

Comparing Image Quality Metrics of T1w MRI Data Within & Between Datasets

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Background

Comparison of automated and robust quality control protocols using large multi-site MRI datasets are needed. Here, we use the open source MRIQC tool [1] to assess the quality of anatomical T1w-MRI images while comparing our image quality metrics (IQM's) to ABIDE [2], an open-source dataset.

Methods

We ran MRIQC on our 1333 scans from two different multi-site studies (CARTBIND [3], THREE-D [4]) and one single-site study (FOUR-D [5]).

Three IQM's were used to assess MRI quality:

1. Contrast-to-noise ratio (CNR; measures difference in the signal intensity of two different regions, higher values indicate better quality)
2. Entropy-focus criterion (EFC; higher values indicate increased ghosting and blurring induced by head motion)
3. Full-width half maximum (FWHM; higher values indicate greater blurriness)

Three one-way ANOVA's were run to assess differences in IQM's in our dataset compared to the ABIDE dataset, which had over 1000 scans for each metric.

Results

Group	Site	N	Mean (Standard Deviation)		
			CNR	EFC	FWHM
THREE-D	CAMH & UHN	641	1.42 (0.23)	0.56 (0.03)	3.75 (0.25)
	UBC	98	1.52 (0.23)	0.71 (0.02)	3.81 (0.14)
CARTBIND	CAMH	136	1.23 (0.18)	0.53 (0.03)	4.93 (0.22)
	UBC	87	2.04 (0.31)	0.68 (0.03)	4.63 (0.15)
	UHN	108	1.29 (0.19)	0.63 (0.02)	4.45 (0.35)
FOUR-D	CAMH	253	1.10 (0.19)	0.54 (0.03)	3.99 (0.32)
ABIDE	Multiple	>1000	11.0 (4.55)	3.45 (5.40)	4.67 (8.85)

Table 1. Descriptives of the datasets

	ANOVA				
	F-value	df	Significance	η^2	Post-hoc
CNR	996.4	6	$p < 0.001$	0.718	ABIDE > all; CART UBC > CART CAMH & FOUR-D
EFC	62.76	6	$p < 0.001$	0.137	ABIDE > all
FWHM	2.163	6	$p = 0.044$	0.005	ABIDE & CART CAMH > THREE-D CAMH & UHN

Table 2. Statistical outcomes. Note: df, degrees of freedom

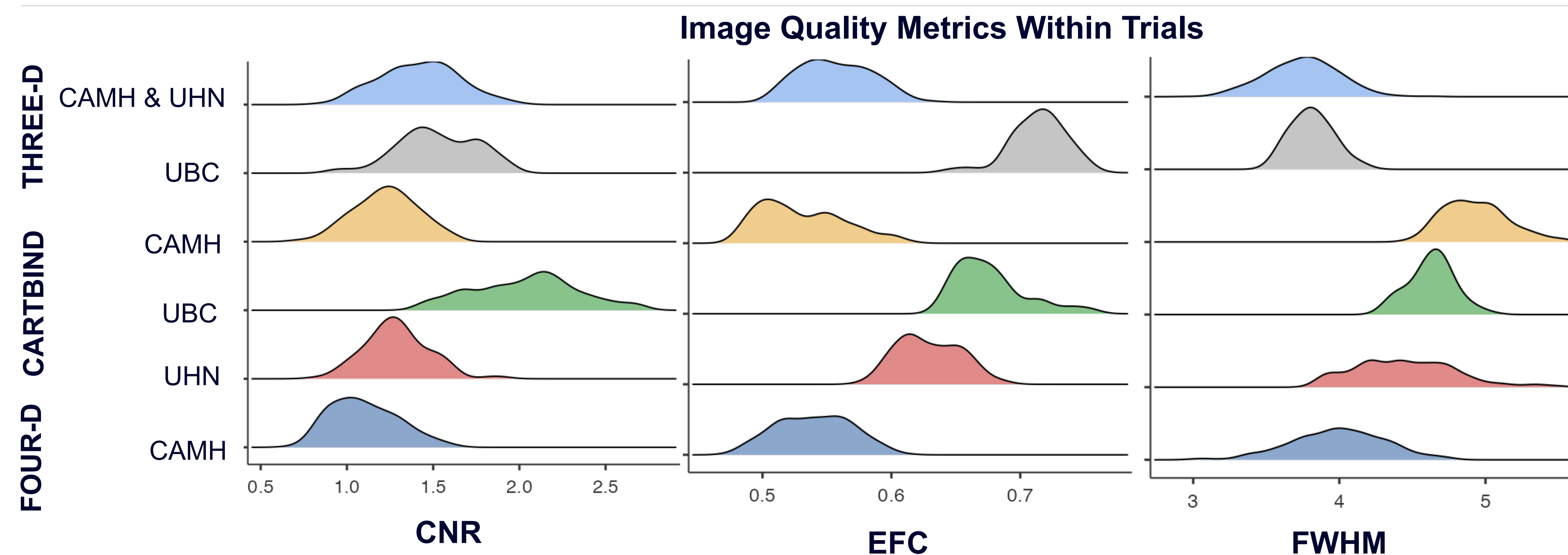


Figure 1. IQM's within our dataset

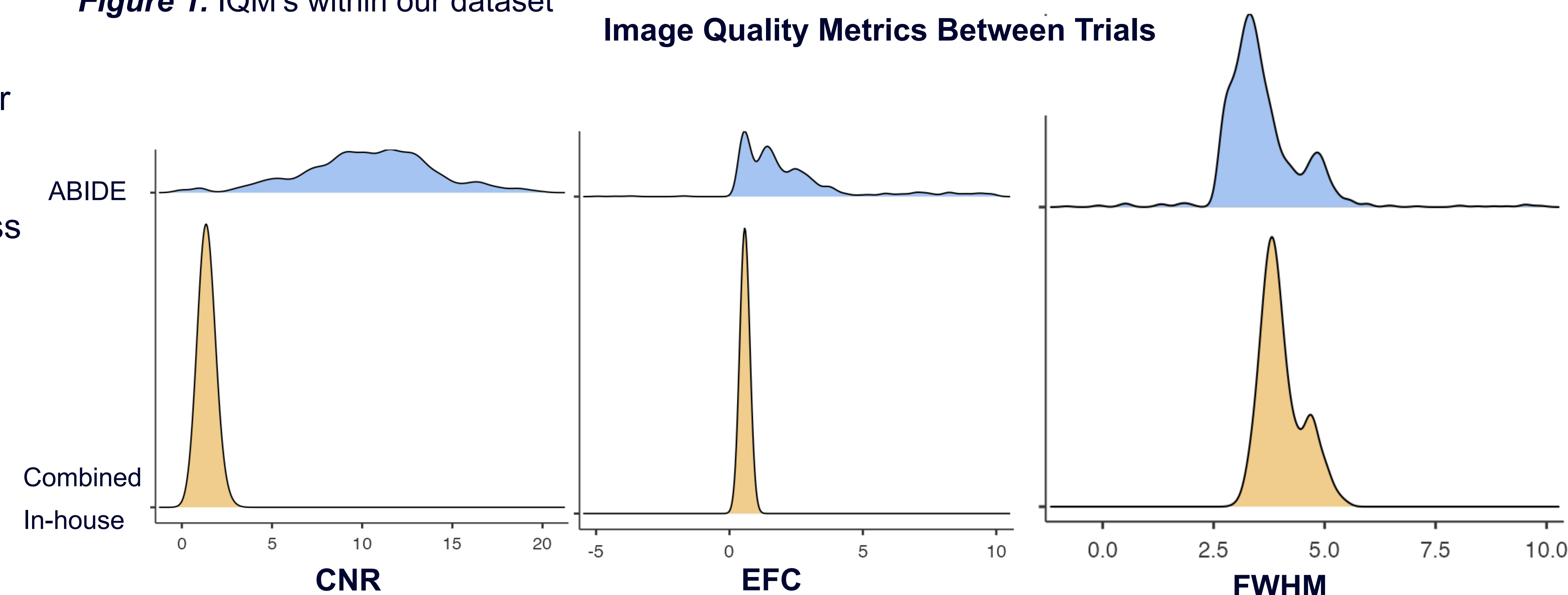


Figure 2. IQM's between our dataset and ABIDE

Discussion

This large-scale comparison revealed small IQM differences within our datasets, showing largely consistent image quality between sites and studies. However, when our data were compared with ABIDE data, there was a large effect size difference in the CNR (ABIDE had greater CNR relative to all our data; indicating better quality scans) and a small effect size difference in the EFC metric (indicating ABIDE data had greater head motion). Potential differences in scanning site parameters, protocols, and participants could result in these differences. For example, participants in ABIDE were younger than those in ours; it may be more difficult for younger individuals to lay still.

References

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