Temporal network properties of self-reported fatigue and associated mood, activity and pain variables in immune-mediated inflammatory diseases

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Introduction

- Patients with immune-mediated inflammatory disorders (IMID) have prominent symptoms of fatigue which affect HRQoL and function.[1,2]
- Previous research has demonstrated correlations between fatigue and variables such as sleep, physical activity and affective states (e.g. depressed and anxious mood).[1,3–5]
- Day-to-day changes in fatigue and associated symptoms have not been comprehensively addressed, and it is unclear to what extent the relationship between fatigue and other variables exhibits disease-specific patterns.
- Understanding how these variables function within a dynamic system may help uncover further causes and consequences of fatigue and identify candidate targets for intervention.

E-poster **References** **Supplementary material**

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Methods

- Participants with IMID and healthy volunteers (HV) completed brief PRO measures of mental fatigue, physical fatigue, depressed mood, anxious mood and sleepiness (KSS) remotely on the CANTAB™ app three times each day (morning, afternoon and evening).
- Multi-level vector autoregressive (mlVAR) was used to assess **Contemporaneous** (within session) and **Temporal** (lagged across-sessions within day) relationships between PRO measures.
- The following overall network properties were also extracted from the networks:
  - **Density:** the degree to which the network as a whole is interconnected across measures, calculated from both Contemporaneous and Temporal networks
  - **Strength:** the degree to which variables are connected to each other in the contemporaneous network
  - **Instrength centrality:** the degree to which variables are influenced by other variables in the temporal network
  - **Outstrength centrality:** the influence of a variable on others in the temporal network.
- Network properties were compared between each cohort and HV.

See the **supplementary material** for further details on the study design and statistical methods.

Results

Table 1. Baseline Demographics

Cohort	N	Age, mean (SD)	Female, n (%)
Healthy volunteers (HV)	94	47.2 (15.1)	67 (71.3)
Primary Sjögren's syndrome (PSS)	81	56.8 (12.5)	72 (88.9)
Inflammatory bowel disease (IBD)	262	45.4 (14.1)	154 (58.8)
Rheumatoid arthritis (RA)	74	59.6 (11.2)	58 (78.4)
Systemic lupus erythematosus (SLE)	77	47.0 (11.2)	75 (97.4)

Figure 1. Patients with IMID showed significantly greater physical (A) and mental (B) fatigue over all daily sessions than HV, but also showed higher pain (C), depressed (D) and anxious (E) mood and physical activity (F)

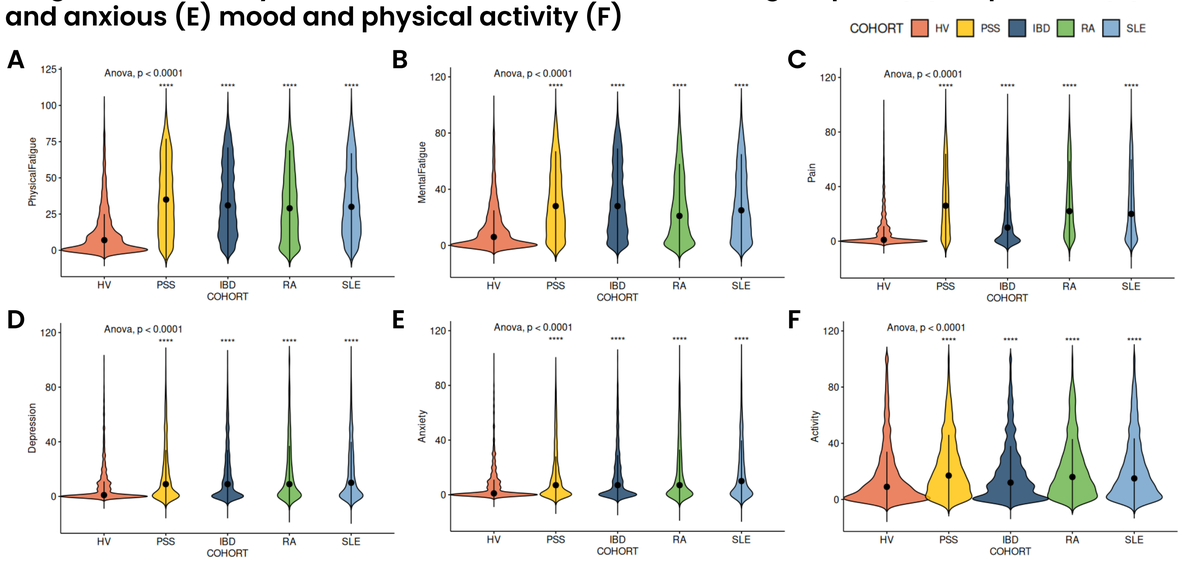
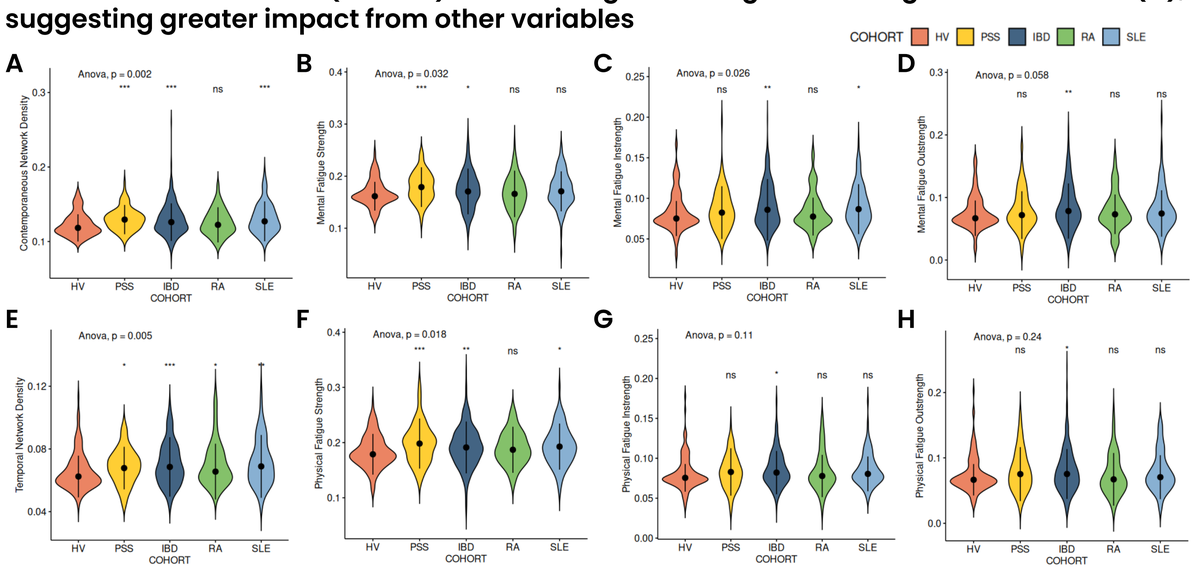
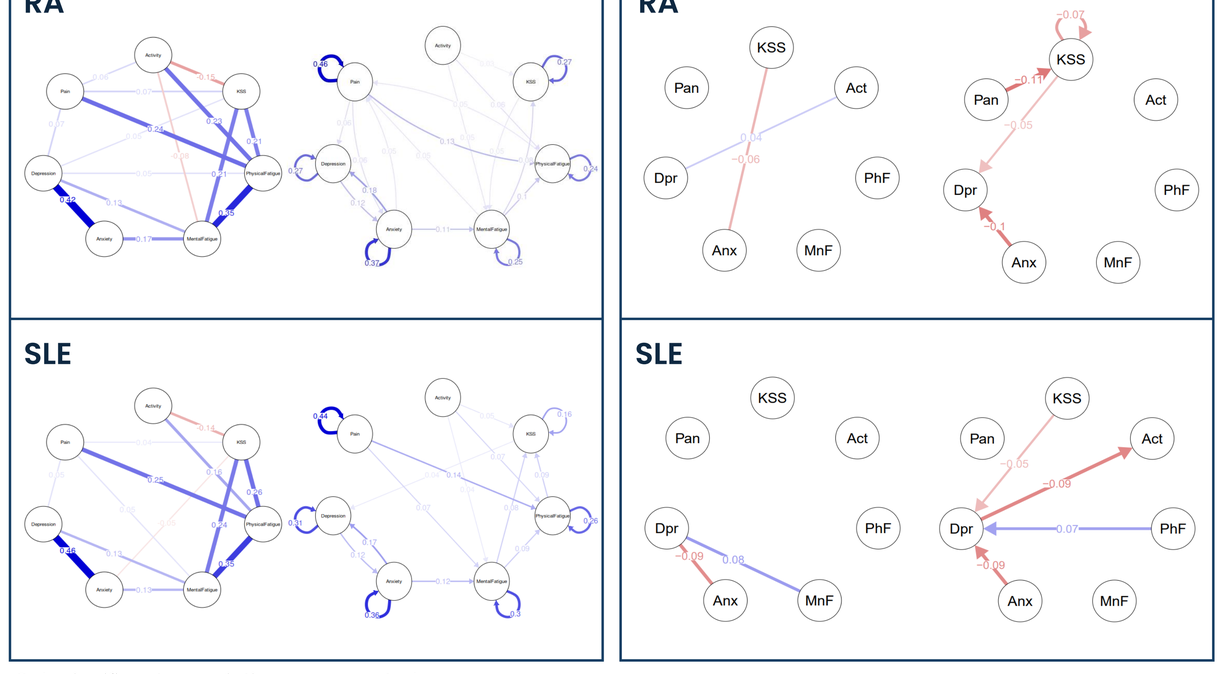


Figure 2. Overall network density was higher in patients with IMID relative to HV (A and E), and both physical fatigue and mental fatigue were more strongly connected to other variables in the network (B and F). Mental fatigue had higher instrength relative to HV (C), suggesting greater impact from other variables



These results differed across IMID cohorts, with IBD showing significant differences from controls in all measures of network properties, while none were seen in RA. This may in part reflect differences in sample size.

Figure 3. Significant Contemporaneous and Temporal associations between variables were observed in all patient groups (A) and differences in these networks were also seen relative to HV (B), particularly in connections with depressed mood.



Only significant associations are reported.

Conclusions

Patients with IMID show higher levels of fatigue relative to other symptoms, as well as higher scores than HV on all other PRO measures, including physical activity.

The properties of fatigue-related symptom networks differ between patients and HV, and across different IMID cohorts. Overall, symptom networks were more interconnected in patients than in HV, indicating stronger coupling between symptoms.

Mood symptoms show significant differences in network properties relative to HV across cohorts, although the details of this differ. This points to the clinical relevance of depression and anxiety symptoms in patients with IMIDs.

These findings emphasize the importance of assessing patient symptoms of fatigue within the context of other variables and provide a method for understanding the connections between different aspects of the patient experience.

Abbreviations

HRQoL, health-related quality of life; **HV**, healthy volunteers; **IBD**, inflammatory bowel disease; **IMID**, immune-mediated inflammatory disorders; **KSS**, Karolinska Sleepiness Scale; **PRO**, patient-reported outcome; **PSS**, Primary Sjögren's Syndrome; **RA**, rheumatoid arthritis; **SD**, standard deviation; **SLE**, systemic lupus erythematosus.

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FC, **NT** and **AK** are employees of Cambridge Cognition and may own stock or stock options in Cambridge Cognition.

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