# Variability in Quantitative Sensory Testing in Adolescents with Functional Abdominal Pain: Associations with Heterogeneity of Pain Experiences

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## Conclusion

→ There was significant variability of static and dynamic QST findings in adolescents with FAP.

→ Higher pain ratings (heat, pressure, facilitated testing) were associated with higher usual pain intensity and abdominal pain severity; lower pressure pain threshold and tolerance were significant for worst pain intensity and widespread pain.

→ Further investigations should test longitudinal changes in the relationships between QST and clinical pain.

## Background

- Little is known regarding quantitative sensory testing (QST) and clinical pain in adolescents with functional abdominal pain (FAP).
- Given known associations of QST and clinical pain in adults and their prognostic features, understanding QST profiles in a well-defined pediatric cohort may provide insight into mechanistic changes in pain processing.

## Aims

- Examine the associations of QST parameters and clinical pain in adolescents with FAP.
- Hypothesis: Higher pain intensity, increased number of pain sites, abdominal pain severity and higher pain-related disability would be associated with pain facilitation and lack of pain inhibition on QST.

## Methods

- Cross-sectional study: 14- to 18-year old adolescents with FAP (ROME IV) recruited from Gastroenterology and Pain Clinics at the local institution completed validated measures and QST assessments.

Measures:
- Abdominal pain: Usual and worst pain intensity assessed using Numerical Rating Scale (NRS; 0-10)
- Abdominal pain severity: Abdominal Pain Index (API)
- Widespread pain (WP): Participants denoted pain sites on a body diagram, and WP defined as pain in each body quadrant and midline
- Pain-related disability: Child Activity Limitations Interview (CALI)
- Psychological functioning: PROMIS Pediatric Anxiety Short-Form and Depressive Symptoms Short-Form, Pain Catastrophizing Scale

QST Assessment:
- Pain ratings for each QST task using NRS
- Heat pain threshold and tolerance (forearm; Medoc Q-Sense)
- Pressure pain threshold and tolerance (forearm and trapezius; Algomed)
- Temporal summation using von Frey filament of 10 successive stimuli
- Conditioned pain modulation (CPM) was assessed with immersion of the non-dominant hand in 10°C water bath as the conditioning stimulus, and thermal pain as the painful stimulus.

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## Results

- N = 75, females 81%, mean age = 16.4 years (SD 1.4)
- White 67%, Black 1%, Asian 5%, AIAN 1%, Hispanic 12%
- Usual pain intensity M = 5.3 (SD 2.1), worst pain intensity M = 7.0 (SD 2.0), API = 2.4 (SD 0.8, range 0-3.9)
- Non-abdominal pain sites median = 4 (range 0-17), WP: 29%
- CALI = 31.8 (range 0-70.6, SD 17.5)
- Spearman correlation coefficients indicated:
  - Significant positive correlations between pain ratings and pain intensity and pain-related disability (rho = 0.28-0.50).
  - Significant negative correlations between CPM index and pain-related disability (rho = -0.26).

**Data Analyses**
- Temporal summation = 10th pain rating – 1st pain rating
- CPM ratio = conditioning heat pain threshold/testing heat pain threshold
- Simple correlations and multivariable regression models examined the association between each QST parameter and each pain outcome.
- The Benjamini-Hochberg Procedure controlled the False Discovery Rate (FDR) at 0.20 for multiple hypothesis testing.

**Table 1: Adjusted associations between pain ratings on QST assessment and clinical pain[a]**

| Pain Ratings on QST parameters (interquartile range increase) | Usual pain intensity[b] (beta, 95% CI) | Worst pain intensity[b] (beta, 95% CI) | API[b] (beta, 95% CI) | WP[c] (odds ratio, 95% CI) | CALI[b] (beta, 95% CI) |
|---|---|---|---|---|---|
| Heat threshold pain rating | **1.09 (0.21, 1.97)** | 0.74 (–0.10, 1.59) | 0.34 (–0.06, 0.73) | 0.83 (0.28, 2.46) | 4.8 (–2.6, 12.3) |
| Heat tolerance pain rating | 0.41 (–0.31, 1.13) | 0.30 (–0.37, 0.96) | 0.02 (–0.30, 0.33) | 0.98 (0.34, 2.82) | 1.6 (–3.8, 7.1) |
| Pressure threshold pain rating (forearm) | **1.32 (0.30, 2.35)** | 0.78 (–0.21, 1.78) | 0.33 (–0.14, 0.80) | 1.23 (0.34, 4.43) | 6.3 (–2.5, 15.0) |
| Pressure tolerance pain rating (forearm) | 0.34 (–0.55, 1.23) | 0.37 (–0.46, 1.21) | 0.06 (–0.33, 0.45) | 2.02 (0.67, 6.04) | 6.7 (–0.4, 13.8) |
| Pressure threshold pain rating (trapezius) | 1.22 (–0.03, 2.48) | 1.09 (–0.11, 2.28) | **0.80 (0.24, 1.36)** | 13.24 (0.69, 252.4) | 9.1 (–1.6, 19.6) |
| Pressure tolerance pain rating (trapezius) | 0.02 (–0.81, 0.86) | –0.01 (–0.80, 0.78) | 0.21 (–0.17, 0.60) | Not estimable | 4.9 (–1.8, 11.6) |
| Temporal summation | **1.38 (0.22, 2.54)** | 1.07 (–0.08, 2.21) | 0.41 (–0.14, 0.96) | 2.55 (0.37, 17.7) | 2.8 (–7.2, 12.8) |

[a]Models adjusted for age, sex, depression, anxiety, and pain catastrophizing. [b] Linear regression model. [c] Logistic regression model.
**Red** – significant after FDR-correction; **Bold** – significant at single testing but not significant after FDR-correction.

**Table 2: Adjusted associations between QST parameters and clinical pain[a]**

| QST parameters (interquartile range increase) | Usual pain intensity[b] (beta, 95% CI) | Worst pain intensity[b] (beta, 95% CI) | API[b] (beta, 95% CI) | WP[c] (odds ratio, 95% CI) | CALI[b] (beta, 95% CI) |
|---|---|---|---|---|---|
| Heat pain threshold | 0.57 (–0.20, 1.34) | 0.18 (–0.55, 0.91) | 0.18 (–0.16, 0.52) | 0.72 (0.28, 1.81) | 0.6 (–5.8, 7.0) |
| Heat pain tolerance | 0.63 (–0.28, 1.53) | –0.11 (–0.95, 0.72) | 0.05 (–0.35, 0.45) | 1.01 (0.28, 3.61) | –1.3 (–8.3, 5.8) |
| Pressure pain threshold (forearm) | 0.47 (–0.15, 1.10) | 0.16 (–0.44, 0.75) | 0.15 (–0.12, 0.43) | 0.94 (0.41, 2.14) | –1.4 (–6.6, 3.8) |
| Pressure pain tolerance (forearm) | 0.27 9–0.44, 0.98) | 0.16 (–0.51, 0.83) | 0.16 (–0.15, 0.47) | 1.11 (0.42, 2.90) | –2.2 (–8.0, 3.6) |
| Pressure pain threshold (trapezius) | 0.23 (–0.58, 1.04) | –0.14 (–0.90, 0.63) | –0.06 (–0.45, 0.33) | **0.20 (0.04, 0.96)** | –2.5 (–9.2, 4.2) |
| Pressure pain tolerance (trapezius) | –0.70 (–1.71, 0.31) | **–1.09 (–1.98, –0.20)** | –0.43 (–0.90, 0.04) | 0.01 (0.00, 1.30) | –7.0 (–15.2, 1.3) |
| CPM ratio | –0.19 (–0.71, 0.33) | –0.03 (–0.52, 0.46) | 0.04 (–0.19, 0.27) | 0.97 (0.52, 1.82) | –3.4 (–7.6, 0.8) |