Supplementary Table 1: Indications for fetal MRI

Referral Reason (Confirmation/Clarification of)	Number of Fetuses[a]	
	Included	**Excluded**
Abdominal cystic lesion	*n*=3	*n*=0
Abdominal tumor	*n*=0	*n*=2
Cleft palate	*n*=1	*n*=1
CNS anomaly	*n*=3	*n*=19
Congenital heart defect	*n*=2	*n*=6
Duodenal stenosis	*n*=0	*n*=1
Gallbladder agenesis	*n*=0	*n*=1
Genetic disorder	*n*=0	*n*=1
IUGR	*n*=2	*n*=0
Lung pathology	*n*=0	*n*=3
Oligohydramnios	*n*=1	*n*=0
Ovarian cyst	*n*=0	*n*=1
Renal pathology	*n*=3	*n*=2
Thyroid goiter	*n*=0	*n*=2
TTTS[b]	*n*=0	*n*=1
Vertebral anomaly	*n*=0	*n*=2
GA at MRI[c]	27+5, *SD*=3+1; *R*=23+6–34+0	28+3, *SD*=4+4; *R*=21+4–37+7

[a] Fetuses could be represented in multiple rows (more than one referral reason)

[b] MRI following laser surgery for twin-to-twin transfusion syndrome

[c] Data represented as mean, standard deviation (*SD*), and range (*R*)

CNS: Central nervous system

GA: Gestational age

IUGR: Intrauterine growth restriction

MRI: Magnetic resonance imaging

TTTS: Twin-to-twin transfusion syndrome

Supplementary Table 2: Fetal MRI protocol

Sequence	Plane	FOV[a]	Voxel Size[a]	Slice Thickness[a]	Matrix (slices)	TR[b]	TE[b]	AT
T1 FFE	Cor.	327x327x82	1.56x1.96	5	208x168x15	131	4.6	00:15
T2 SSH-TSE	Ax.	230x230x83	0.9x1.37	4	256x168x19	10915	140	00:22
T2 SSH-TSE	Cor.	230x230x83	0.9x1.37	4	256x168x19	10915	140	00:22
T2 SSH-TSE	Sag.	230x230x83	0.9x1.37	4	256x168x19	10915	140	00:22
Snap-shot IR	Cor.	260x260x79	1.35x1.93	4	192x135x18	10000	4.4	00:30
FLAIR	Ax.	230x230x69	2.05x2.56	4	112x90x14	10000	90	00:20
FLAIR	Cor.	230x230x69	2.05x2.56	4	112x90x14	10000	90	00:20
EPI	Ax.	250x250x66	2x2	3	124x125x22	1000	54	00:16
DWI	Ax.	290x290x82	2.27x2.66	5	128x109x16	1501	127	00:18
MDME	Ax.	220x220x75	1.4x1.57	5	156x132x15	2226	13	03:20

[a] mm

[b] ms

AT: Acquisition time

DWI: Diffusion-weighted imaging

EPI: Echo planar imaging

FFE: Fast field echo

FLAIR: Fluid attenuated inversion recovery

FOV: Field-of-view

IR: Inversion recovery

MDME: Multi-dynamic multi-echo

SSH-TSE: Single-shot turbo spin echo

TE: Echo time

TR: Repetition time

Supplementary Table 3: Criteria for the assessment of fetal brain maturity

Score[a]	Appearance of Frontal and Occipital Cortex[b]	Appearance of Insular Cortex[b]	Presence of Germinal Matrix	Identifiability of Primary Sulci[c]	Myelination[d]					
					T1-weighted	T2-weighted	T1R-map[e]	T2R-map[f]	R1-map[g]	R2-map[h]
0			Present	No presence of primary sulci	Isointense to DWM/CSF	Isointense to DWM/CSF	Color-coding according to T1R>2000	Color-coding according to T2R>200	Color-coding according to R1<0.268	Color-coding according to R2<2.680
1	Completely smooth[b]	Completely smooth[b]	Not present	Identification of one or two primary sulci	Slightly hyperintense to DWM/CSF	Slightly hypointense to DWM/CSF	Color-coding according to T1R 1650–2000	Color-coding according to T2R 165–200	Color-coding according to R1 0.268–0.537	Color-coding according to R2 2.680–5.370
2	Smooth, some occipital sulci evident[b]	Shallow sulci[b]		Identification of three or four primary sulci	Hyperintense to DWM/CSF	Hypointense to DWM/CSF	Color-coding according to T1R 1300–1650	Color-coding according to T2R 130–165	Color-coding according to R1 0.537–0.806	Color-coding according to R2 5.370–8.060
3	Similar number of sulci frontal and occipital[b]	Deep/multiple sulci[b]		Identification of five or more primary sulci	Clearly hyperintense to DWM/CSF	Clearly hypointense to DWM/CSF	Color-coding according to T1R 950–1300	Color-coding according to T2R 95–130	Color-coding according to R1 0.806–1.075	Color-coding according to R2 8.060–10.75
4	Richness of sulci frontal and occipital[b]				Considerably hyperintense to DWM/CSF	Considerably hypointense to DWM/CSF	Color-coding according to T1R<950	Color-coding according to T2R<95	Color-coding according to R1>1.075	Color-coding according to R2>10.75

[a] Points allocated per criteria (final result of fetal brain maturity score by totaling of allocated points)

[b] According to Vossough et al.[23]

[c] Primary sulci reliably detectable on axial MR image data: parieto-occipital sulcus; calcarine sulcus; central sulcus; precentral sulcus; postcentral sulcus; superior temporal sulcus; superior frontal sulcus; inferior frontal sulcus[24]

[d] Assessment of medulla oblongata, midbrain and inferior colliculus, thalamus, posterior limb of the internal capsule (PLIC), and central region (on the basis of descriptions by Schmidbauer et al.[15])

[e] Quantitative map based on T1-relaxation time (ms) – color-coding as demonstrated in Figure 2

[f] Quantitative map based on T2-relaxation time (ms) – color-coding as demonstrated in Figure 2

[g] Quantitative map based on T1-relaxation rate (s^{-1}) – color-coding as demonstrated in Figure 2

[h] Quantitative map based on T2-relaxation rate (s^{-1}) – color-coding as demonstrated in Figure 2

CSF: Cerebrospinal fluid

DWM: Deep white matter (frontal/parieto-occipital regions)

R1: T1-relaxation rate

R2: T2-relaxation rate

T1R: T1-relaxation time

T2R: T2-relaxation time

Supplementary Table 4: Inter-rater reliability (quantitative measurements)

	Medulla Oblongata	Midbrain
	ICC	ICC
T1R	0.891 (CI: 0.644–0.968)	0.979 (CI: 0.932–0.994)
R1	0.963 (CI: 0.882–0.989)	0.980 (CI: 0.919–0.994)
T2R	0.907 (CI: 0.647–0.974)	0.989 (CI: 0.962–0.997)
R2	0.879 (CI: 0.643–0.963)	0.984 (CI: 0.947–0.995)
PD	0.984 (CI: 0.949–0.995)	0.978 (CI: 0.929–0.994)
SI	0.945 (CI: 0.814–0.984)	0.969 (CI: 0.892–0.991)

CI: Confidence interval

ICC: Intra-class correlation coefficient

PD: Proton density

R1: T1-relaxation rate

R2: T2-relaxation rate

SI: Signal intensity

T1R: T1-relaxation time

T2R: T2-relaxation time

Supplementary Table 5: Qualitative assessment of fetal brain maturation

n=12	Rater	Appearance of Frontal and Occipital Cortex[a, b]	Appearance of Insular Cortex[a, b]	Presence of Germinal Matrix[a]	Identifiability of Primary Sulci[a]	Myelination[c]						Total Score[f]
						Medulla Oblongata[a]	Midbrain[a]	Inferior Colliculus[a]	Thalamus[a]	PLIC[a]	Central Region[a]	
1	1	1(4)[d]; 1(4)[e]	1(4)[d]; 1(4)[e]	0(4)[d]; 0(4)[e]	0(4)[d]; 0(3)[e]	2(3)[d]; 1(4)[e]	1(3)[d]; 1(3)[e]	1(3)[d]; 1(1)[e]	0(3)[d]; 0(3)[e]	0(3)[d]; 0(3)[e]	0(3)[d]; 0(3)[e]	6(34)[d]; 5(32)[e]
	2	1(4)[d]; 1(3)[e]	2(4)[d]; 2(3)[e]	0(4)[d]; 0(4)[e]	1(4)[d]; 1(3)[e]	4(4)[d]; 1(4)[e]	2(4)[d]; 1(1)[e]	2(4)[d]; 1(2)[e]	0(4)[d]; 0(2)[e]	0(4)[d]; 0(4)[e]	0(4)[d]; 0(4)[e]	12(40)[d]; 7(30)[e]
2	1	1(4)[d]; 1(4)[e]	1(4)[d]; 1(4)[e]	0(4)[d]; 0(4)[e]	1(4)[d]; 1(1)[e]	2(3)[d]; 2(4)[e]	0(3)[d]; 0(4)[e]	1(3)[d]; 1(3)[e]	0(3)[d]; 1(3)[e]	1(3)[d]; 0(3)[e]	0(3)[d]; 0(2)[e]	7(34)[d]; 7(32)[e]
	2	1(4)[d]; 1(4)[e]	2(4)[d]; 2(4)[e]	0(4)[d]; 0(4)[e]	1(4)[d]; 1(4)[e]	4(3)[d]; 3(4)[e]	3(4)[d]; 2(2)[e]	3(3)[d]; 2(2)[e]	0(3)[d]; 1(3)[e]	0(3)[d]; 0(3)[e]	2(3)[d]; 0(4)[e]	16(35)[d]; 12(34)[e]
3	1	2(4)[d]; 2(4)[e]	1(4)[d]; 2(4)[e]	0(4)[d]; 0(4)[e]	1(3)[d]; 1(3)[e]	1(3)[d]; 2(4)[e]	1(3)[d]; 1(3)[e]	2(3)[d]; 2(3)[e]	1(3)[d]; 0(2)[e]	0(3)[d]; 0(2)[e]	0(3)[d]; 0(3)[e]	9(33)[d]; 10(32)[e]
	2	1(4)[d]; 1(3)[e]	2(4)[d]; 2(4)[e]	0(4)[d]; 0(4)[e]	1(2)[d]; 1(3)[e]	4(3)[d]; 4(3)[e]	2(3)[d]; 3(4)[e]	3(3)[d]; 4(4)[e]	0(3)[d]; 2(2)[e]	0(3)[d]; 0(3)[e]	0(4)[d]; 0(4)[e]	13(33)[d]; 17(34)[e]
4	1	3(4)[d]; 3(3)[e]	1(4)[d]; 1(3)[e]	0(4)[d]; 0(4)[e]	2(4)[d]; 2(2)[e]	2(3)[d]; 2(4)[e]	2(3)[d]; 1(4)[e]	2(3)[d]; 1(4)[e]	1(3)[d]; 1(4)[e]	0(3)[d]; 0(3)[e]	0(3)[d]; 1(2)[e]	13(34)[d]; 12(33)[e]
	2	2(3)[d]; 2(2)[e]	2(4)[d]; 2(3)[e]	0(4)[d]; 0(4)[e]	2(2)[d]; 1(2)[e]	4(4)[d]; 3(4)[e]	3(4)[d]; 3(2)[e]	4(3)[d]; 3(2)[e]	1(2)[d]; 0(4)[e]	0(3)[d]; 0(4)[e]	1(2)[d]; 0(4)[e]	19(31)[d]; 14(31)[e]
5	1	2(4)[d]; 2(3)[e]	1(4)[d]; 1(4)[e]	0(4)[d]; 0(4)[e]	1(4)[d]; 1(3)[e]	2(3)[d]; 2(4)[e]	1(3)[d]; 1(4)[e]	1(3)[d]; 2(4)[e]	1(3)[d]; 0(4)[e]	1(3)[d]; 0(4)[e]	0(3)[d]; 0(4)[e]	10(34)[d]; 9(38)[e]
	2	2(3)[d]; 2(3)[e]	2(3)[d]; 2(3)[e]	0(4)[d]; 0(4)[e]	1(4)[d]; 1(3)[e]	4(4)[d]; 3(3)[e]	3(4)[d]; 2(3)[e]	4(3)[d]; 2(3)[e]	0(3)[d]; 0(4)[e]	0(3)[d]; 0(4)[e]	1(3)[d]; 0(4)[e]	17(34)[d]; 12(34)[e]
6	1	1(4)[d]; 1(2)[e]	1(4)[d]; 1(2)[e]	0(4)[d]; 0(2)[e]	1(4)[d]; 1(1)[e]	1(3)[d]; 1(2)[e]	1(3)[d]; 1(2)[e]	1(3)[d]; 1(2)[e]	1(3)[d]; 1(2)[e]	1(3)[d]; 1(2)[e]	0(3)[d]; 0(2)[e]	8(34)[d]; 8(19)[e]
	2	1(4)[d]; 2(2)[e]	1(4)[d]; 2(2)[e]	0(4)[d]; 0(4)[e]	1(4)[d]; 0(1)[e]	4(3)[d]; 2(2)[e]	3(3)[d]; 1(1)[e]	4(3)[d]; 1(1)[e]	0(3)[d]; 0(1)[e]	0(3)[d]; 0(1)[e]	0(1)[d]; 0(1)[e]	14(32)[d]; 8(16)[e]
7	1	2(4)[d]; 2(3)[e]	1(4)[d]; 1(3)[e]	0(4)[d]; 0(4)[e]	2(4)[d]; 1(4)[e]	2(3)[d]; 2(4)[e]	1(3)[d]; 1(4)[e]	1(3)[d]; 1(4)[e]	1(3)[d]; 1(4)[e]	0(3)[d]; 1(4)[e]	0(3)[d]; 0(4)[e]	10(34)[d]; 10(38)[e]
	2	2(4)[d]; 1(3)[e]	2(4)[d]; 1(4)[e]	0(4)[d]; 0(4)[e]	2(4)[d]; 1(2)[e]	4(4)[d]; 2(2)[e]	3(4)[d]; 2(3)[e]	3(3)[d]; 2(3)[e]	1(2)[d]; 0(4)[e]	0(3)[d]; 0(4)[e]	2(2)[d]; 0(4)[e]	19(34)[d]; 9(33)[e]
8	1	3(4)[d]; 4(3)[e]	2(4)[d]; 3(3)[e]	1(4)[d]; 0(3)[e]	3(4)[d]; 2(3)[e]	2(3)[d]; 2(4)[e]	1(3)[d]; 1(4)[e]	1(3)[d]; 2(4)[e]	1(3)[d]; 1(4)[e]	0(3)[d]; 0(4)[e]	0(3)[d]; 1(4)[e]	14(34)[d]; 16(36)[e]
	2	3(4)[d]; 2(3)[e]	3(4)[d]; 3(4)[e]	0(4)[d]; 0(3)[e]	1(4)[d]; 3(4)[e]	4(4)[d]; 3(3)[e]	3(4)[d]; 3(3)[e]	4(4)[d]; 3(3)[e]	2(3)[d]; 1(3)[e]	0(4)[d]; 0(3)[e]	3(3)[d]; 1(2)[e]	23(38)[d]; 19(31)[e]
9	1	3(4)[d]; 2(3)[e]	1(4)[d]; 2(3)[e]	1(4)[d]; 1(2)[e]	2(4)[d]; 2(3)[e]	3(3)[d]; 2(3)[e]	2(3)[d]; 1(3)[e]	3(3)[d]; 2(3)[e]	2(3)[d]; 0(3)[e]	1(3)[d]; 0(3)[e]	1(3)[d]; 0(3)[e]	19(34)[d]; 12(29)[e]
	2	2(4)[d]; 3(2)[e]	2(4)[d]; 2(4)[e]	1(4)[d]; 1(4)[e]	3(4)[d]; 1(4)[e]	4(3)[d]; 4(4)[e]	3(3)[d]; 4(4)[e]	3(3)[d]; 4(2)[e]	1(3)[d]; 2(2)[e]	0(4)[d]; 0(4)[e]	3(4)[d]; 1(4)[e]	22(36)[d]; 22(34)[e]
10	1	4(4)[d]; 4(3)[e]	2(4)[d]; 3(3)[e]	1(4)[d]; 1(2)[e]	2(4)[d]; 2(3)[e]	2(3)[d]; 3(3)[e]	2(3)[d]; 2(3)[e]	1(3)[d]; 2(3)[e]	2(3)[d]; 2(3)[e]	1(3)[d]; 2(3)[e]	1(3)[d]; 1(3)[e]	18(34)[d]; 22(29)[e]
	2	4(4)[d]; 2(2)[e]	2(4)[d]; 2(4)[e]	0(4)[d]; 1(4)[e]	1(4)[d]; 1(4)[e]	4(3)[d]; 4(4)[e]	4(3)[d]; 4(4)[e]	4(3)[d]; 3(2)[e]	1(3)[d]; 3(3)[e]	0(4)[d]; 0(4)[e]	1(4)[d]; 3(2)[e]	21(36)[d]; 23(33)[e]

11	1	4(4)[d]; 4(3)[e]	3(4)[d]; 3(3)[e]	1(4)[d]; 1(3)[e]	3(4)[d]; 3(3)[e]	2(3)[d]; 3(4)[e]	2(3)[d]; 1(4)[e]	2(3)[d]; 3(4)[e]	1(3)[d]; 1(4)[e]	2(3)[d]; 1(4)[e]	1(3)[d]; 1(4)[e]	21(34)[d]; 21(36)[e]
	2	4(4)[d]; 3(3)[e]	3(4)[d]; 3(4)[e]	0(4)[d]; 0(3)[e]	3(4)[d]; 3(3)[e]	4(3)[d]; 4(4)[e]	4(3)[d]; 4(3)[e]	4(3)[d]; 4(3)[e]	2(3)[d]; 0(3)[e]	0(3)[d]; 0(3)[e]	3(4)[d]; 0(4)[e]	27(35)[d]; 21(33)[e]
12	1	4(4)[d]; 4(3)[e]	3(4)[d]; 3(3)[e]	1(4)[d]; 1(2)[e]	3(4)[d]; 3(3)[e]	3(3)[d]; 3(4)[e]	3(3)[d]; 2(4)[e]	3(3)[d]; 3(4)[e]	2(3)[d]; 1(4)[e]	1(3)[d]; 2(3)[e]	1(3)[d]; 2(3)[e]	24(34)[d]; 24(33)[e]
	2	4(3)[d]; 3(4)[e]	3(4)[d]; 3(3)[e]	1(4)[d]; 1(4)[e]	3(4)[d]; 3(3)[e]	4(3)[d]; 4(4)[e]	4(4)[d]; 4(4)[e]	4(4)[d]; 4(4)[e]	2(2)[d]; 1(3)[e]	0(3)[d]; 0(2)[e]	3(1)[d]; 1(3)[e]	28(32)[d]; 24(34)[e]

[a] Points allocated for each developmental aspect (according to Supplementary Table 3) and self-assessment of confidence (in parentheses) – confidence per region: 1: not very confident; 2: rather confident; 3: confident; 4: highly confident

[b] According to Vossough et al.[23]

[c] On the basis of descriptions by Schmidbauer et al.[15]

[d] Assessment based on conventionally acquired MR data

[e] Assessment based on “SyMRI”-generated MR data

[f] Fetal brain maturity total score and total score for confidence (in parentheses)

PLIC: Posterior limb of the internal capsule

Supplementary Table 6: Quantitative measurements of the fetal brainstem (determined by investigator 1)

	Medulla Oblongata						Midbrain					
***n*=12**	**T1R (ms)**	**R1 (s^{-1})**	**T2R (ms)**	**R2 (s^{-1})**	**PD (%)**	**T2 (SI)**	**T1R (ms)**	**R1 (s^{-1})**	**T2R (ms)**	**R2 (s^{-1})**	**PD (%)**	**T2 (SI)**
1	1289	0.792	198	5.588	82.6	818	1349	0.746	165	5.978	86.4	884
2	1094	0.925	176	5.888	79.8	640	1257	0.800	228	4.413	85.6	716
3	1159	0.841	180	5.403	79.4	786	1496	0.673	179	5.563	88.6	824
4	1007	1.044	197	5.032	64.7	908	1397	0.720	234	4.216	81.3	938
5	1023	1.073	232	5.065	81.7	817	1204	0.808	186	5.291	80.3	910
6	1461	0.690	174	5.939	85.9	1046	1638	0.609	217	4.768	86.7	1155
7	1454	0.689	169	6.133	91.6	603	1394	0.709	204	5.001	83.7	725
8	1262	0.851	140	7.607	107.2	768	1220	0.841	160	6.362	88.4	762
9	1184	0.865	177	5.934	86.7	624	1120	0.918	197	5.380	80.6	678
10	1177	0.883	141	7.387	82.2	744	1168	0.853	192	5.461	81.9	776
11	1178	0.837	138	7.554	75.8	761	1401	0.718	148	6.777	87.8	749
12	897	1.426	132	7.704	76.6	756	1235	0.808	170	6.086	82.3	817

PD: Proton density

R1: T1-relaxation rate

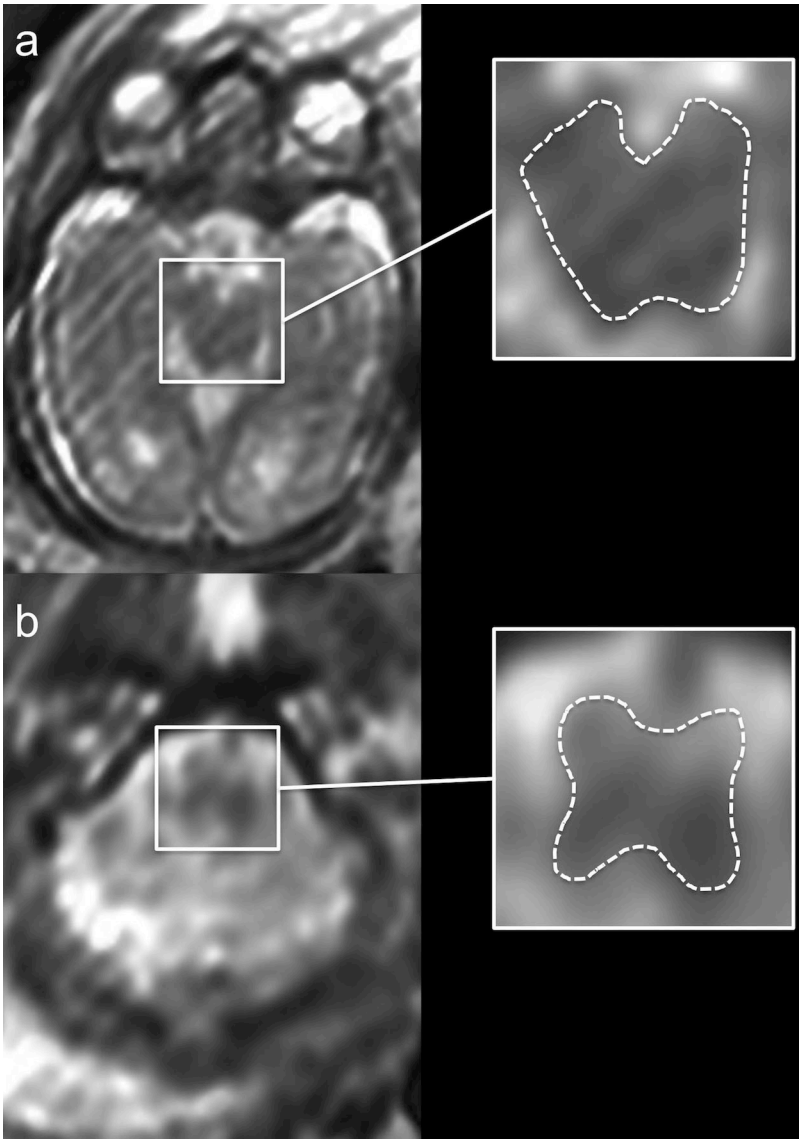
R2: T2-relaxation rate

SI: Signal intensity

T1R: T1-relaxation time

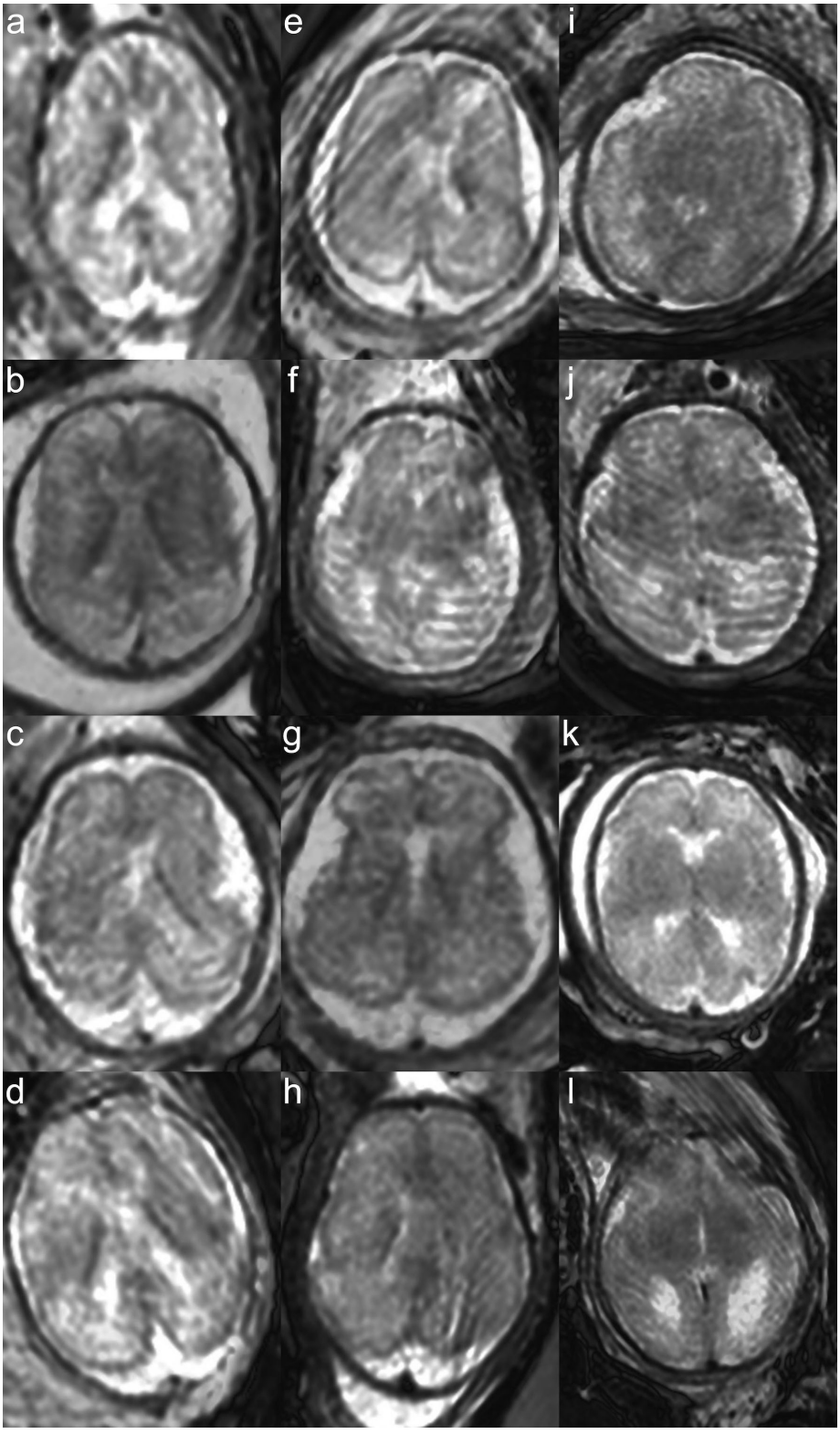
T2R: T2-relaxation time

Supplementary Figure 1:



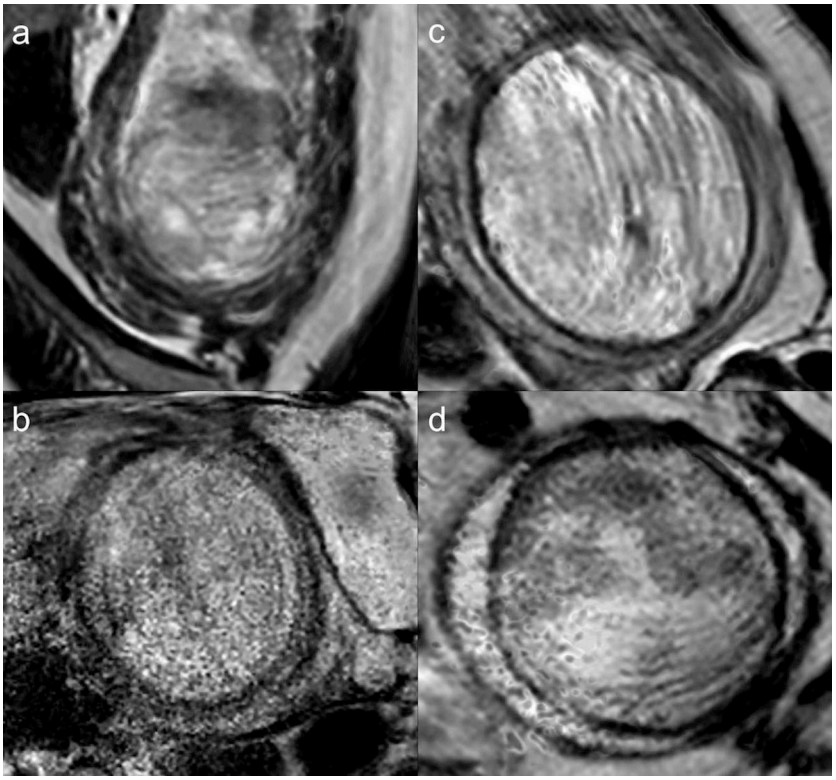
ROI placement is shown based on an “SyMRI”-generated T2-weighted STIR image (TR: 15000 ms, TE: 100 ms, TI: 300 ms) (fetal MRI at 25+5 weeks GA): a) midbrain; b) medulla oblongata.

Supplementary Figure 2:



Demonstration of included fetal MDME sequence acquisitions [T2-weighted STIR MR contrast (TR: 15000 ms, TE: 100 ms, TI: 300 ms)]: a) 23+6; b) 24+6; c) 25+4; d) 25+4; e) 25+5; f) 25+5; g) 26+6; h) 27+4; i) 29+6; j) 30+1; k) 32+4; l) 34+0.

Supplementary Figure 3:



Demonstration of highly motion-degraded fetal MDME sequence acquisitions [T2-weighted MR contrast (TR: 4500 ms, TE: 100 ms)]: a) 23+0; b) 29+4; c) 32+0; d) 33+3.

Supplementary Figure 4:

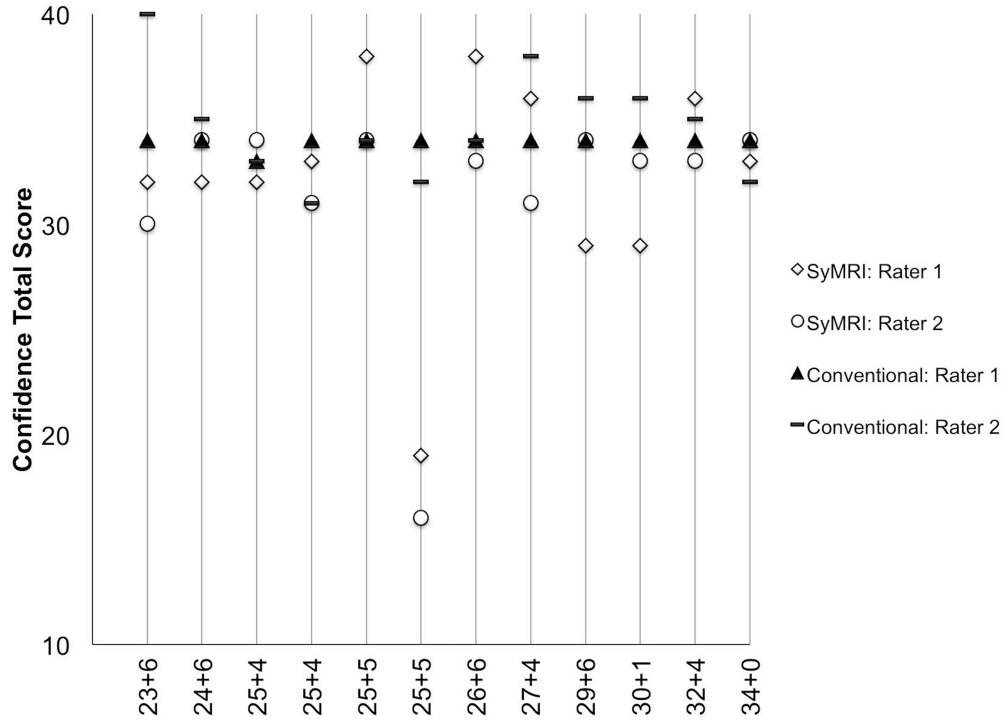


Illustration of the self-assessment of confidence (confidence total score): both raters reported higher levels of confidence when fetal brain maturity was evaluated on the basis of conventionally acquired images.