Supplementary Materials

Imaging Protocol

High resolution T_1-weighted anatomic images were acquired with a 5-echo multi-echo Magnetization Prepared Rapid Acquisition Gradient Echo sequence (echo time [TE] = 1.64, 3.5, 5.36, 7.22, 9.08 msec; repetition time [TR] = 2.53 sec; inversion time [TI] = 1.2 sec; 7° flip angle, number of excitations [NEX] = 1; slice thickness = 1 mm; field of view [FOV] = 256 mm; resolution = 256 × 256) for all participants. All participants also underwent a T_2-weighted scan with a fast spin echo sequence (TE = 77.0 msec; TR = 1.55 sec; flip angle 152°; NEX = 1; slice thickness = 1.5 mm; FOV = 220 mm; matrix = 192 × 192; voxel size = 1.15 × 1.15 × 1.5 mm³) to examine for structural damage following injury.

Lower-order group-level spatial ICA

Processing and testing methods for lower-order group independent component analysis (ICA) supplementary analyses were identical to those at the higher model orders with two notable exceptions. First, group-level spatial ICAs were conducted with two separate lower-order model decompositions at 20 and 30 components. Secondly, from the resulting thresholded components, the anterior default-mode network (aDMN), rostral anterior cingulate cortex (rACC), and the posterior default-mode network (pDMN) components were manually identified by expert raters (A.M. and J.L.) at each model order. Pair-wise static resting state functional connectivity within these DMN components was tested in an identical fashion to the higher-order group comparisons. Results indicate the effect of group was not significant for either of the lower-order models ($p > 0.10$; Supplementary Fig. 1 and Supplementary Table 3).

SUPPLEMENTARY TABLE 1. DEMOGRAPHIC AND INJURY INFORMATION FOR ALL mTBI PATIENTS

Age	Gender	Injury mechanism	AAN rating	Days post-injury		LOC (h:min:sec)	PTA (h:min:sec)	Number of previous injuries*
				MRI	NP			
19	F	Fall	3	18	17	0:03:00	0:00:00	NA
19	F	MVA	3	14	14	0:12:30	24:00:00	NA
20	F	MVA	3	11	11	0:00:00	0:00:03	NA
21	F	MVA	3	14	16	0:05:00	NA	0
21	F	Fall	3	16	15	0:01:20	0:00:00	0
21	F	Fall	3	20	20	0:00:02	0:00:00	1
22	F	Assault	2	18	18	0:00:00	0:03:30	0
22	F	Fall	3	6	7	0:30:00	0:25:00	NA
22	F	MVA	3	11	11	0:02:30	2:10:00	0
22	F	MVA	3	16	16	0:00:00	0:00:05	2
23	F	Assault	1	5	9	0:00:00	0:01:00	NA
23	F	Assault	2	11	11	0:00:00	0:30:00	0
23	F	Assault	3	21	21	0:00:30	0:00:00	0
24	F	Assault	1	7	5	0:00:00	0:00:00	NA
24	F	MVA	3	20	20	0:00:30	1:00:00	NA
25	F	MVA	3	20	20	0:07:30	7:00:00	0
26	F	Fall	3	21	17	0:02:00	0:00:00	0
27	F	Assault	2	8	8	0:00:00	NA	0
27	F	MVA	2	18	13	0:00:00	NA	NA
28	F	Assault	1	11	9	0:00:00	0:05:00	0
28	F	Fall	3	18	20	0:00:30	18:00:00	1
37	F	Fall	3	3	8	0:01:00	0:00:00	0
41	F	Fall	3	17	18	0:01:00	NA	0
48	F	Assault	2	19	19	0:00:00	0:00:00	0
50	F	MVA	3	7	7	0:01:30	4:00:00	NA
18	M	Fall	2	16	20	0:07:30	0:45:00	1
18	M	Assault	2	16	16	0:00:00	0:00:40	0
18	M	Assault	3	17	16	0:00:05	0:00:00	1
19	M	Assault	3	14	15	0:00:03	0:00:00	0
19	M	Fall	3	9	10	0:00:05	0:00:45	1
22	M	MVA	3	20	20	0:00:30	0:00:00	1
23	M	Fall	1	11	7	0:00:00	0:00:00	0
23	M	Fall	3	17	NA	NA	NA	0
24	M	Fall	3	13	13	0:00:03	0:30:00	0
24	M	Fall	3	10	10	0:02:30	0:30:00	0
28	M	MVA	3	15	15	0:00:25	0:00:00	0
30	M	MVA	3	9	9	0:05:00	0:00:00	0
30	M	Assault	3	16	16	0:05:00	24:00:00	0
32	M	Assault	3	3	5	0:01:00	5:00:00	NA
32	M	MVA	3	16	13	0:00:30	0:00:00	0
33	M	Assault	3	20	19	0:00:02	0:03:00	1
33	M	Fall	3	20	19	0:00:15	0:00:00	0
36	M	MVA	3	19	18	0:00:00	2:00:00	1
41	M	Fall	2	18	18	0:00:00	1:00:00	0
45	M	Assault	3	9	9	0:04:00	0:10:00	1
46	M	Fall	2	13	13	0:00:00	0:00:00	0
49	M	Assault	3	7	4	0:02:00	0:00:00	NA
51	M	Fall	2	19	18	0:00:00	24:00:00	0

*Previous injuries were documented using a modified version of the Rivermead scale, and data collection with this instrument began after the start of the study. Duration of LOC and PTA are based on subjective self-report at initial assessment for the study. The assault category also includes injuries sustained from falling objects or during collisions (e.g., sports-related).

mTBI, mild traumatic brain injury; AAN, American Academy of Neurology; MRI, magnetic resonance imaging; NP, neuropsychological testing; LOC, loss of consciousness; PTA, post traumatic amnesia; F, female; NA, not available; MVA, motor vehicle accident; M, male.

Findings

CT: "Small amount of subdural blood along the falx and tentorium, with punctate subarachnoid hemorrhage within the vertex. Nasal bone fractures."

CT: "Small amount of subarachnoid hemorrhage layering within the right sylvian fissure without significant mass effect or shift of midline structures"

CT: "Thin right supratentorial subdural hematoma. Right posterior parietal scalp swelling extending to the vertex."

CT: "Left ZMC fracture pattern. Intermediate attenuation fluid within left maxillary sinus, likely hemorrhage."

MRI: "Slight asymmetry of the temporal horn of the right lateral ventricle. Probably, anatomic variant. Subtle T1 hypointensity in the central/left paracentral upper pons. Not well seen on the T2WI's. Question of artifact vs. subtle finding. Consider clinical correlation and possible diagnostic MR."

MRI: "Left maxillary sinus mucous retention cysts. A cluster of small oval fluid signal areas can be found involving the right periatrial/parietal white matter. Largest area measuring about 4 mm. Nonspecific. Could represent dilated virchow robin spaces as other smaller areas of similar signal can be found in the left parietal lobe. Recommend correlation with clinical history and location of injury. REV2: Maxillary sinus mucous retention cysts. Findings most c/w Virchow-Robin spaces mainly in the parietal periventricular white matter. Low signal in the frontal interfalcine area most likely represents dural calcification. Doubtful clinical significance. Recommend clinical correlation nonetheless."

MRI: "Subtle, non-specific white matter lesion in the right centrum semiovale. May be post-traumatic in nature."
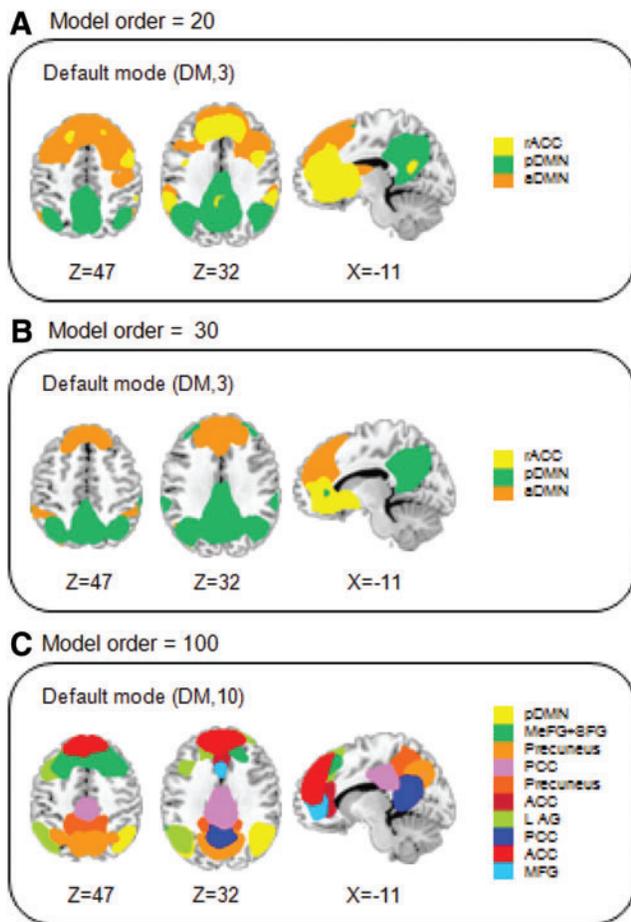
MRI: "CSF or fluid signal is seen in the left anterior middle cranial fossa, anterior to the temporal lobe. This could represent CSF associated with volume loss of the left temporal lobe. Any history of prior trauma or vascular insult. This CSF signal area could also represent a small arachnoid cyst (2.3 cm × 1.5 cm)."

CT, computed tomography; ZMC, zygomaticomaxillary complex fractures; MRI, magnetic resonance imaging; MR, magnetic resonance; REV2, second visit review; c/w, consistent with; CSF, cerebrospinal fluid.

Component Pairs	mTBI Mean(SD)	HC Mean(SD)	p value	Cohen's d (mTBI – HC)
	Model order = 20 components			
rACC and pDMN	0.21(0.23)	0.19(0.19)	0.720	0.08
rACC and aDMN	0.31(0.20)	0.29(0.24)	0.589	0.12
pDMN and aDMN	0.46(0.22)	0.38(0.24)	0.141	0.32
	Model order = 30 components			
rACC and pDMN	0.17(0.22)	0.14(0.24)	0.490	0.15
rACC and aDMN	0.37(0.25)	0.35(0.24)	0.715	0.08
pDMN and aDMN	0.40(0.20)	0.37(0.22)	0.625	0.11

mTBI, mild traumatic brain injury; HC, healthy controls; SD, standard deviation; rACC, rostral anterior cingulate cortex; pDMN, posterior default-mode network; aDMN, anterior default-mode network.

A Model order = 20

Default mode (DM,3)

Z=47   Z=32   X=-11

rACC
pDMN
aDMN

B Model order = 30

Default mode (DM,3)

Z=47   Z=32   X=-11

rACC
pDMN
aDMN

C Model order = 100

Default mode (DM,10)

Z=47   Z=32   X=-11

pDMN
MeFG+SFG
Precuneus
PCC
Precuneus
ACC
L AG
PCC
ACC
MFG

SUPPLEMENTARY FIG. 1. Lower model-order independent component analysis results for 20 (**A**) and 30 (**B**) components relative to our full model (Panel **C** and Fig. 1 and Fig. 2). For the purposes of these analyses, we focused on nodes of the default-mode network (DMN), including anterior (aDMN) and posterior aspects (pDMN), as well as the rostral anterior cingulate cortex (rACC).