

Post-concussive clinical and neuroimaging alterations specific to female, woman and girl athletes

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BACKGROUND

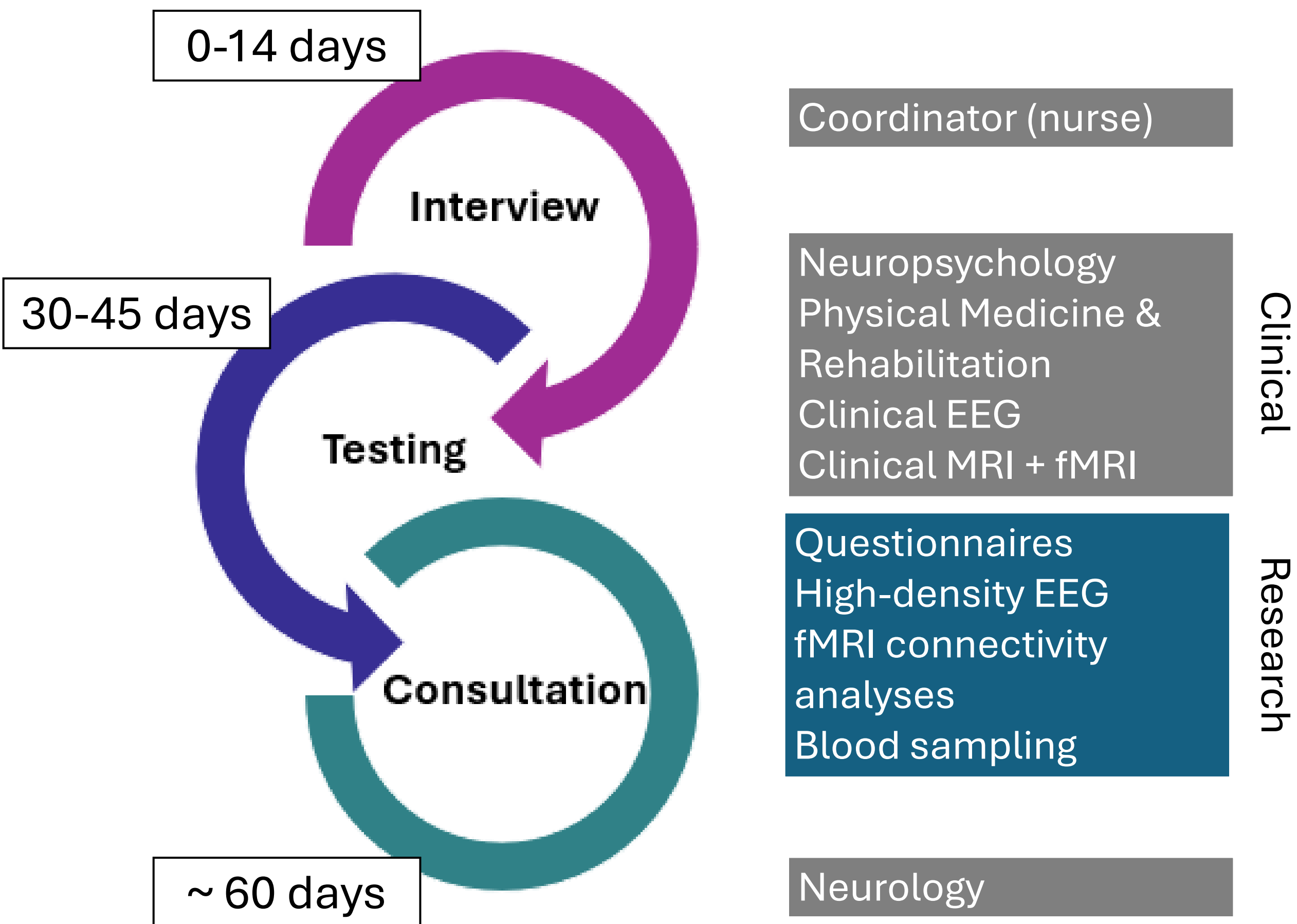
Sport-related concussion (SRC) recovery is predominantly described in male, men and boy (MMB) athletes, or in mixed populations, with limited data specific to female, women and girls (FWG).

The **objective** of this prospective observational study is to characterize clinical and neuroimaging features of SRC in FWG and compare them with MMB and non-SRC cases using data from an institutional concussion care pathway.

METHODS

Institutional standardized concussion care pathway

Concussion programme co-built with University Hospital, Research Labs and patients' associations – **running in year 3**



Questionnaires

- Rivermead Post-concussion Symptoms Questionnaire (RPQ)
- Beck Depression Inventory (BDI)
- Pittsburgh Sleep Quality Index (PSQI)

Neuroimaging

- High-density EEG (127 channels) resting state – spectral analysis + functional connectivity
- Functional MRI resting state – network-based functional connectivity in default mode network (DMN) and dorsal attentional network (DAN)

➔ Comparison with a cohort of 40 healthy controls and classification of normal versus abnormal features

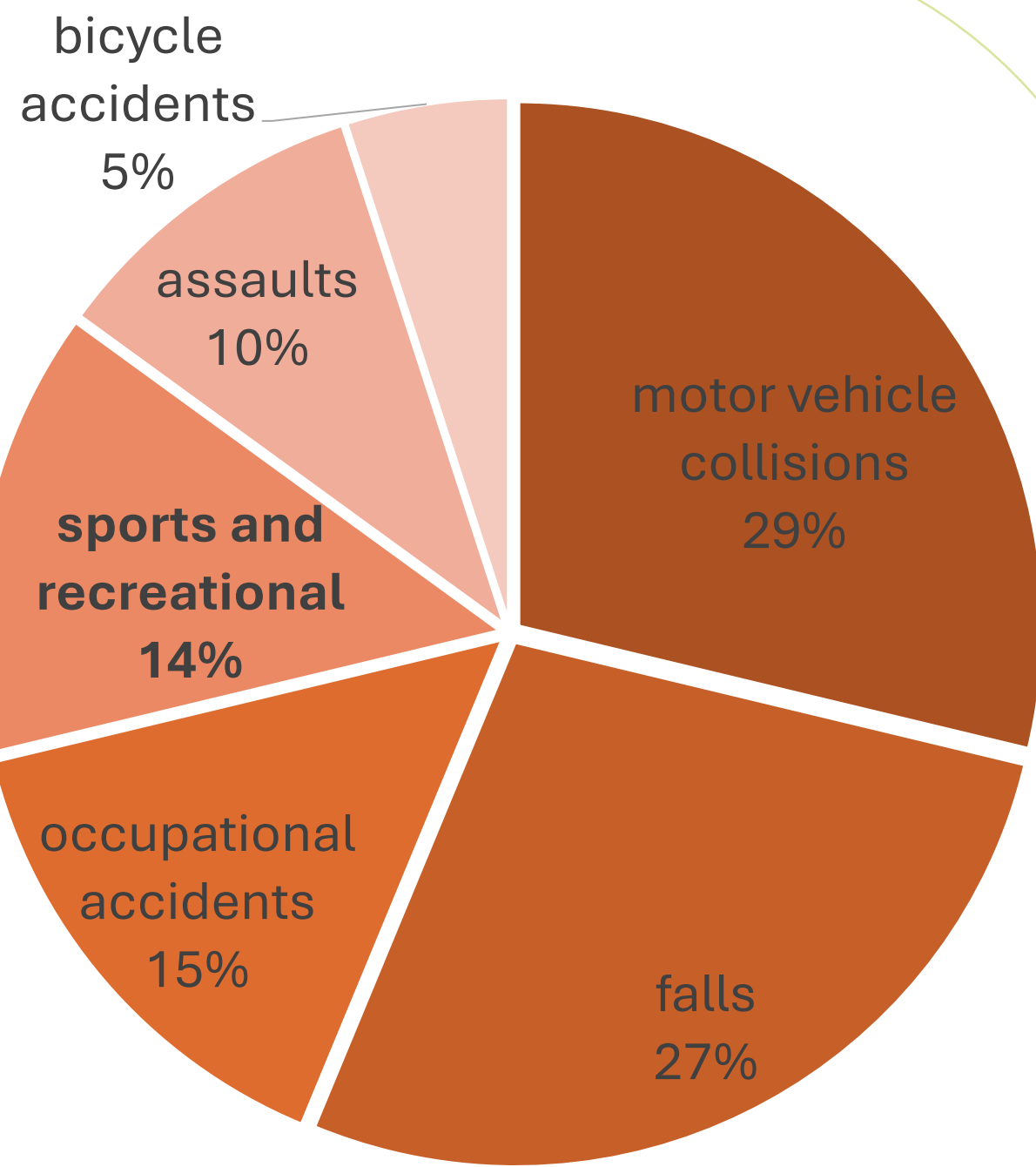
CONCLUSIONS

- In this preliminary case-series, FWG distinctive features are revealed by neuroimaging
- The reduced alpha power and DAN hyperconnectivity do not translate in conventional questionnaires but analyses including in-depth neuropsychological evaluation are under way
- The FWG neuroimaging alterations suggest a disruption in thalamocortical circuits and maladaptive network reorganization
- Further investigation is needed to better inform management and return-to-sport decisions

RESULTS

Concussion database (n=80)

Age (years)	38,5 ± 11,5
Sex (F/M)	54 (68%) / 26 (32%)
Time since injury (months)	4,3 ± 2,9
PPCS (RPQ)	32,7 ± 12,9
Depression (BDI)	15,3 ± 9,5
Sleep quality (PQSI)	9,9 ± 4,3



SRC only (n=11)

Clinical characteristics

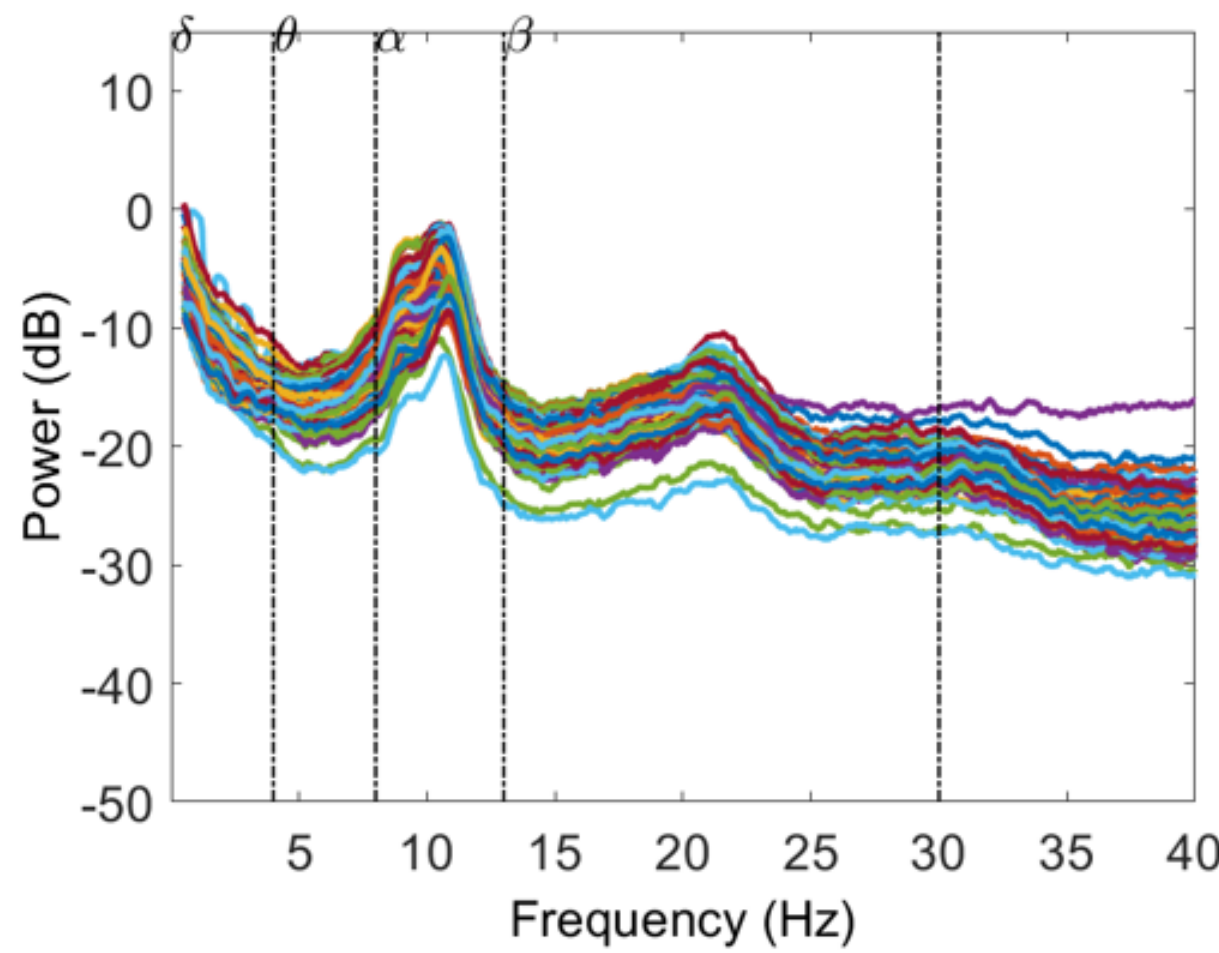
	FWG (n=4)	MMB (n=7)	p value
Age (years)	35,0 ± 12,2	25,6 ± 4,2	0,29
Time since injury (months)	3,2 ± 2,9	2,0 ± 0,9	0,85
PPCS (RPQ)	34,5 ± 10,5	24,7 ± 7,9	0,17
Depression (BDI)	15,8 ± 9,5	8,9 ± 4,0	0,25
Sleep quality (PQSI)	9,3 ± 4,2	8,6 ± 4,3	0,81

Neuroimaging characteristics

EEG spectral power

	Decreased	Normal
FWG	4	0
MMB	1	6

p=0.02



EEG alpha connectivity (dwPLI)

	Decreased	Normal
FWG	2	2
MMB	4	3

p=0.20

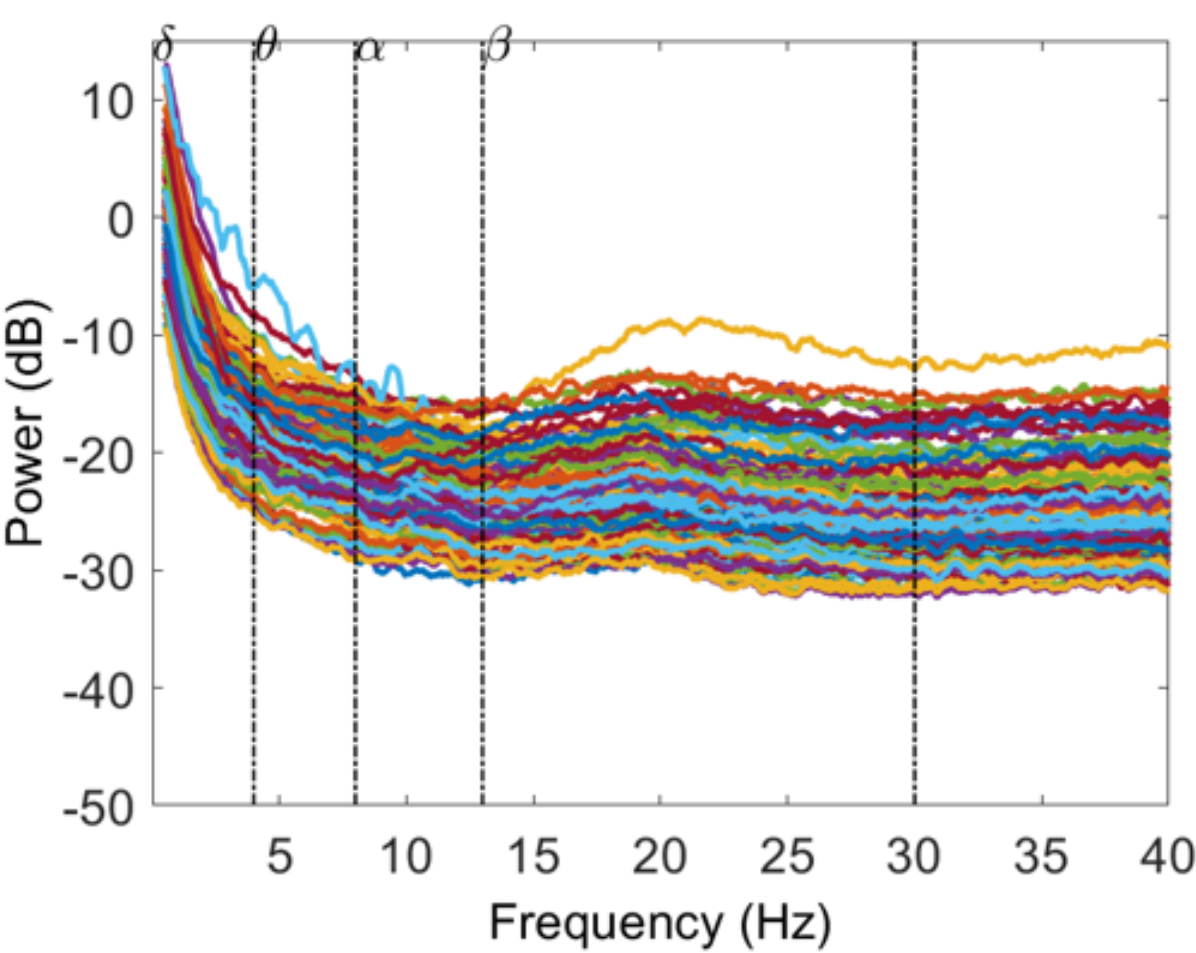


Fig.2 | High-density EEG spectral power for a healthy control (left) and a female athlete with SRC (right). A suppression of the alpha peak, a proxy for thalamo-cortical function, is observed.

fMRI DMN connectivity

	Hypo	Normal	Hyper
FWG	0	1	3
MMB	2	2	5

p=0.36

fMRI DAN connectivity

	Normal	Hyper
FWG	1	3
MMB	7	0

p=0.007

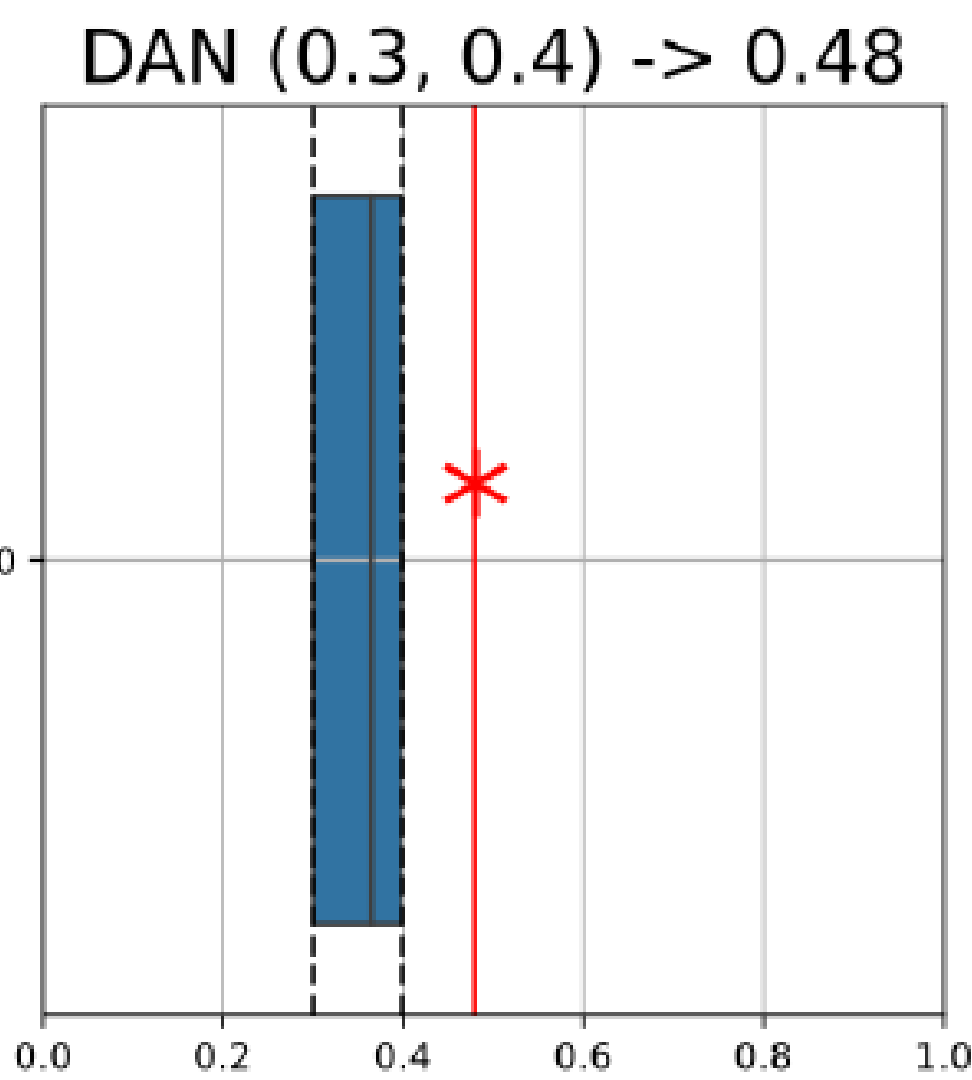


Fig.2 | Dorsal attention network (part of the task-positive network) measured at rest. The red asterisk represents the athlete's spontaneous activity compared to that of healthy subjects (in blue). An increase in connectivity is observed (DAN hyperconnectivity).

FWG athletes demonstrated similar clinical profiles than MMB but distinct neuroimaging alterations post-SRC, including reduced alpha power and DAN hyperconnectivity

References

Vinck et al., *Neuroimage*, 2011
Schaefer et al., *Cereb Cortex*, 2018



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