Identifying Predictors of Opioid Misuse in Chronic Pain Using Machine Learning

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Introduction

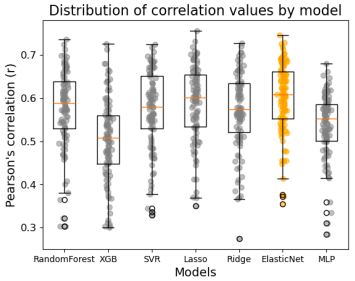
- In 2022, 14,716 U.S. Americans died from prescription opioid overdose (National Center for Health Statistics)
- About 21~29% of patients taking prescription opioid for chronic pain misuse opioid (Vowles et al., 2015)
- Prescription opioid misuse is a risk factor for
  - Abuse/misuse substances or other prescriptions (e.g., Benzodiazepine)
  - Depression and suicidal ideation/behaviors
  - Poor physical and psychological health
  - Increased mortality
- Reducing the risk and prevalence of opioid misuse in pain management is an urgent public health challenge.
- As a first step, **the current study aims to identify risk factors associated with opioid misuse in patients with chronic pain taking daily prescription opioid.**

Methods

- **Target population:** Patients with chronic pain taking daily prescription opioid were invited for Empowered Relief® (ER), a single-session pain psychology intervention.
  - Current study used the baseline data.
- **Machine Learning Analysis**
  - **Outcome variable**: Current Opioid Misuse Measure (COMM, Butler 2007, 2010, Cronbach α = 0.86 - 0.83)
    - Total score range 0 – 68, Cutoff score for problematic misuse: 9
  - **Predictor variables** (n = 51):
    - Demographics (see below)
    - Psychosocial outcomes
    - Clinical characteristics (see table)
- **Participants (N = 314):**
  - Age M = 54.4, SD = 11.9, range = 19-86
  - Female n = 241, 76.8%
  - White 89.8%/Non-Hispanic 94.6%
  - College or more education 96.6%
  - Disabled: 47%
- **Clinical Characteristics:**
  - COMM scores: M = 6.8, Median 6.0, SD = 5.2, Range = 0 - 33
    - 27.7% COMM total score ≥ 9

		Mean	SD	Range
Duration of opioid medications (years)		12	8.1	0 - 55
DSM-5 OUD symptom severity		0.6	0.4	0 - 6
PROMIS	Pain Interference	64.4	6.8	40.7 - 77
	Fatigue	60.4	9.3	33.1- 77.7
	Sleep Disturbance	57.3	8.7	30.5 - 77.5
	Depression	53.4	9.6	38.2 - 81.1
	Anxiety	53.8	9.6	37.1 - 82.8
	Anger	43.2	8.5	32.9 - 79.6
Pain Catastrophizing (PCS)		16.9	11.6	0 - 52
Ambivalence of Emotion Expression (AEQ		31.7	11.2	14 - 69
Childhood Trauma (CTQ)		31.7	11.2	25 - 199
Pain Intensity	Worst	8.57	1.31	3-10
	Average	5.33	1.63	2-10
	Current	5.54	1.92	0-10

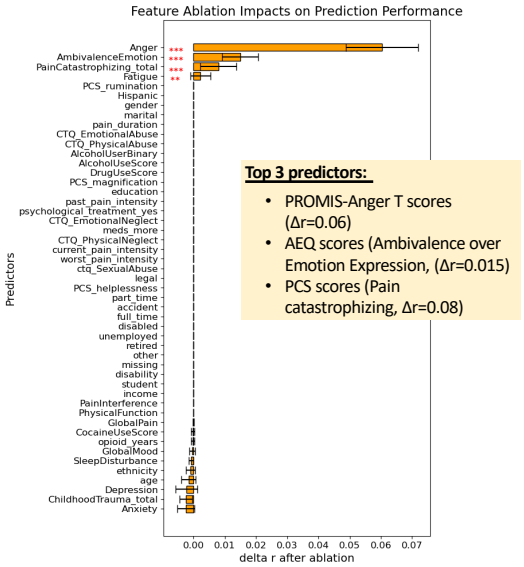
Model Performance Results



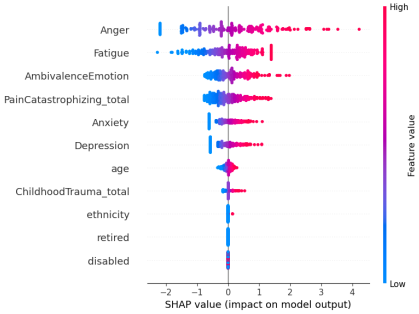
- Model parameters were selected using grid search based on r2 and mean squared errors.
- Monte Carlo Cross validation: n = 100, test size = 0.3
- Best model: **Elastic Net** (alpha = 5, L1 ratio = 0.5)
- Mean r = 0.602, r2 = 0.362, p < 0.001
- Median r = 0.608

Feature Interpretation Results

- **Feature Ablation**: replace feature values with 0, and repeat for each feature
- **Delta r**: how much r value was reduced from the full model without ablation. Higher r value means greater impact this feature has on the model performance.



Feature Interpretation Results



- SHapley Additive exPlanations (SHAP, Lundberg, 2017)
- Higher scores in anger improves model prediction the most
- Higher scores in fatigue, pain catastrophizing, anxiety, depression and childhood trauma have positive impacts on model predictions

Conclusions

- Our results highlight emotion factors (anger, ambivalence of emotion expression) as important predictors for opioid misuse in patients with chronic pain who take daily prescription opioids.
- Our results are consistent with previous studies (Gadi et al., 2020, Hah, 2017) that identified negative affect (anxiety, anger, and depression) as important predictors for opioid misuse, but also inconsistent as the previous studies have also identified pain intensity and sleep disturbance as significant predictors for opioid misuse in this patient population.
- This is the second study to show ambivalence of emotion expression as a risk factor for opioids misuse (Oberleitner et al., 2019).
- Emotion-focused therapy (EAET, DBT, CBT for anger, anxiety, and depression) may reduce opioid misuse in this patient population.

References and Funding

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