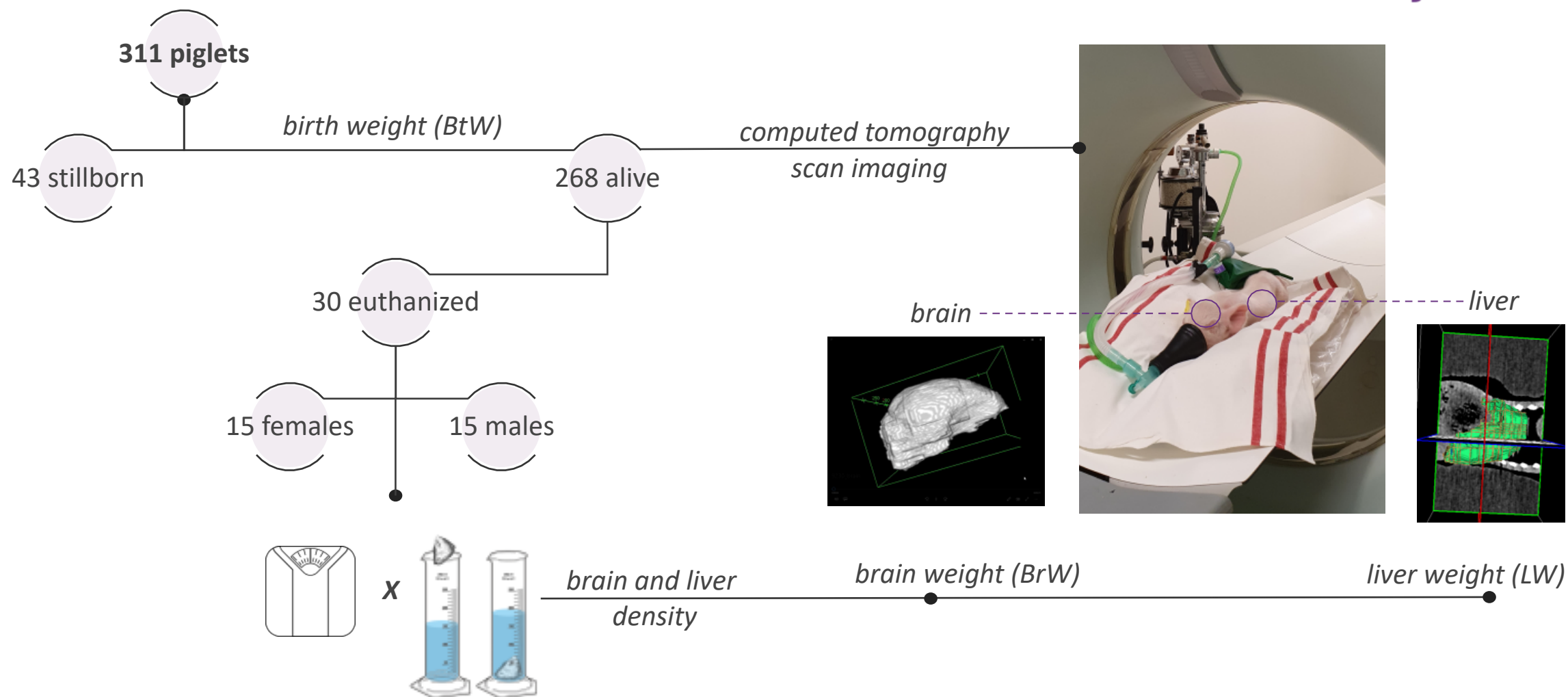
6. Relative **increase in brain size** when compared to other organs



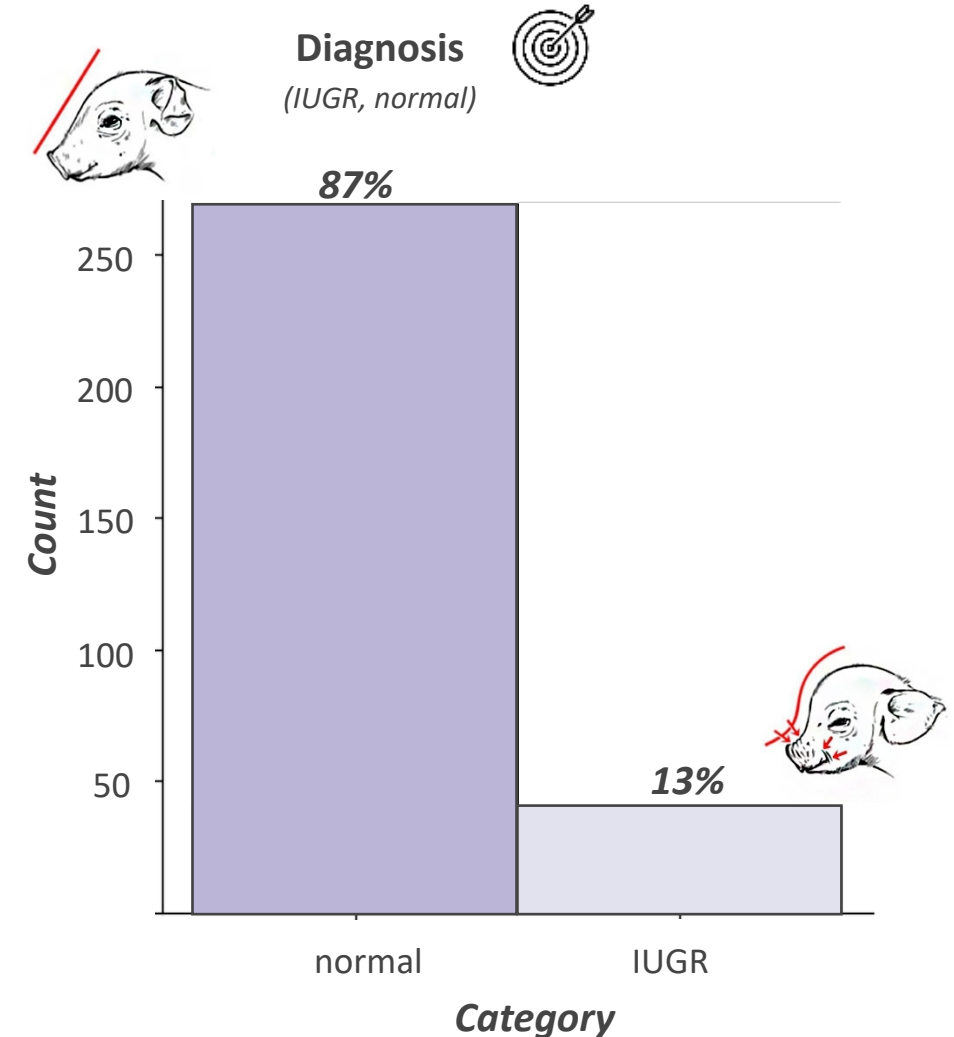
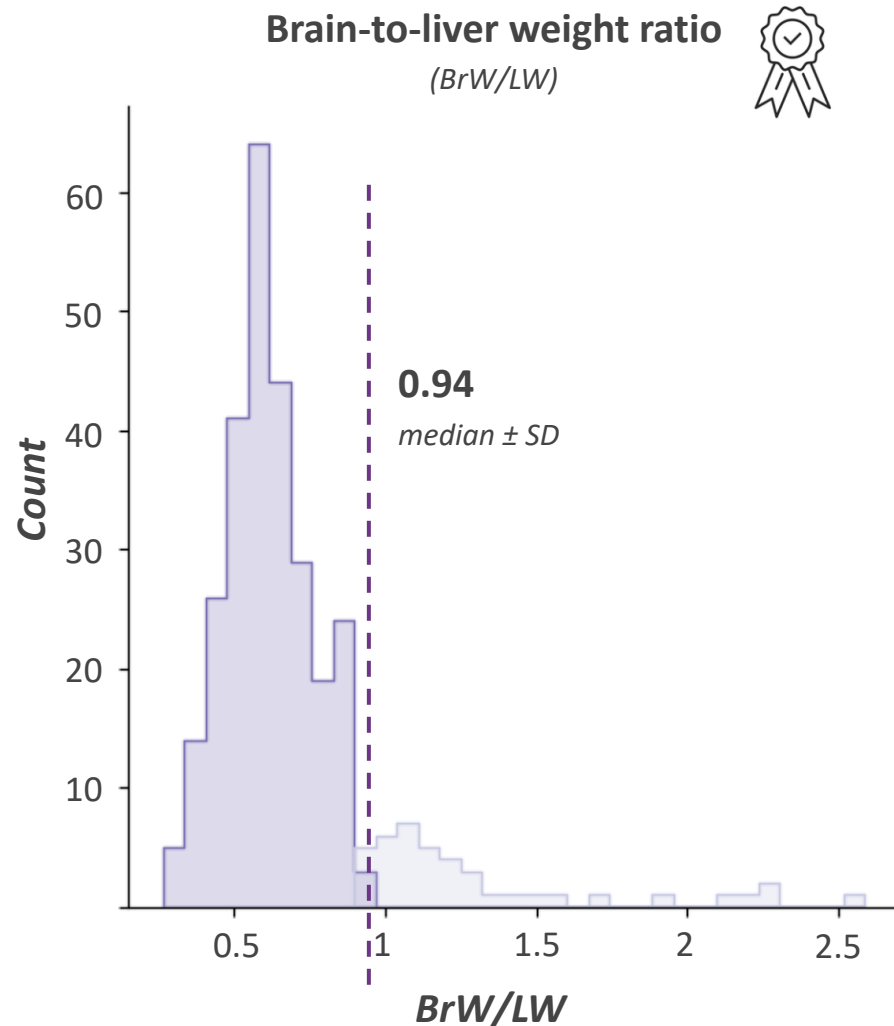
8. Develop a model to **predict the ratio** and **diagnose IUGR**



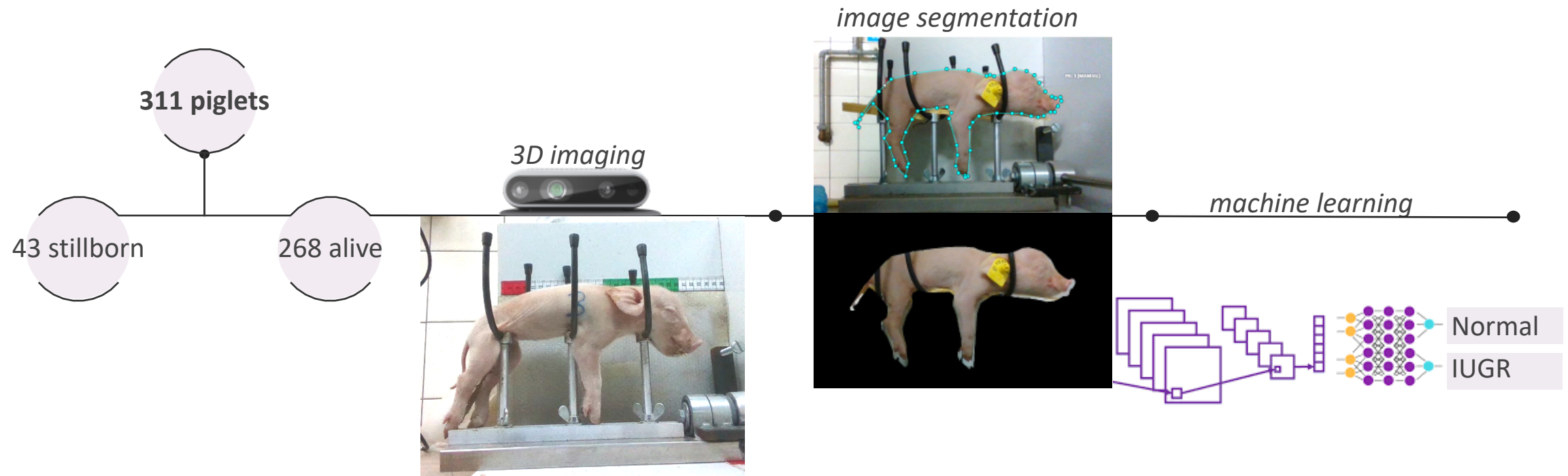
Materials and methods – data collection study 1



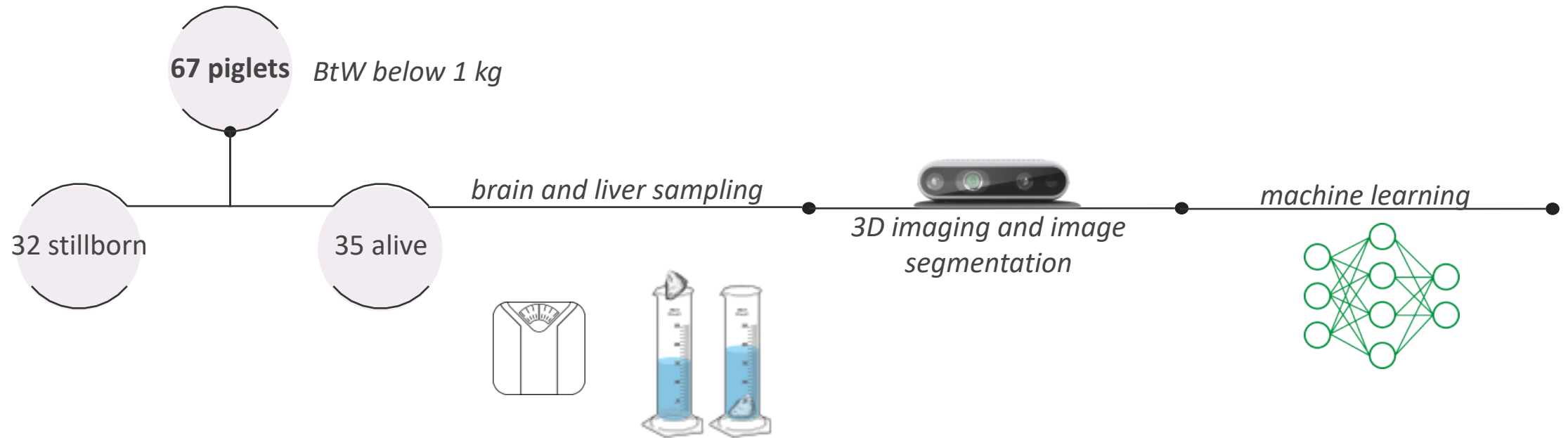
Materials and methods – data visualization study 1



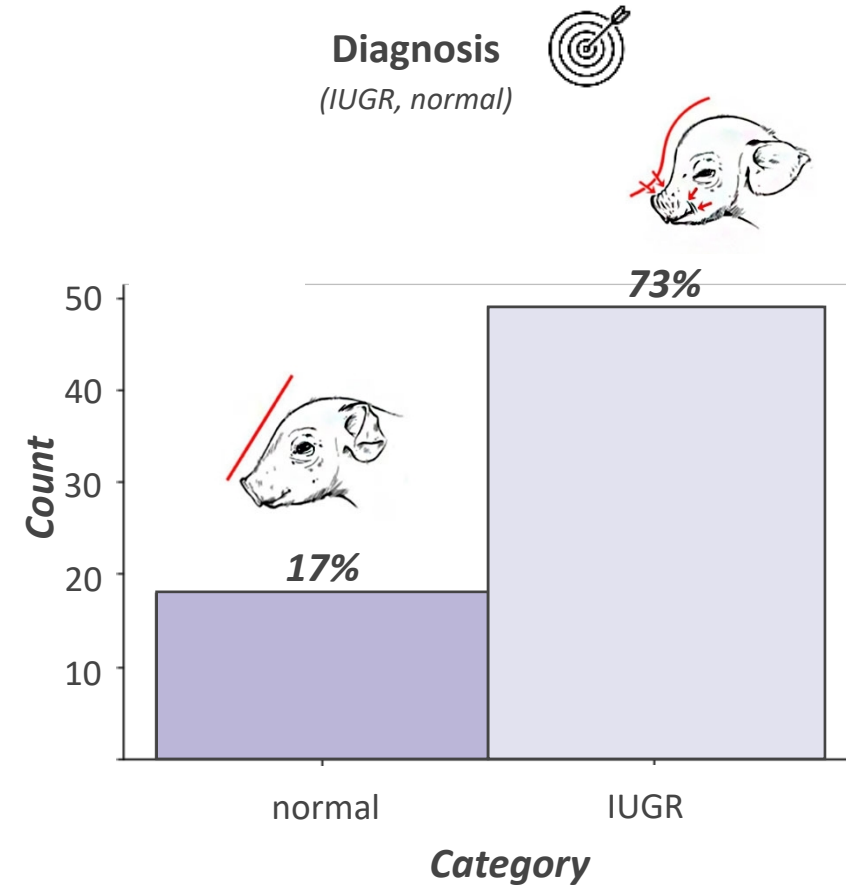
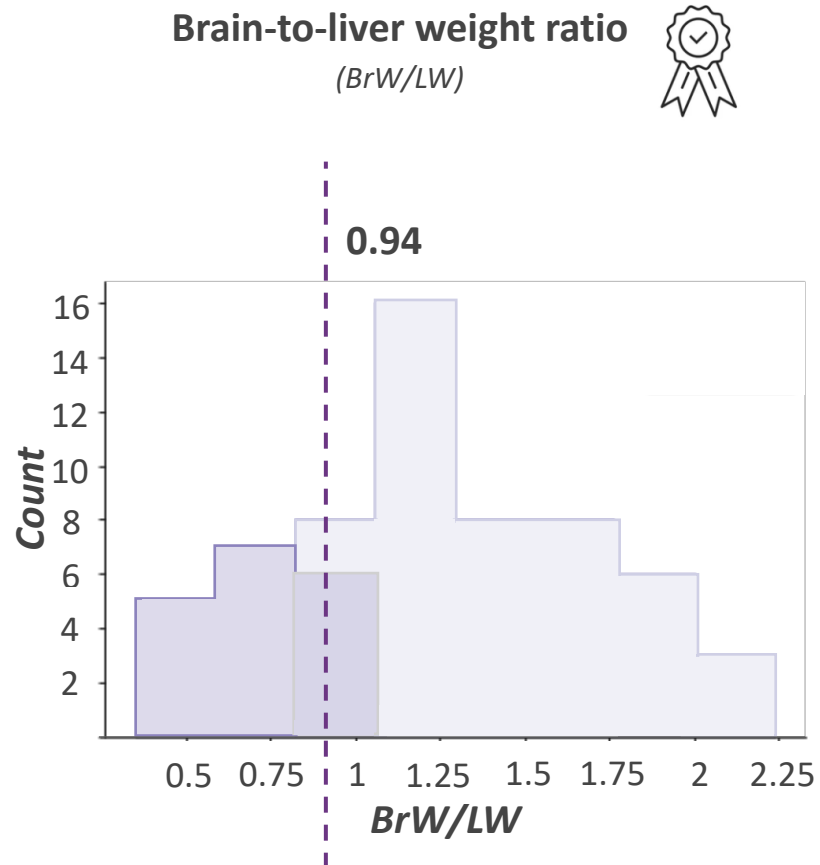
Materials and methods – data collection study 1



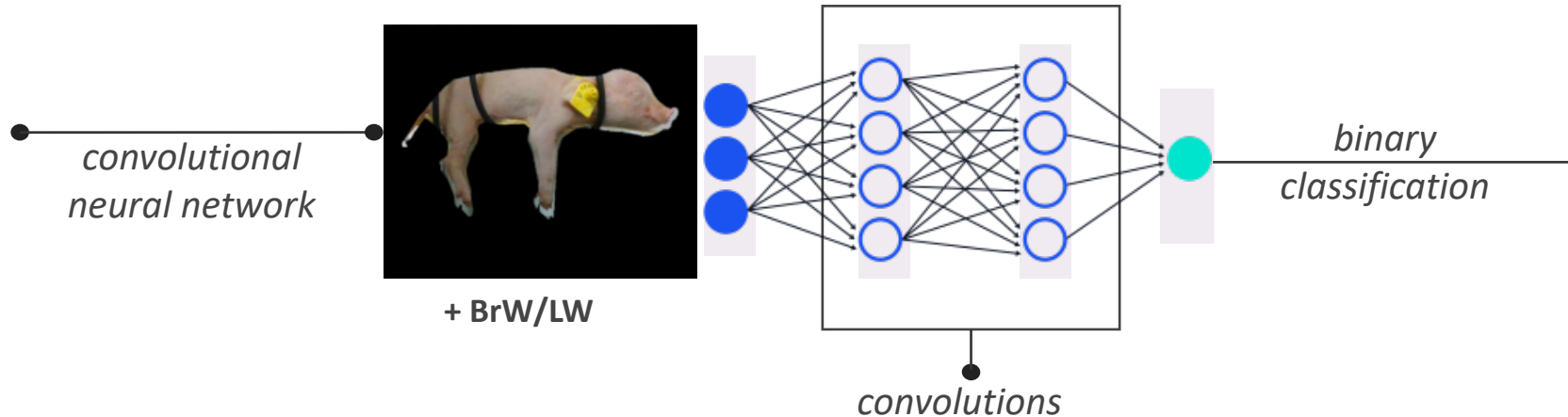
Materials and methods – data collection study 2



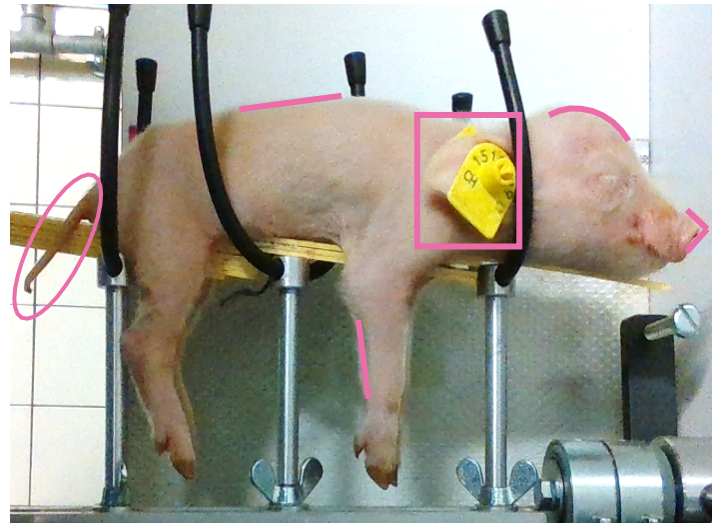
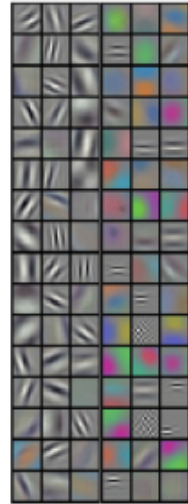
Materials and methods – data visualization study 2



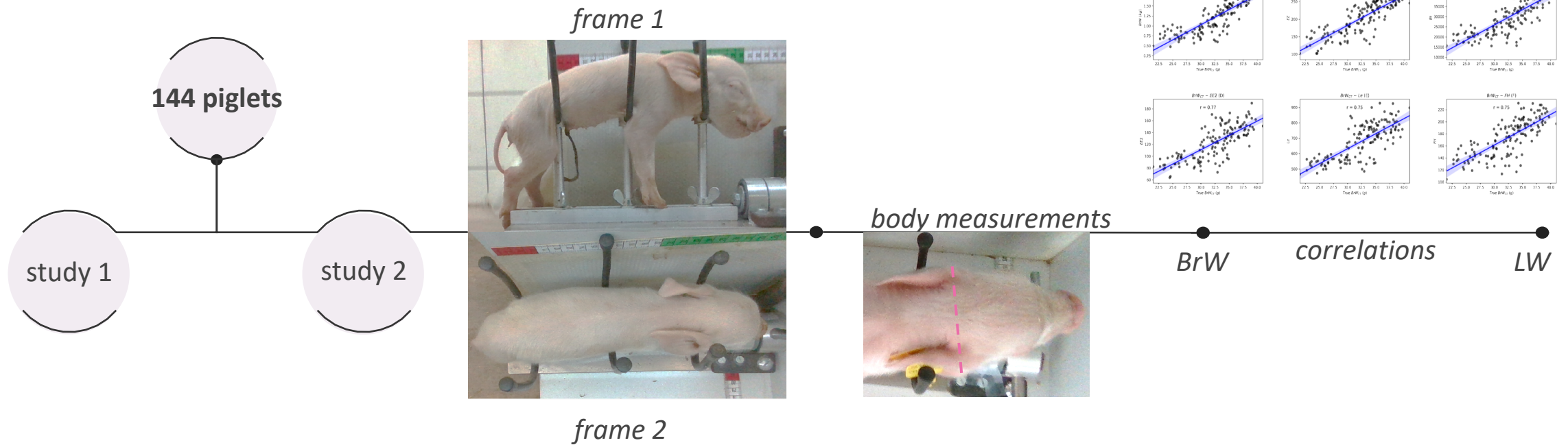
Materials and methods – machine learning



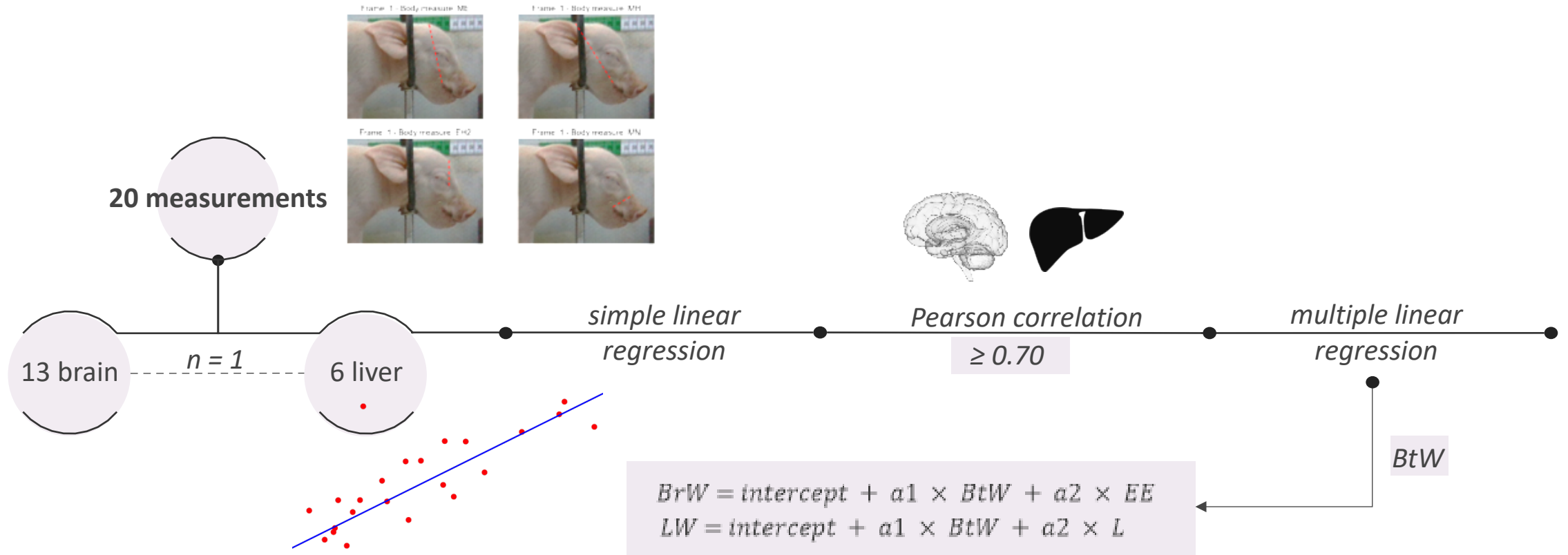
- ✓ **Recall:** detected IUGR cases on total IUGR cases
- ✓ **Precision:** correct IUGR predictions on total IUGR precisions
- ✓ **F1 score:** harmonic mean of recall and precision



Materials and methods – regressions



Materials and methods – regressions



Results – machine learning

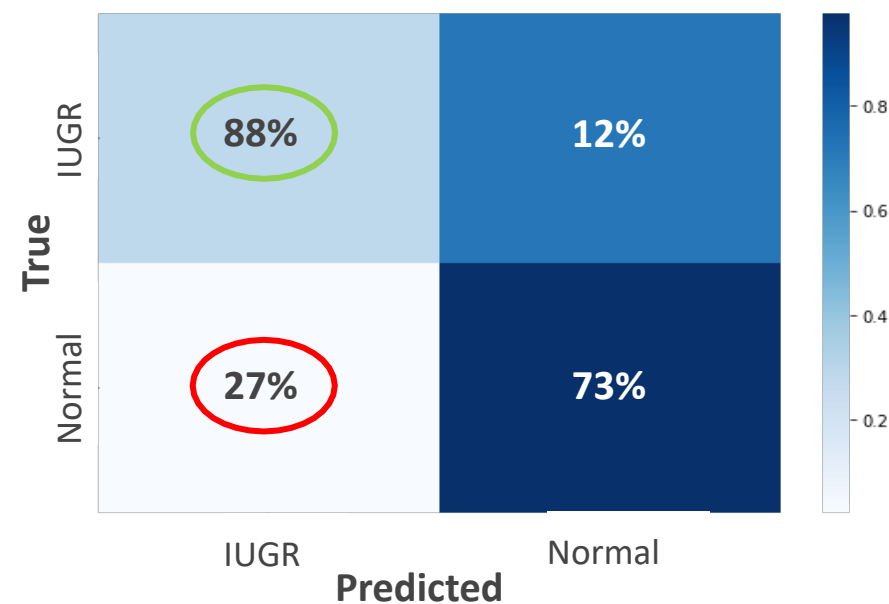


- ✓ Recall: 88%
- ✓ Precision: 50%
- ✓ F1 score: 64%

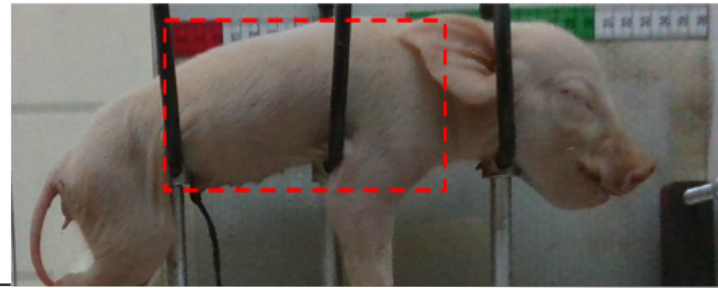
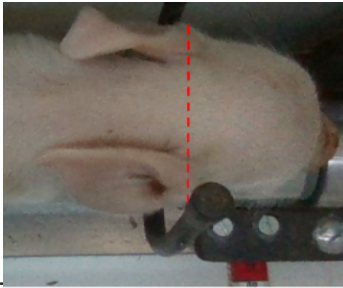
Training

- ✓ Recall: 97%
- ✓ Precision: 53%
- ✓ F1 score: 65%

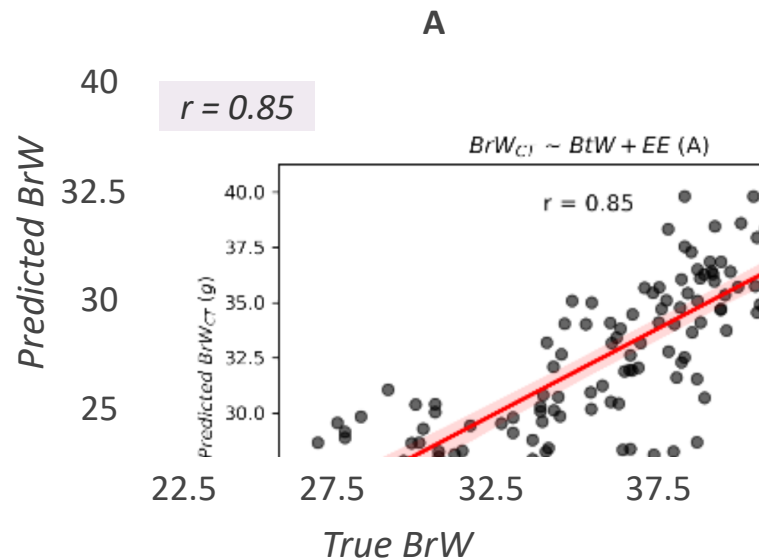
Validation



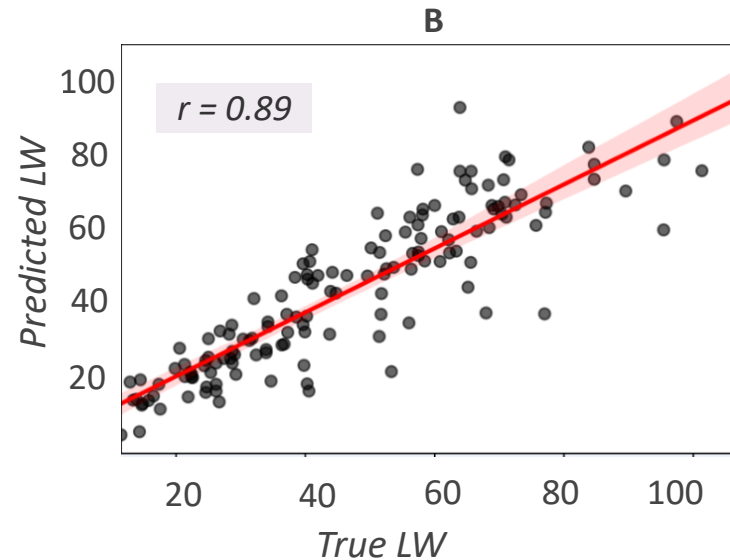
Results – regressions



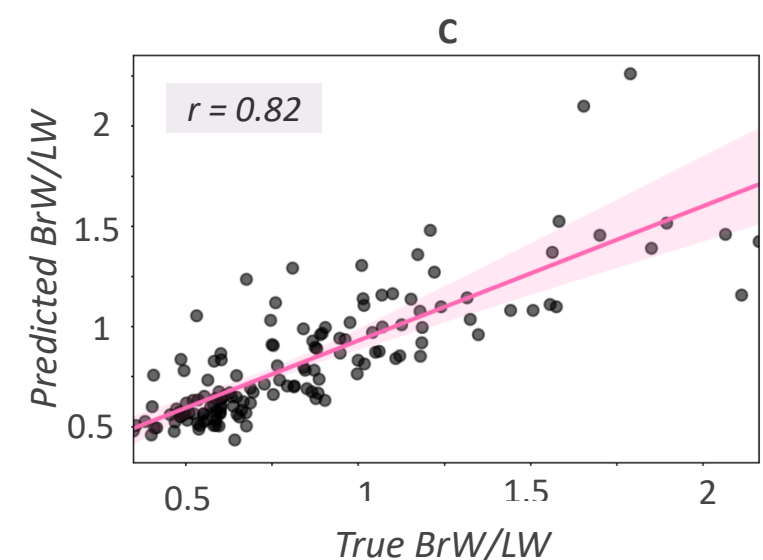
Correlation between the true and predicted BrW (A), LW (B) and BrW/LW (C)



Mean absolute
percentage error: **6%**



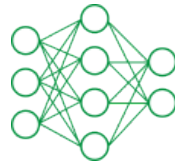
Mean absolute
percentage error: **17%**



Mean absolute
percentage error: **18%**

Take home message

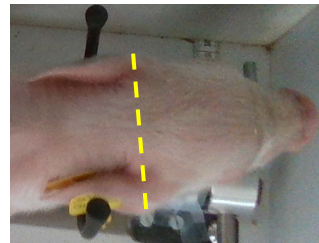
1. Convolutional neural networks can be used to **diagnose IUGR** in newborn piglets



True	Predicted	
	IUGR	Normal
IUGR	88%	12%
Normal	27%	73%

2. Our convolutional network is highly **sensitive** in detecting the IUGR cases (88%) but **precision** (50%) needs to be improved

3. Several morphometric traits can be used to **estimate** the **brain** and **liver weight** from images of newborn piglets



4. If the **relative brain weight** of a newborn piglet is below the **3%** of its **body weight**, the piglet can be diagnosed as normal (Amdi et al., 2013)

5. The brain weight **estimated** with our equations (error rate: 6%) can be compared with the **birth weight**, enabling a **non-invasive** and **accurate** diagnosis of normal piglets



6. Future studies should focus on **validating** these models in **larger populations** and exploring their **applicability in the field**

THANK YOU

Do you have any questions?

Organisation

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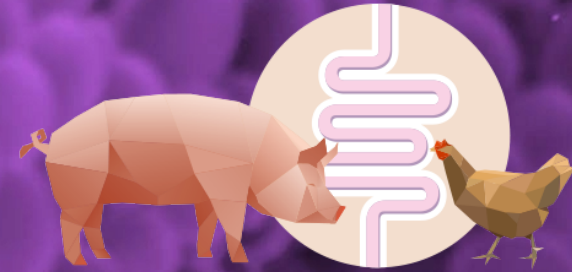
Website [ESR1: What are IUGR pigs? – phenotypic and metabolic differentiation - MonoGutHealth](#)



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



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