SEX DIFFERENCES IN THE DOCUMENTATION OF CENTRAL SENSITIZATION: AN NLP ANALYSIS OF CLINICAL CONCEPTS IN THE ELECTRONIC HEALTH RECORD

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"Making Waves"
25th Annual Pain Medicine Meeting
November 5-7, 2026 | Tampa, Florida
ASRA PAIN MEDICINE

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BACKGROUND

- Central sensitization contributes to chronic pain and opioid consumption, and appears to operate differently by sex.
- In a prior prospective cohort undergoing total knee arthroplasty, central sensitization correlated strongly with opioid use duration in males but not females, despite comparable patient-reported outcomes.
- Central sensitization has no ICD diagnostic code. Identification depends on self-report instruments and prospective recruitment, which constrains sample size and limits genetic investigation.

OBJECTIVE

Compare how central sensitization is documented in male and female patients within a cohort selected for the same phenotype, and assess the feasibility of an EHR-based phenotype to support future genetic studies.

METHODS

- **Data source.** Synthetic Derivative, Vanderbilt University Medical Center's de-identified longitudinal EHR repository.
- **Cohort.** Patients with notes containing terms indicating central sensitization together with treatment for nociplastic pain.
- **Concept extraction.** UMLS CUIs extracted from clinical notes, aggregated per patient and weighted by documented occurrence count.
- **Weighting.** TF-IDF computed once across the full cohort, with both sexes sharing one vocabulary and one IDF vector. Strata obtained by partitioning the fitted matrix rather than by separating fits.
- **Two summaries per concept:**
    1. **Mean weight, all patients:** contribution to the average record. Reported with patient-level prevalence.
    2. **Mean weight, patients with the concept documented:** prominence within the records containing it. Favors concepts appearing in fewer patients.

RESULTS

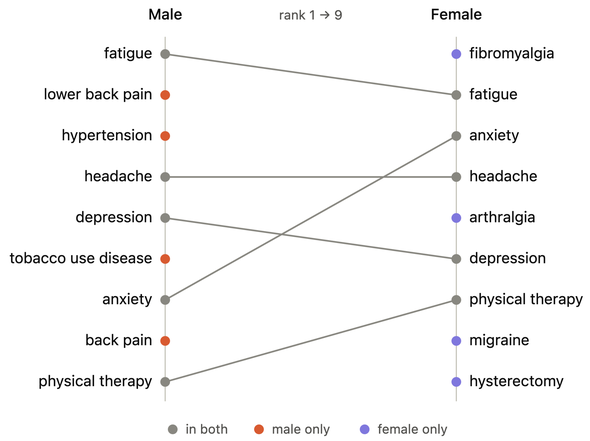


Figure 1. Top 9 concepts by TF-IDF weights of entire cohort, male, and female, representing common defining terms in patients with central sensitization.

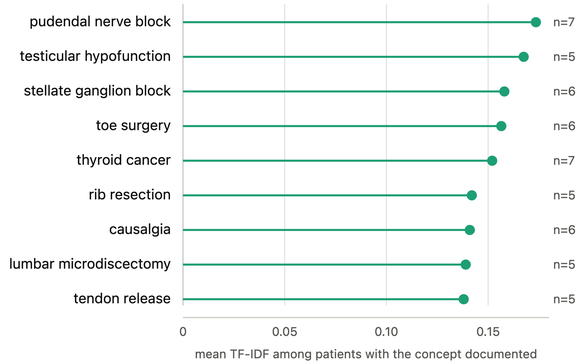


Figure 2. Top 9 concepts by TF-IDF weights of at least 5 patients containing the concept in the overall cohort, representing rare defining terms in patients with central sensitization.

DISCUSSION

- Within a cohort selected for central sensitization:
    - Male records emphasized anatomically localized pain
    - Female records emphasized generalized symptoms.
    - 6 of 10 top concepts in both sexes represented **SPACE** symptoms (sleep, pain, affect, cognition, energy), characteristic of central sensitization.
    - Fibromyalgia, the prototypical central sensitization diagnosis, was applied far less often in men despite identical inclusion criteria.
- Restricting weights to patients with each concept documented revealed some interventional pain procedures in a minority of records.
- Because both sexes met the same inclusion criteria, this asymmetry can reflect clinical framing rather than actual phenotype prevalence and may underlie previously observed sex differences in opioid consumption.

Limitations

- Documented concepts reflect care-seeking and documentation practice, not true disease burden
- Single institution
- Note-based ascertainment may itself differ by sex
- Male stratum smaller (n = 116), yielding less precise estimates

Future Directions

- Expanded cohort with prescribing data to test whether differential recognition drives differential treatment
- Sex stratification of the procedure-focused concepts
- Validation of the EHR phenotype toward genetic investigation in BioVU, Vanderbilt's genetic repository.

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