Relation Between Dental Fear and Fear of Pain: How Heritable?

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Overview and Significance

• Minimal dental care-related fear research has incorporated genetic variables (e.g., Binkely et al., 2009; Ray et al., 2010; Vassend, Roysamb, & Nielsen, 2011)

• Genetic factors may be important for understanding mechanisms involved in dental care-related fear

• Complete understanding of etiological mechanisms is critical for treatment development
Introduction

• Greater levels of dental care-related fear $\rightarrow$ avoidance of treatment (Doerr et al., 1998; Moore et al., 1996)

• Avoidance associated with poorer oral and systemic health (Schuller et al., 2003; Williams et al., 2008)

• Between 10% and 20% of adults report a high level of fear associated with dental visits (Smith & Heaton, 2003)
• Fear of pain is a critical component of dental care-related fear (McNeil & Berryman, 1989)

• Interplay of fear of pain and pain sensitivity is important for understanding dental-care related fear (Kent, 1985; McNeil et al., 2011)
• Dental care-related fear has been hypothesized to be at least partly heritable (e.g., Thomson et al., 2009; Vassend et al., 2011)

• Inheritance may be, at least in part, a result of the inheritance of pain sensitivity and, relatedly, an inclination toward fear of pain
Objectives

1. Determine the heritability of dental care-related fear

2. Determine the heritability of fear of pain

3. Determine the shared heritability of dental care-related fear and fear of pain
Participants

• Members of families taking part in the Center for Oral Health Research in Appalachia (COHRA) study on determinants of oral diseases in families

• $N = 1370$ (632 female)
• Ages 11 – 81 years ($M = 29.1$, $SD = 12.2$)
• Appalachia population (McNeil, Crout, Marazita, 2012)
Method

• Measures
  • **Dental Fear Survey** – 20-item, self-report measure of anxious reactions to dental situations (Kleinknecht et al., 1973)
  • **Fear of Pain Questionnaire-Short Form** – 9-item, self-report measure of pain-related fear (McNeil & Rainwater, 1998)

• DNA Collection
  • Blood and saliva sampling (Oragene*DNA Self-Collection Kit; DNA Genotek Inc., Ottawa, Ontario, Canada)
Method

• Participants completed study questionnaires as part of a larger, comprehensive protocol (Polk et al., 2008)

• Heritability and genetic correlation estimated from families using likelihood-based methods under the variance components framework
Results - Relative Pairs

- 1370 Individuals
- 480 Parent-Offspring Pairs
- 146 Sibling Pairs
- 10 Grandparent-Grandchild Pairs
- 31 Avuncular Pairs
- 41 Half-Sibling Pairs
- 1 Half-Avuncular Pair
- 16 First Cousin Pairs

Relative pairs used in heritability analysis
## Results - Heritability

Heritability Estimates for Measured Phenotypes

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>$h^2r$</th>
<th>$R^2$</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DFS – Total Score</strong></td>
<td>.30</td>
<td>.03</td>
<td>$1 \times 10^{-4}$</td>
</tr>
<tr>
<td><strong>DFS – Avoidance Subscale</strong></td>
<td>.22</td>
<td>.02</td>
<td>$4 \times 10^{-3}$</td>
</tr>
<tr>
<td><strong>DFS – Specific Stimuli Subscale</strong></td>
<td>.36</td>
<td>.02</td>
<td>$3 \times 10^{-6}$</td>
</tr>
<tr>
<td><strong>DFS – Physiological Arousal Subscale</strong></td>
<td>.14</td>
<td>.04</td>
<td>$3 \times 10^{-2}$</td>
</tr>
<tr>
<td><strong>FPQ – Total Score</strong></td>
<td>.35</td>
<td>.05</td>
<td>$4 \times 10^{-6}$</td>
</tr>
<tr>
<td><strong>FPQ – Minor Pain Subscale</strong></td>
<td>.16</td>
<td>.02</td>
<td>$2 \times 10^{-2}$</td>
</tr>
<tr>
<td><strong>FPQ – Severe Pain Subscale</strong></td>
<td>.30</td>
<td>.05</td>
<td>$3 \times 10^{-5}$</td>
</tr>
<tr>
<td><strong>FPQ – Medical Pain Subscale</strong></td>
<td>.35</td>
<td>.04</td>
<td>$3 \times 10^{-6}$</td>
</tr>
</tbody>
</table>

*Note:* Heritability estimates are adjusted for sex and age. Standard Error = .08 for all heritability estimates. Sex effect is significant at $p = 1 \times 10^{-12}$. 
## Results – Genetic Correlations

Genetic Correlations for Selected Phenotypes

<table>
<thead>
<tr>
<th></th>
<th>$\text{rhoG}$</th>
<th>$p$-value $\text{H}_0$ (\text{rhoG} = 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFS – Total Score &amp;</td>
<td>.68</td>
<td>(1 \times 10^{-2})</td>
</tr>
<tr>
<td>FPQ – Total Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFS – Total Score &amp;</td>
<td>.19</td>
<td>(6 \times 10^{-1})</td>
</tr>
<tr>
<td>FPQ – Minor Pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subscale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFS – Total Score &amp;</td>
<td>.72</td>
<td>(7 \times 10^{-3})</td>
</tr>
<tr>
<td>FPQ – Major Pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subscale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFS – Total Score &amp;</td>
<td>.76</td>
<td>(4 \times 10^{-3})</td>
</tr>
<tr>
<td>FPQ – Medical Pain</td>
<td></td>
<td></td>
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<tr>
<td>Subscale</td>
<td></td>
<td></td>
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</tbody>
</table>
Conclusions

• In line with existing literature, dental care-related fear is associated, but not completely overlapping, with fear of pain, $r = 0.50, p < 0.01$ (phenotypic correlation)

• Both dental care-related fear and fear of pain are moderately heritable, 30% and 35%, respectively

• Notably, there is a substantial genetic correlation between dental care-related fear and fear of pain
  • 44.9% of the genes accounting for one phenotype also account for the other phenotype
The findings bolster existing literature that suggests that fear of pain is a critical component of dental care-related fear.
Limitations

• Phenotypes are based solely on self-report data

• One inclusion criterion was that all members of a household participate, so many (but not all) relatives lived together

• Comparison of heritability of subscale score “phenotype” and total score “phenotype” should be done with caution, as one is part of the other

• Did not account for environmental factors given data available and modeling strategy

• Though heritability is evident, it is unclear what role genes play in development/maintenance of dental care-related fear, and which genes
Acknowledgements

- Participating families and community partners
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Thank you for your attention.