The secret of each sow: exploring the impact of sow and litter features on within-litter uniformity

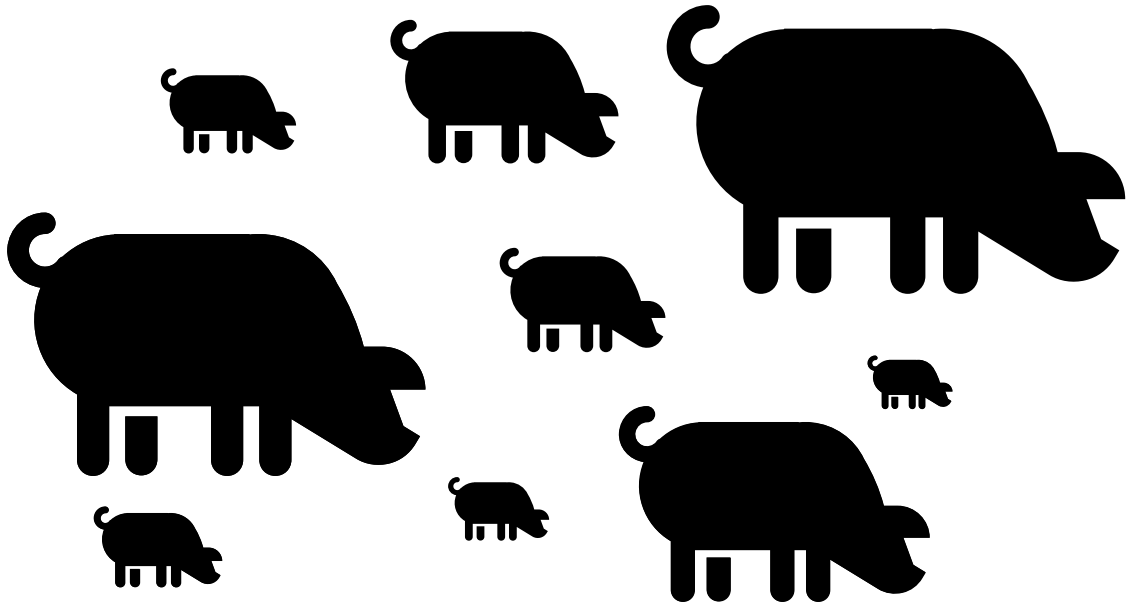
Katrijn Hooyberghs, S. Goethals, W. Gorssen, L. Chapard, R. Meyermans, N. Aerts, S. Millet, S. Janssens and N. Buys

Center for Animal Breeding and Genetics, Department of Biosystems, KU Leuven, 3001 Leuven, Belgium

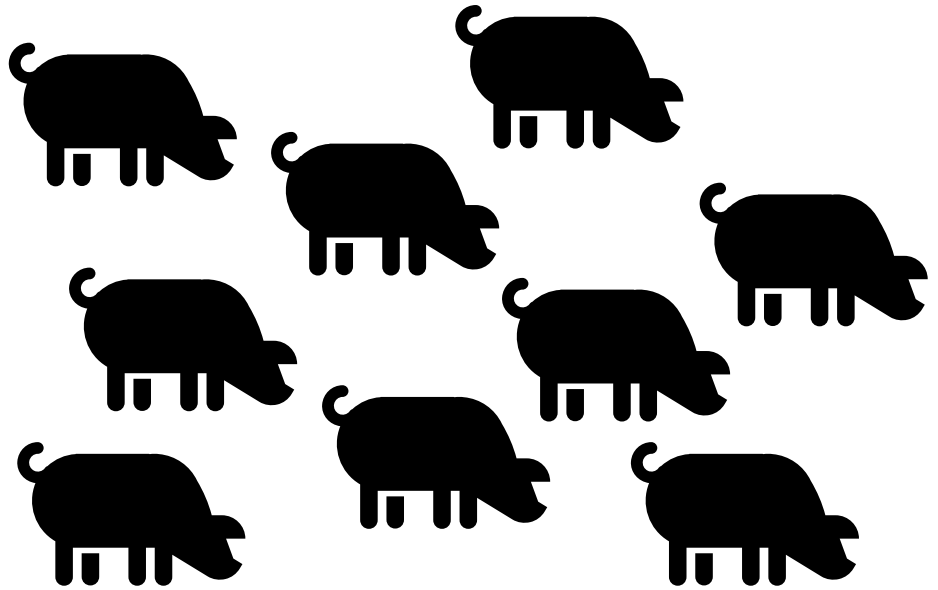
Session 8: “Innovative approaches to pig and poultry production"

What is body weight uniformity?

Low uniformity in body weight



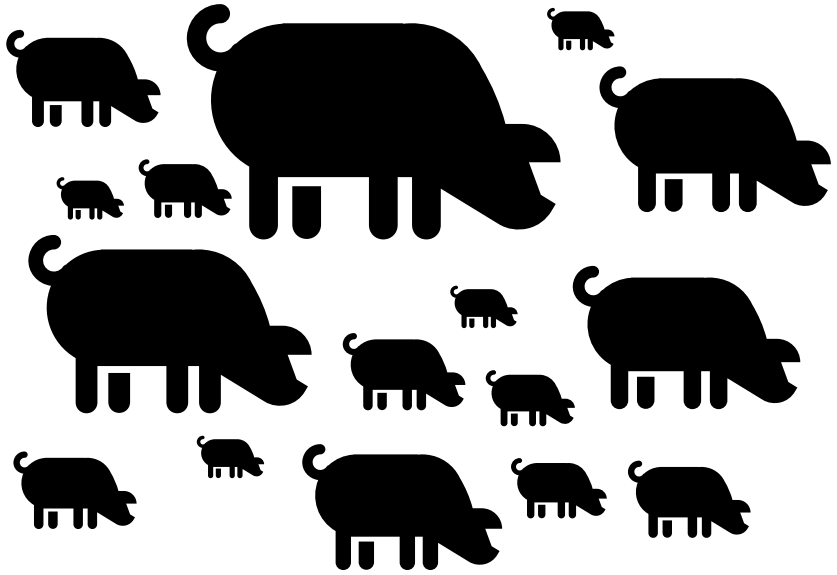
High uniformity in body weight



Uniformity of body weight = degree of **similarity in weights** of individual pigs within a group

Small piglets causing big challenges

Non-uniform litter



↑ the proportion of lightweight piglets
↑ risk of encountering challenges shortly after birth
↓ pre-weaning survival

↓ daily gain and less desirable carcass composition

Objectives

1. Investigate common **metrics** for quantifying the within-litter uniformity in pigs
2. Explore the associations between **sow- and litter-related factors** and the different metrics of uniformity

Data collection

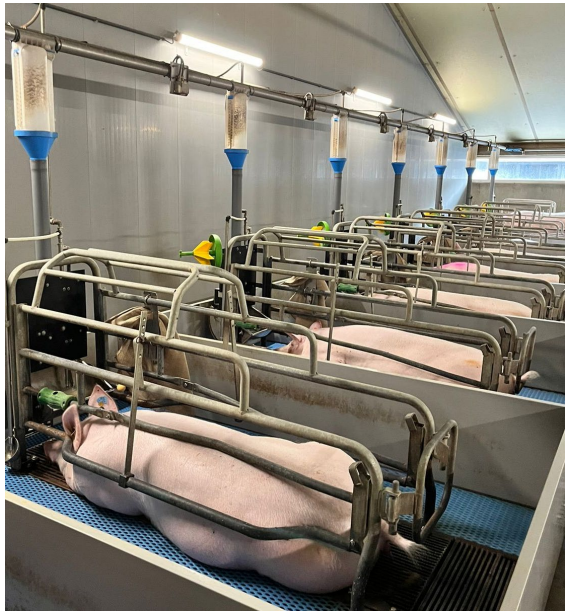
	Farm 1	Farm 2
NBA	14,307	11,716
Litters	958	732

Quality control:

- Difference between the reported number of piglets born alive (NBA) and the number of live-born piglets weighed at birth
- Litters with only 1 piglet
- Litters of sows with only 1 litter in the dataset
- Litters of boars with only 1 litter in the dataset

	Farm 1	Farm 2
Period of data collection	December 2020 to January 2024	January 2021 to February 2024
NBA	811	10,763
Litters	65	667
Piétrain boars line A	14	34
Piétrain boars line B		8
Crossbred sows line 1	29	
Crossbred sows line 2a		9
Crossbred sows line 2b		152

Data collection



- Age at first insemination

- Sow and boar id + their genetic line
- Sow's parity
- Insemination, farrowing and weaning dates
- Gestation and lactation length
- Weaning-to-pregnancy interval
- Number of liveborn, mummified and stillborn piglets, number of males/females

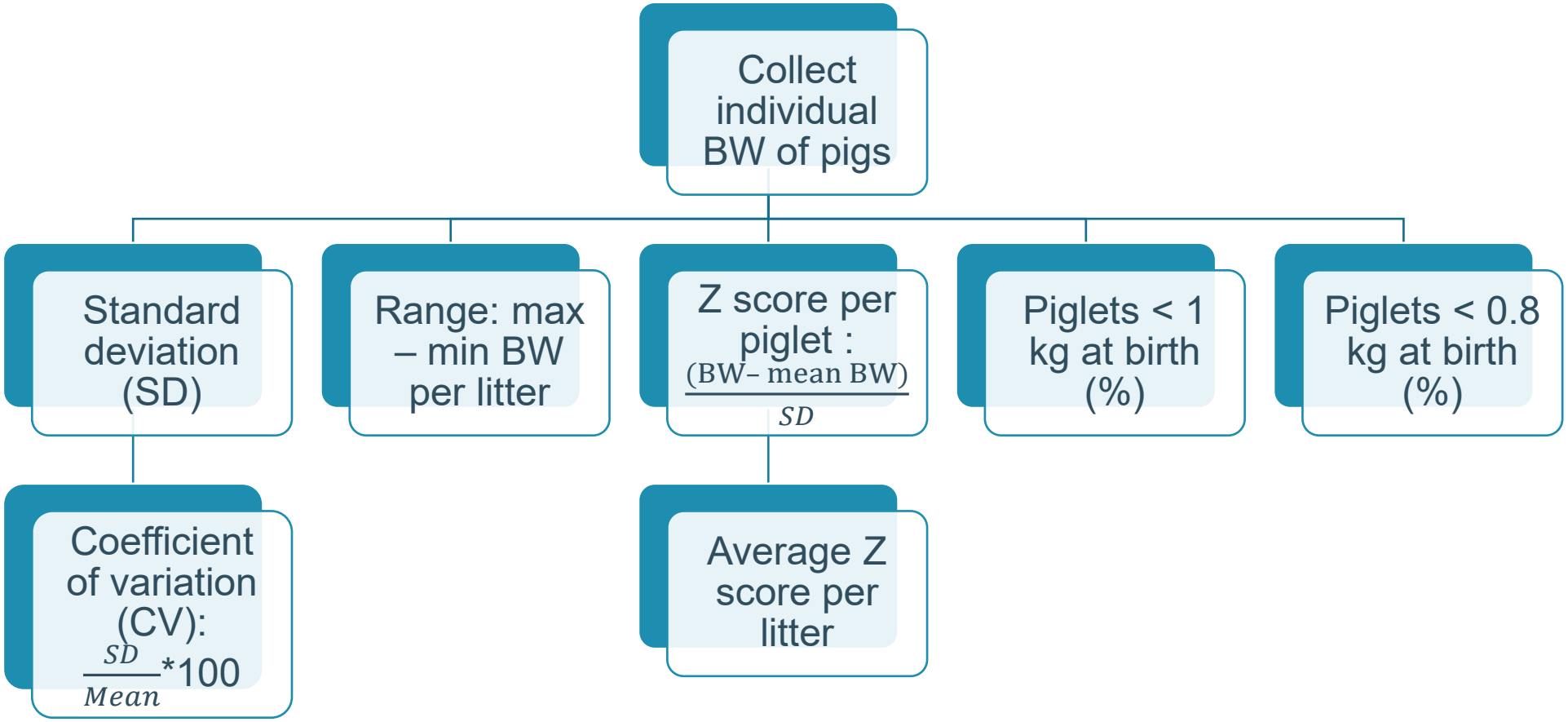
- Individual birth weights of liveborn piglets

Overview collected data

Trait	Total n	Average	SD	Min - Max
Number of piglets born per litter	12,646	17.3	3.9	3 - 27
Number of piglets born alive per litter	11,574	15.8	3.6	2 - 27
Birth weight (kg)	11,574	1.46	0.36	0.40 – 2.78
Coefficient of variation of BW (per litter, %)	732	20.2	6.1	4.4 – 38.7
Parity	732	4.3	2.5	1 - 13
Gestation length (d)	732	116.0	1.4	112 - 120
Lactation length (d)	732	26.5	1.7	20 - 32
Age at first insemination (d)	190	275.0	30.0	223 - 365
Percentage of males per litter (%)	5,975	51.4	13.1	0.0 – 100.0
Percentage of mummies per litter (%)	555	3.8	6.4	0.0 – 75.0
Percentage of stillborn piglets per litter (%)	1072	7.5	10.2	0.0 – 77.8
Average Z score per litter	732	0.07	0.61	-1.41 – 2.64
Within-litter range	732	1.0	0.29	0.14 – 1.74
Percentage of piglets < 0.8 kg per litter (%)	462	3.6	5.7	0.0 – 37.5
Percentage of piglets < 1 kg per litter (%)	1,241	9.8	10.4	0.0 – 55.6

1. Quantifying within-litter uniformity of birth weight: compare six common **metrics**

How is uniformity measured?



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1. Quantifying within-litter uniformity in birth weight:

Pearson correlations between metrics

	CV	SD	Average Z	Range	Piglets < 0.8 kg (%)
SD	0.88				
Average Z	-0.59	-0.18			
Range	0.81	0.91	-0.20		
Piglets < 0.8 kg (%)	0.68	0.43	-0.56	0.39	
Piglets < 1 kg (%)	0.70	0.38	-0.75	0.33	0.73

- Some degree of interchangeability among CV, SD and Range for assessing within-litter uniformity in birth weight.
- The piglets in litters with more variation in birth weight have BW below the population mean compared to more uniform litters.
- Evaluating within-litter uniformity at birth may be feasible by only calculating the percentage of lightweight pigs.

2. Research the **associations** between sow- and litter-related factors and the different uniformity measures

2. Associations between sow- and litter-related factors and within-litter uniformity

- Mixed-effect model per metric

  farm: fixed effect

  sow and boar: random effects

- Intraclass Correlation Coefficient of the sow and boar effects

$$= \frac{\text{variance of random sow or boar effect}}{\text{total variance}}$$

→ How much variance is explained by differences between individual sows or boars

2. Estimates of related factors and within-litter uniformity

	CV (%)	SD	Average Z	Range	Piglets < 0.8 kg (%)	Piglets < 1 kg (%)
Sow/litter factors	**Estimates**	**Estimates**	**Estimates**	**Estimates**	**Estimates**	**Estimates**
Parity 2	-0.99	0.02	0.54	0.08	-1.65	-5.13
Parity 3	-0.77	0.02	0.57	0.09	-1.89	-4.84
Parity 4	0.14	0.03	0.50	0.13	-1.80	-4.56
Parity 5	0.39	0.03	0.48	0.14	-1.37	-3.40
Parity 6 - 7	0.66	0.04	0.40	0.14	-2.22	-3.88
Parity > 7	1.53	0.04	0.31	0.14	-1.31	-2.41
NBA	0.84	0.01	-0.11	0.03	0.46	1.19
Percentage of mummies	0.07		-0.01			0.12
Percentage of stillborn	0.12	0.0007	-0.02	0.002	0.11	0.18
Age at first insemination		0.0002		0.0006		
Gestation length			0.04			
Farm 2	1.52	0.03	0.04	0.11	2.00	2.32
ICC sow	0.14	0.09	0.63	0.08	0.25	0.35
ICC boar	0.02	0.02	0.009	0.008	0.02	0.004
Marginal R^2	0.292	0.155	0.452	0.262	0.120	0.201
Conditional R^2	0.405	0.244	0.800	0.331	0.362	0.485

Conclusion

- CV, SD and Range show strong correlations
- More feasible method to estimate within-litter uniformity at birth: recording the number of lightweight piglets
- Individual sow traits play a crucial role in within-litter uniformity at birth

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ILVO

Flanders Research Institute for Agriculture, Fisheries and Food

Thank you for your attention

katrijn.hooyberghs@kuleuven.be

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