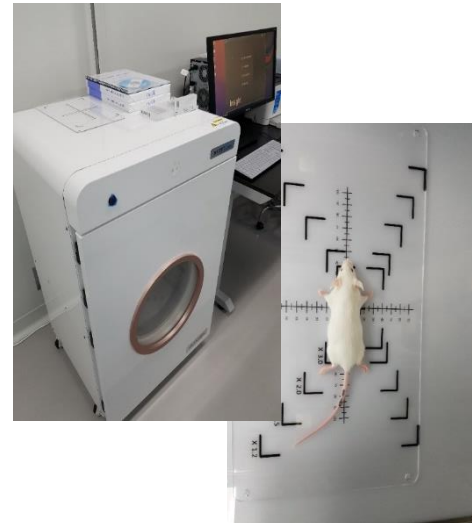


Comparison btw DXA(iNSiGHT VET DXA) and NMR(EchoMRI) in Mouse body Composition Analysis

OsteoSys 2020

Introduction

- Devices used for this study presented here are:
 - iNSiGHT VET DXA(DXA)
 - fat mass (FM), lean mass (LM), weight, bone mineral content (BMC), left femur BMC (lfBMC), femur BMC (fBMC), images
 - EchoMRI(NMR)
 - fat mass (FM), lean mass (LM), water

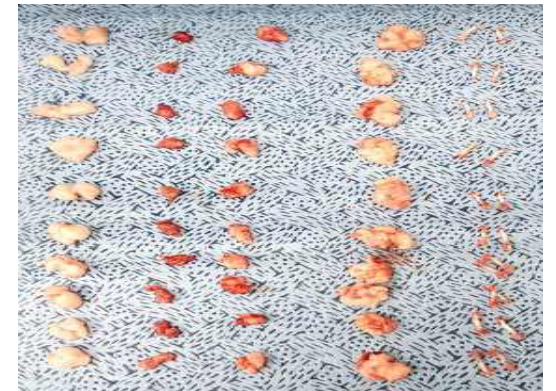


Introduction

- Animals:
 - 30 ICR mice. 29.36 ± 10.16 (16.40-44.00) g. 3 weight groups of low(g1: ~20g)/Middle(g2: 20~30g)/High(g3: 30~44g) for 10 mice each.
- Measuring Devices:
 - DXA -> iNSiGHT VET DXA
 - NMR -> EchoMRI
- Measuring Parameters for Accuracy and Precision:
 - DXA: fat mass (FM), lean mass (LM), weight, bone mineral content (BMC), left femur BMC (lfBMC), femur BMC (fBMC), images
 - NMR: fat mass (FM), lean mass (LM), water
 - Autopsy: weight, weight of major tissues (fat, bone)

- **Experiment** (measuring conditions)

- DXA:
 - Repositioning and Anesthesia (RA) n=3
 - Fixed position and Anesthesia (FA) n=4
 - Repositioning and Euthanasia (RE) n=3
 - Fixed position and Euthanasia (FE) n=4
- NMR:
 - Repositioning and Anesthesia (RA) n=3
 - Fixed position and Anesthesia (FA) n=3
- Autopsy: As References for Weight(whole body, fat mass, bone mass)
 - Done after DXA and NMR measurement



Organizations extracted through autopsy

kidney adipose tissue, epididymal adipose tissue, intestine adipose tissue, and subcutaneous fat and femur

Comparative Study Results

1. Precision: reproducibility [n=3] with Repositioning

- CV(fat mass): DXA < 5.05% @2.18±1.40g, NMR < 17% @3.47±1.74g
- CV(lean mass): DXA < 0.43% @26.13±9.17g, NMR < 3.91% @22.05±7.37g

★ CV=SD/Mean. By definition, lower the mean values, higher the CVs.

2. Accuracy (vs references assumed)

- R^2 (weight): DXA > 0.996 NMR: NA
- R^2 (fat mass): DXA > 0.959, NMR > 0.851
- R^2 (femur BMC): DXA > 0.954 NMR: NA

3. Other features

	Measuring time	Advantages	Limitations
DXA	24.7s (28s including analysis)	'follow-up' + 'fastest' + 'bone' + 'weight' + 'images'	'anesthesia' + '2D'
NMR	79.3s (31.0s excluding water)	'follow-up' + 'no anesthesia' + 'water'	'no bone' + 'no weight' + 'no image'
Autopsy	750.0s	'real value extraction' + 'various data'	'euthanasia' + 'ethics' + 'slowest'

[Precision Comparison]

CV values for repeated measurements of DXA and NMR

		DXA	NMR	DXA	NMR	DXA	NMR
ITEM	Group	RE(CV%)	RE(CV%)	RA(CV%)	RA(CV%)	MEAN±SD(g)	MEAN±SD(g)
FM	g1~g3	3.88±2.53	17.00±12.91	5.05±3.58	14.96±10.46	2.18±1.40	3.47±1.74
LM	g1~g3	0.38±0.18	3.91±2.39	0.43±0.25	2.75±1.70	26.13±9.17	22.05±7.37
weight	g1~g3	0.27±0.15	NA	0.41±0.34	NA	28.65±10.67	NA
water	g1~g3	NA	26.66±43.77	NA	13.65±29.73	NA	18.74±7.19
BMC	g1~g3	2.36±1.44	NA	2.90±1.85	NA	0.336±0.193	NA
lfBMC	g1~g3	6.38±3.73	NA	7.70±5.95	NA	0.012±0.009	NA

- Statistical values of the entire group are summarized based on body composition parameters that can be measured in each equipment (method).
- Overall, DXA has better precision than NMR.

[Precision Comparison]

CV values for repeated measurements of DXA and NMR by Group

		DXA	NMR	DXA	NMR	DXA	NMR
ITEM	Group	RE(CV%)	RE(CV%)	RA(CV%)	RA(CV%)	MEAN±SD(g)	MEAN±SD(g)
FM	g1	5.63±2.90	27.03±14.69	6.92±4.72	19.69±13.08	0.83±0.10	1.81±0.38
	g2	3.47±2.01	13.94±8.96	5.48±2.58	15.28±8.69	1.74±0.08	3.06±0.42
	g3	2.54±1.61	8.29±4.29	3.17±2.58	10.85±9.01	3.96±0.73	5.55±1.17
LM	g1	0.36±0.21	6.11±2.17	0.44±0.32	2.75±1.93	15.03±0.62	12.89±0.46
	g2	0.41±0.17	2.51±1.49	0.42±0.25	2.84±1.68	26.38±0.91	22.80±0.99
	g3	0.38±0.15	2.91±1.49	0.44±0.21	2.66±1.70	37.00±1.29	30.44±1.31
BMC	g1	3.51±1.56	NA	3.31±1.46	NA	0.343±0.192	NA
	g2	1.70±1.08	NA	3.00±1.96	NA	0.351±0.192	NA
	g3	1.86±0.89	NA	2.47±2.11	NA	0.359±0.190	NA

- Statistical values of each group are summarized for important body composition parameters.
- Overall, in the FM and BMC, the larger the MEAN value, the better the precision.

[Accuracy Comparison]

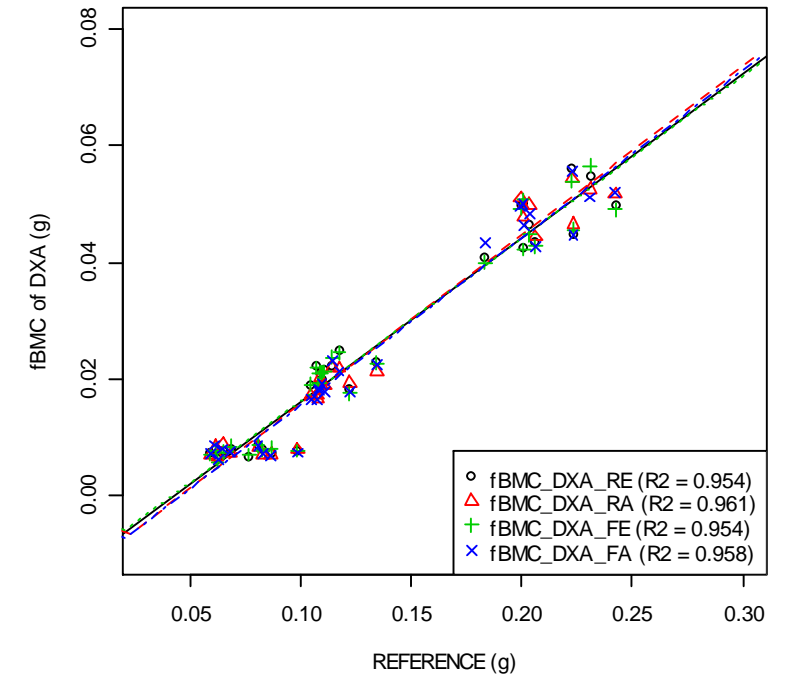
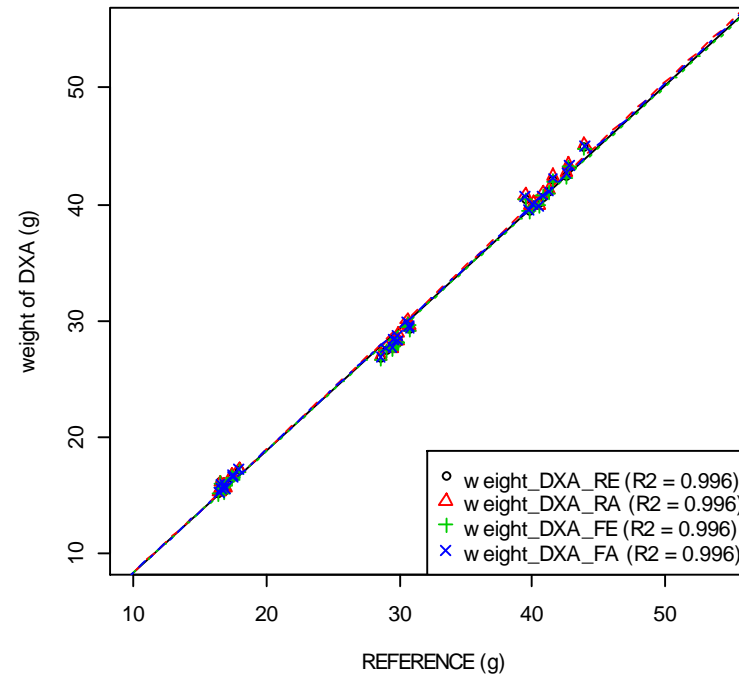
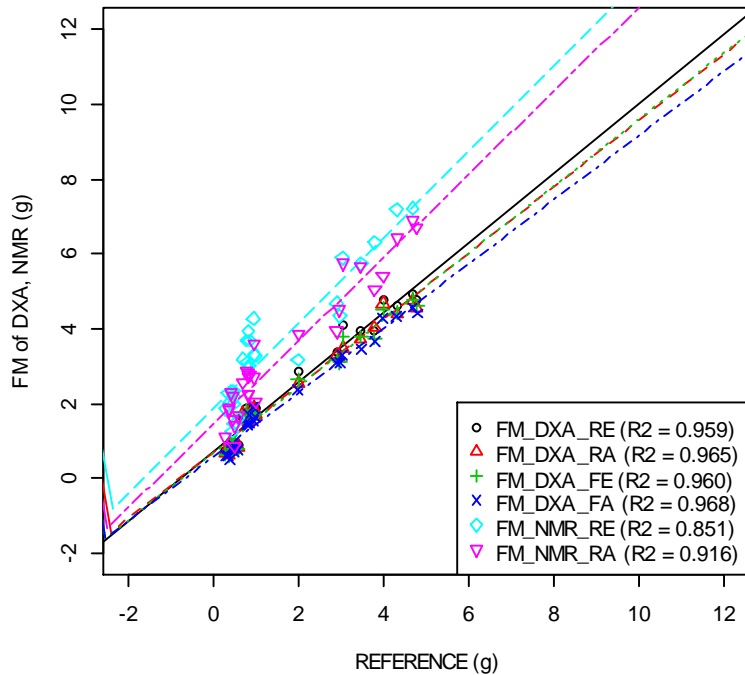
Mean Signed Difference(MSD) of DXA and NMR & Correlation with reference value

ITEM	Group	DXA RE g (R^2)	NMR RE g (R^2)	DXA RA g (R^2)	NMR RA g (R^2)	Electronics Scale REFERENCE MEAN \pm SD (g)
FM	g1~g3	0.61 (0.959)	2.08 (0.851)	0.49 (0.965)	1.63 (0.916)*	1.63 \pm 1.51
weight	g1~g3	-0.80 (0.996)	NA	-0.60 (0.996)	NA	29.36 \pm 10.16
fBMC	g1~g3	-0.108 (0.954)*	NA	-0.108 (0.961)*	NA	0.133 \pm 0.060 (a)

- For FM, the reference is the weight of some tissue representing the whole. However, the correlation value is high, and it seems that the differences between individuals can be accurately estimated.
- For weight, the measurement time of the reference was not the same as that of each instrument. However, like FM, it showed high correlation.
- For fBMC, MSD tends to be large because the reference is the wet weight of the bone, but 23-37% under-estimation compared to the ash weight of the femur estimated based on other studies. And it showed high correlation.

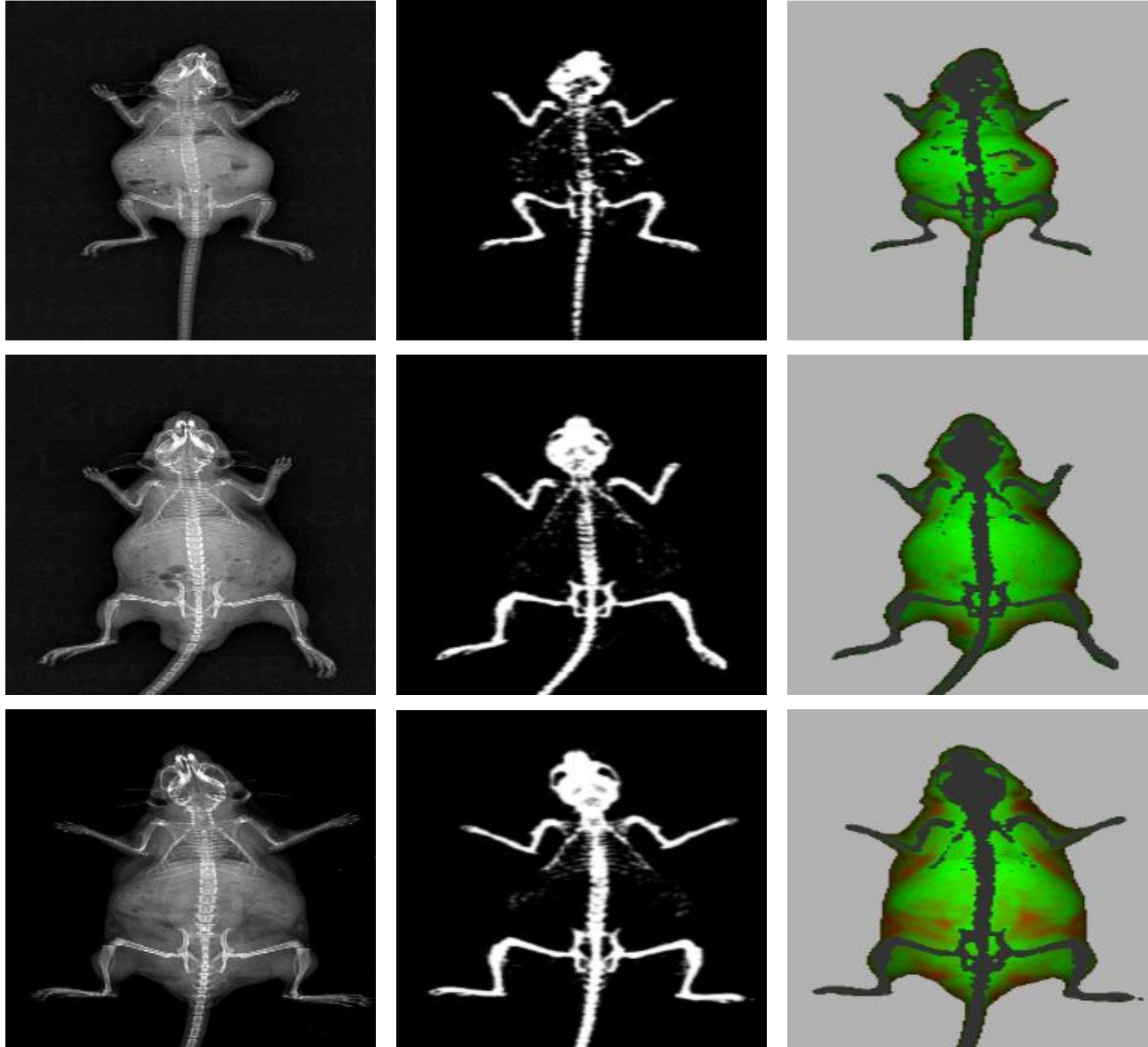
[Accuracy Comparison]

Scatter graph of FM, weight, and fBMC values of DXA or NMR and reference values.



R^2 values calculated through the 1st trend line are indicated in parentheses of Legend for each item together

Through these graphs, it is possible to check the distribution of values of the entire group and the trend difference by measurement conditions.



Measurement images by DXA.

From left to right: X-ray image, bone enhanced (BMD) image, and color composition (color)

From top to bottom: sample image from the low-weight, middle-weight, and high-weight groups.

The DXA used in this study provides various processing images, including high-resolution X-ray images.

iNSiGHT



InAlyz**



Image Quality Comparison
iNSiGHT (OsteoSys) vs.
InAlyz** (Medico***)

iNSiGHT: DR+DXA
InAlyz** : DXA

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