Volumetric fetal brain pilot study in twins with severe discordancy using semiautomatic 3D MR imaging measurements

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Fetal brain MRI

- PubMed search of ‘fetal MRI’ yields 6,346 references (Dec 2017), of which 2,667 include 'fetal brain MRI’.
- Indications for fetal brain MRI:
  - History of sever brain abnormality in previous pregnancy but normal US scan.
  - An isolated abnormality found on US scan.
  - Abnormality on US, but scan can’t be complete due to technical difficulties.
  - High risk of development of brain abnormality, especially in cases of fetal infection.
- Timing:
  - Beginning of third trimester (28-32 weeks) is preferred.

3D volumetric assessment of the fetal brain

Eur Radiol. 2017 May;27(5):2110-2118. doi: 10.1007/s00330-016-4502-4. Epub 2016 Aug 4.

Volumetric MRI study of the intrauterine growth restriction fetal brain.

Polat A[1], Barlow S[2], Ber R[2], Achiron R[2], Katorza E[2].

- Evaluation of regional brain volumes differences in IUGR.
- Cerebellar to supratentorial brain volume ratios were smaller in IUGR fetuses.
- What is the long term effect?

AJNR Am J Neuroradiol. 2017 Nov;38(11):2193-2198. doi: 10.3174/ajnr.A5349. Epub 2017 Aug 24.

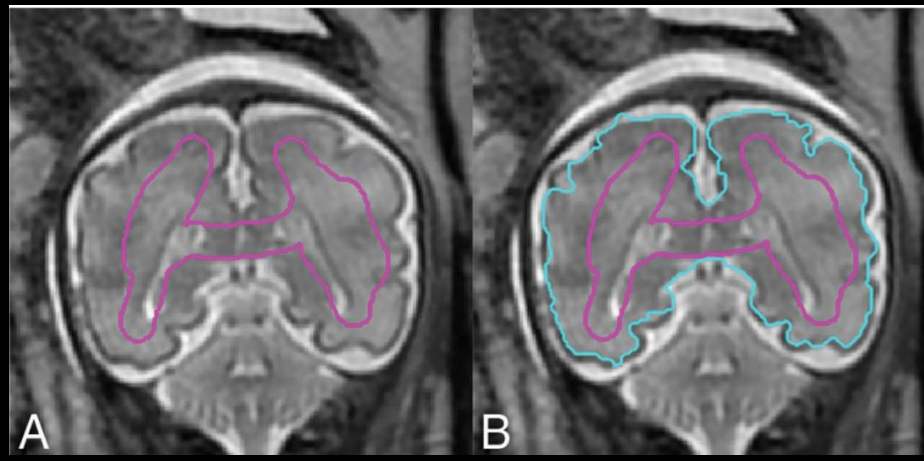
Volume of Structures in the Fetal Brain Measured with a New Semiautomated Method.

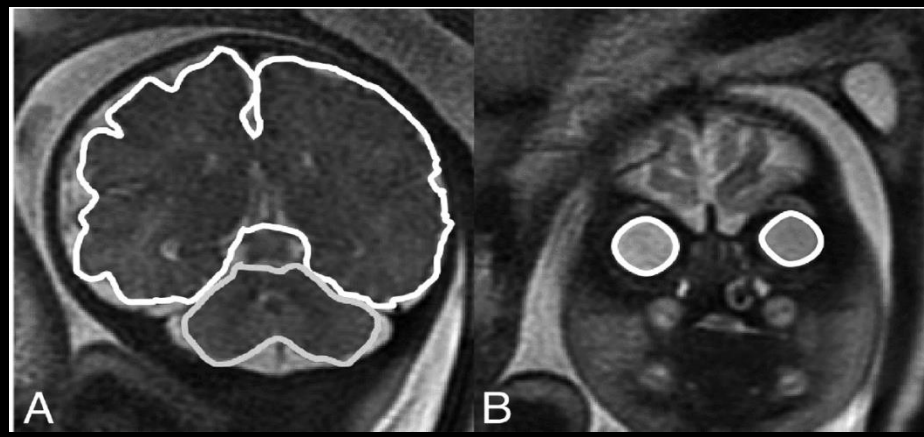
Ber R[1], Hoffman D[2], Hoffman C[3,4], Polat A[2], Derazne E[4], Mayer A[3], Katorza E[2].

- Good to excellent interobserver agreement.
- Semiautomated results are not inferior to manual technic and are less time consuming and user dependent.
- MRI semiautomated brain volume growth curves

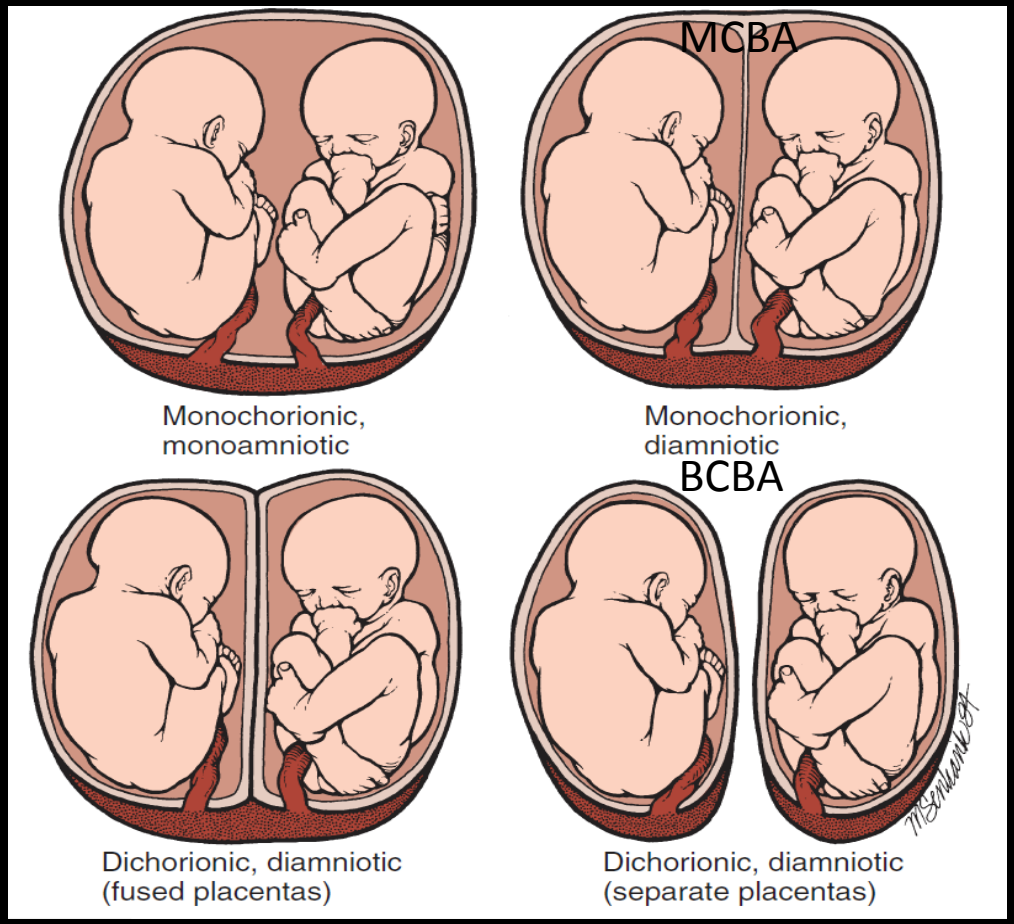
Semiautomated measurement

- Retrospective coronal section measurements of the following volumes will be obtained:
  - Supratentorial brain
  - Left and right hemispheres
  - Cerebellum
  - Left and right eyeballs





Twins BABC MCBA



Discordancy/sIUGR

- **Discordance** – when anomaly is detected in a twin gestation the co-twin is usually normal.
  - In growth, this is defined by difference in weight grater than 20% of actual or estimated weight.
- **sIUGR** – estimated fetal weight < 10^{th} percentile of one twin with adequate for gestational age co-twin.
- 10 – 15% of MCBA twins but also present in BCBA pregnancies.

Research questions

Is there a difference:

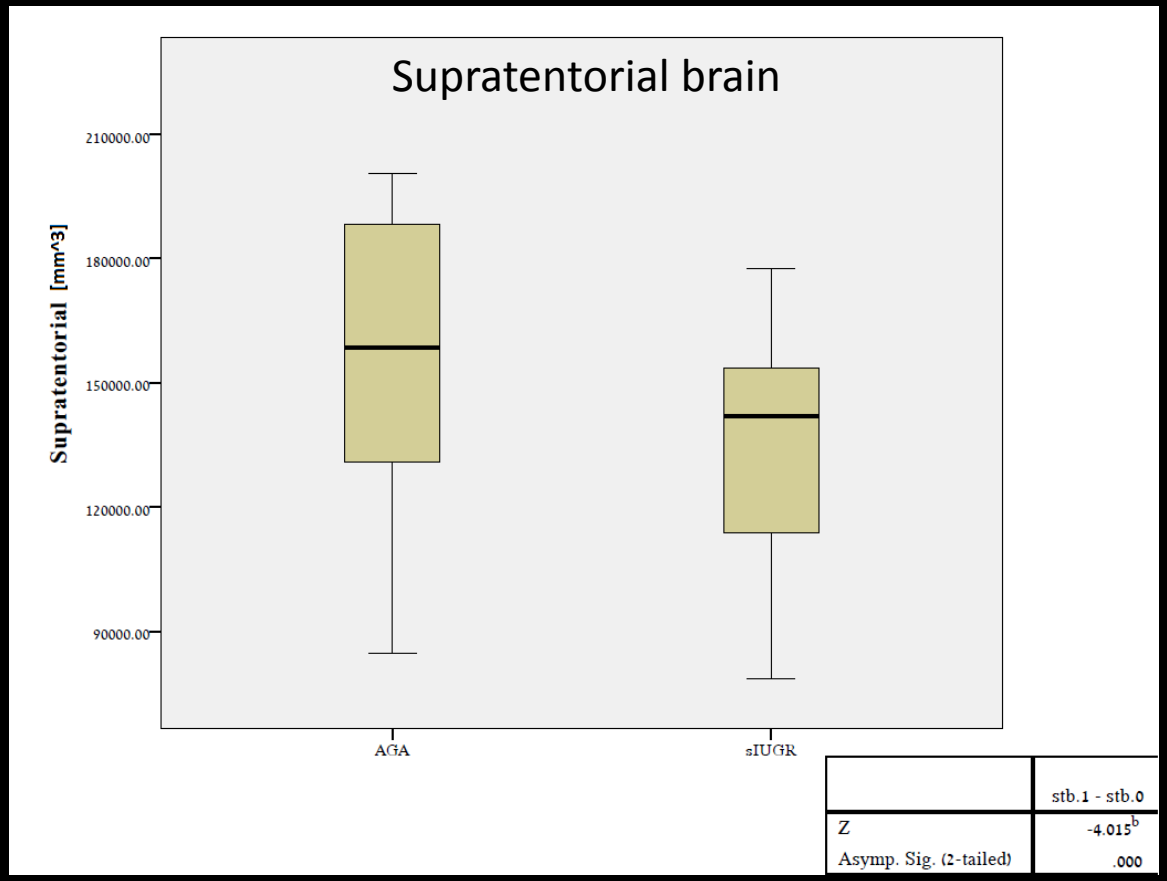
- In brain volumes between the twins with severe discordancy/sIUGR that are measured by MRI?
- In brain volumes comparing to the whole body weight discordancy?
- In the outcome which correlate to above?
- In the discordancy patterns between BCBA to MCBA twins?

Materials and methods

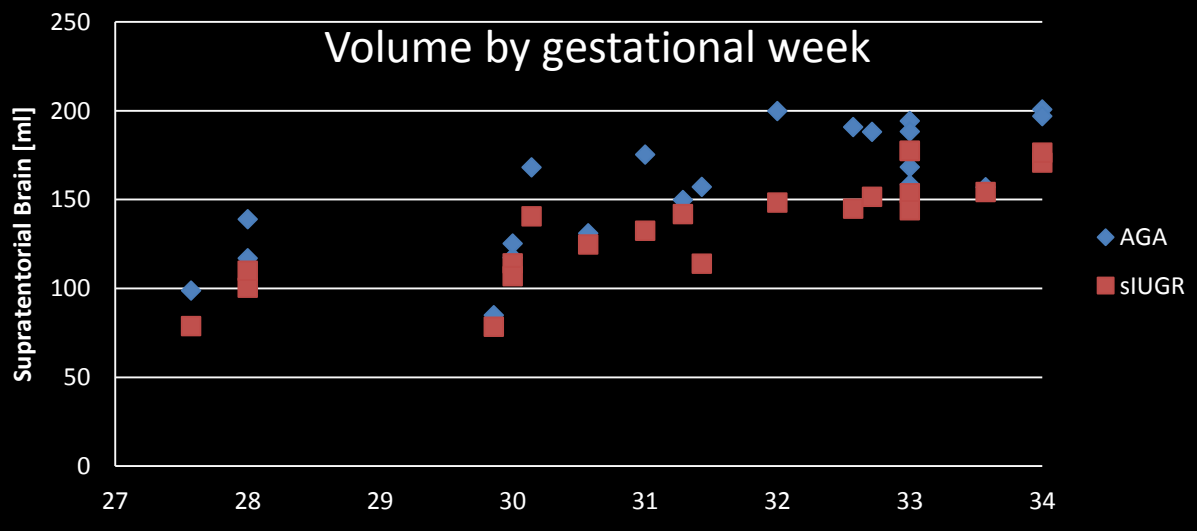
- **Data collection of 18 pairs of MCBA and 15 pairs of BCBA.**
  - MRI scans
  - Antenatal complications
  - Mode of delivery
  - Birth weight
  - Dolberg percentile
  - Appgar score
- **Assessment of brain volumes**
  - Analysis by Matlab-based semiautomated software.
- **Performing Vineland's questioners.**

Results

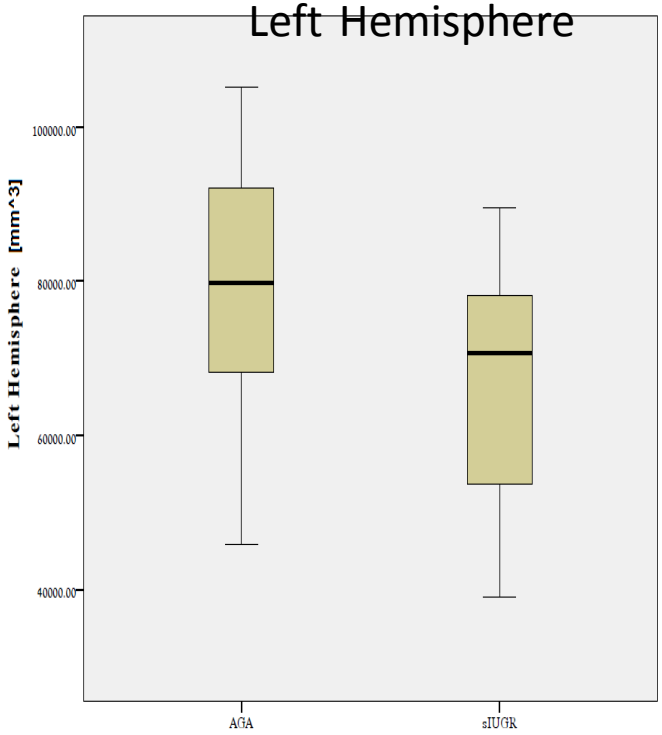
Fetal brain volume of 14 BCBA and 7 MCBA twins analyzed by MRI semiautomated measurements.



	stb.1 - stb.0
Z	-4.015[b]
Asymp. Sig. (2-tailed)	.000

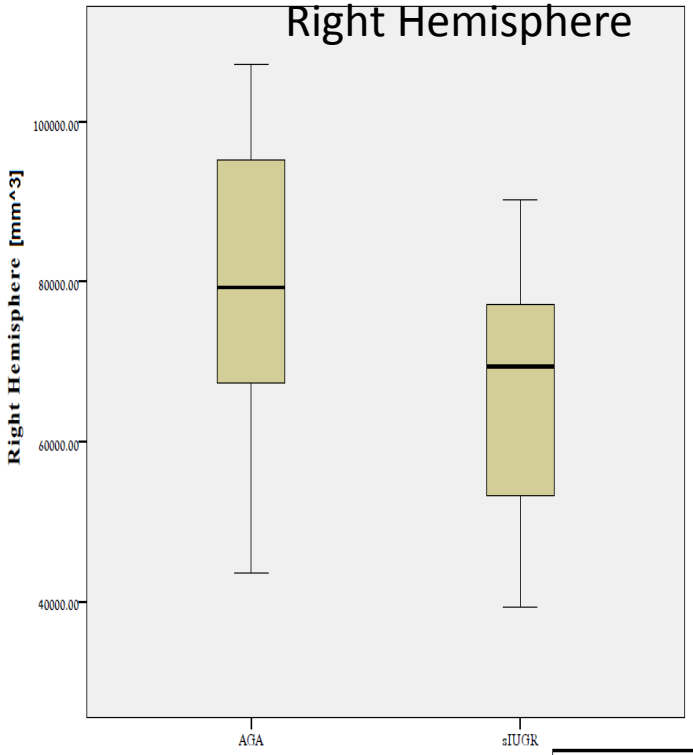


Left Hemisphere



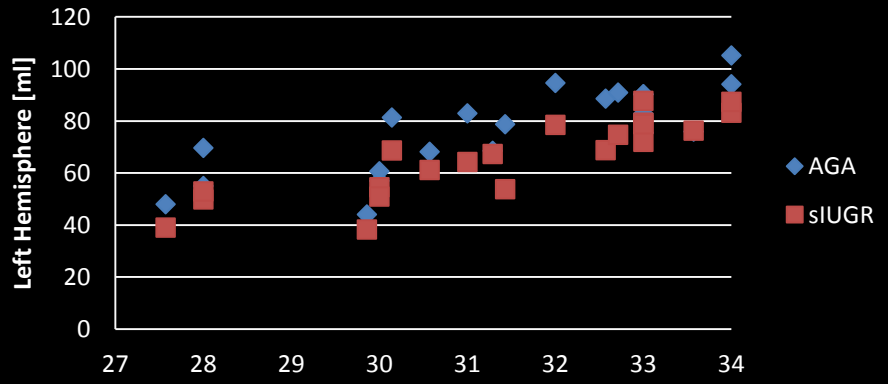
	lt_hemi.1 - lt_hemi.0
Z	-3.980[b]
Asymp. Sig. (2-tailed)	.000

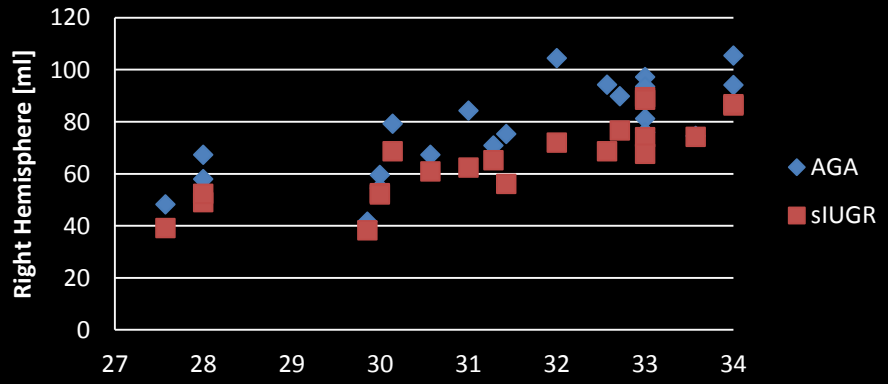
Right Hemisphere

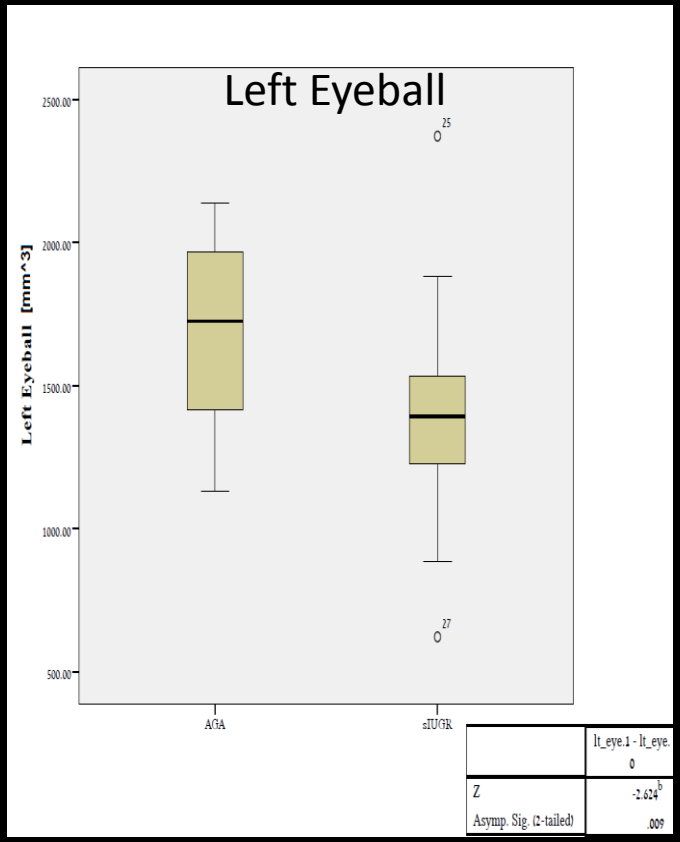


	rt_hemi.1 - rt_hemi.0
Z	-4.015[b]
Asymp. Sig. (2-tailed)	.000

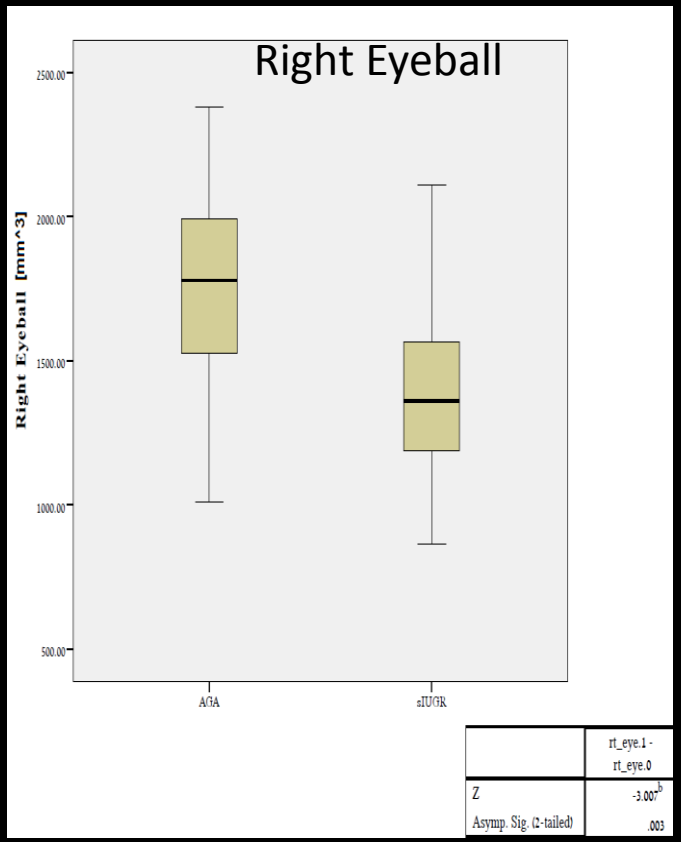
Volume by gestational week





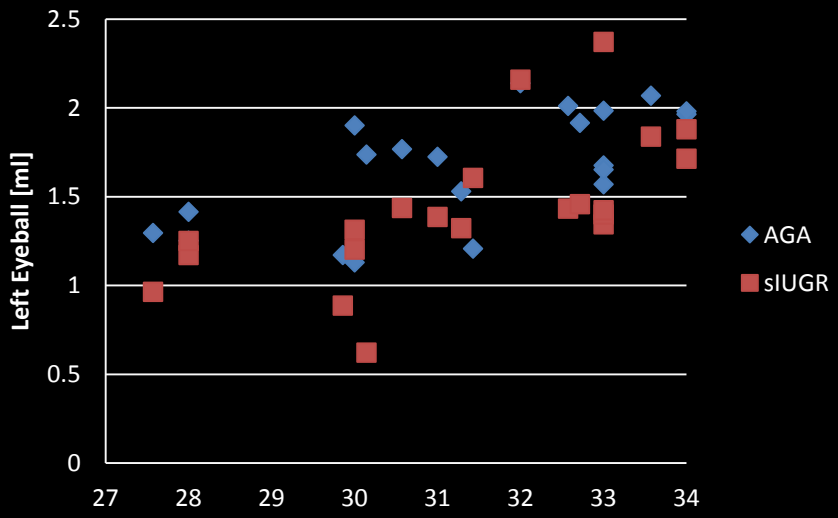


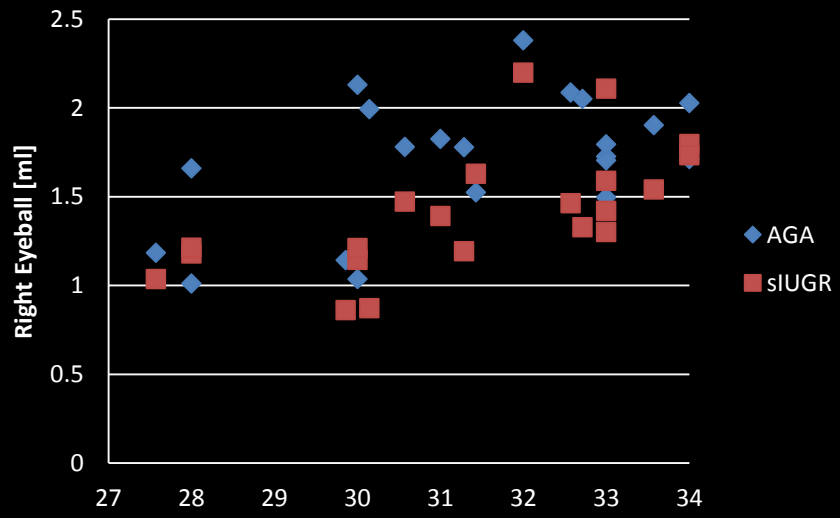
	lt_eye.1 - lt_eye.0
Z	-2.624[b]
Asymp. Sig. (2-tailed)	.009

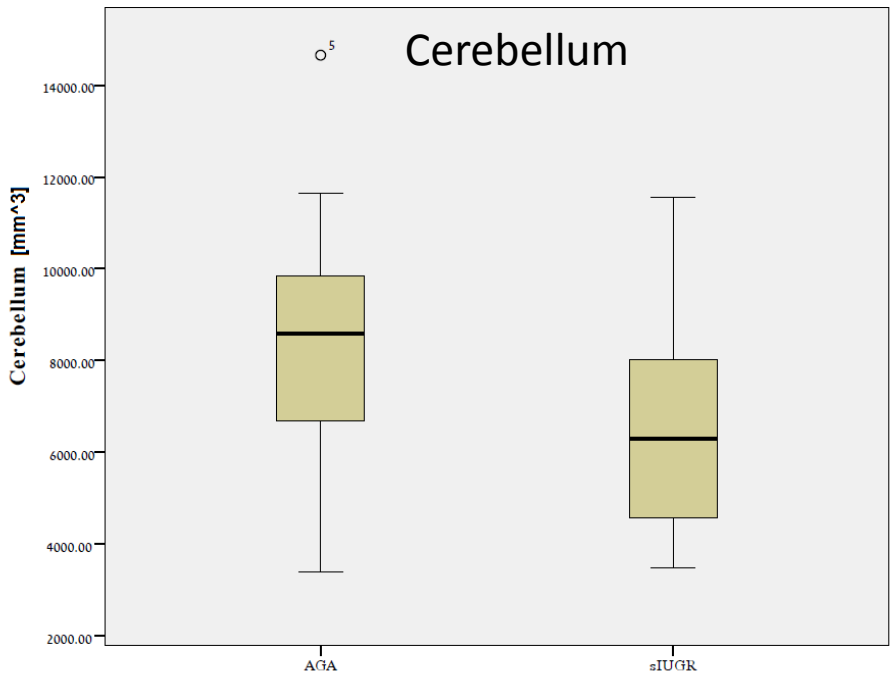


	rt_eye.1 - rt_eye.0
Z	-3.007[b]
Asymp. Sig. (2-tailed)	.003

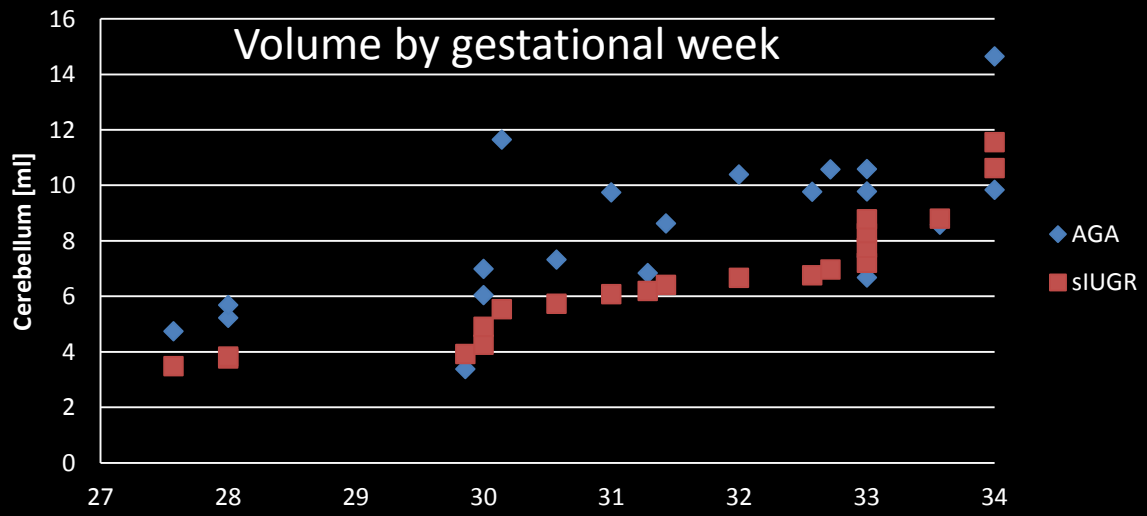
Volume by gestational week







	cerebellum.1 - cerebellum.0
Z	-3.215[b]
Asymp. Sig. (2-tailed)	.001



Neurodevelopment

- Follow up will be done using VINELAND questioners.
- The Vineland-3 is a standardized measure of adaptive behavior.
- Focuses on what the examinee's actually does in daily life.
- Adaptive functioning is compared to that of others his or her age.
- ABC score is based on scores for three specific adaptive behavior domains:
  - Communication
  - Daily Living Skills
  - Socialization

Conclusions

- Brain volumes between AGA to sIUGR's twins is significantly different.
- Further evaluation:
  - Brain structures volume to corrected normal growth curve.
  - Brain to body weight ratio is needed.

References

- Salomon, L.J. & Garel, C., 2007. Magnetic resonance imaging examination of the fetal brain. *Ultrasound in Obstetrics and Gynecology*, 30(7), pp.1019–1032.
- Gabbe, S., 2016. *Obstetrics : normal and problem pregnancies* 7th ed., Elsevier.
- Ber, R. et al., 2017. Volume of Structures in the Fetal Brain Measured with a New Semiautomated Method. *American Journal of Neuroradiology*, 38(11), pp.2193–2198.
- Polat, A. et al., 2017. Volumetric MRI study of the intrauterine growth restriction fetal brain. *European radiology*, 27(5), pp.2110–2118.

Questions?