Gender Differences in Response to Experimental Pain among Medical Students from a Western State of India

Pratik Akhani,1 Samir Mendpara,2 Bhupendra Palan,1 Jaman Harsoda.1

Abstract

Background: Pain is one of the most common reasons for patients to seek medical attention and it causes considerable human suffering. Pain is a complex perception that differs enormously among individual patients. Gender plays an important role in how pain is experienced, coped with and treated. Even young healthy individuals often differ in how they perceive and cope with pain. This study was done to investigate gender differences in response to experimental pain among medical students from a western state in India. Methods: A total of 150 medical students (86 males and 64 females) participated in this interventional study. The Cold Pressor Test was used to exert experimental pain. To study the response, cardiovascular measures (radial pulse, systolic blood pressure and diastolic blood pressure) and pain sensitivity parameters (pain threshold, pain tolerance and pain rating) were assessed. Results: No significant difference was found in cardiovascular response to experimental pain between both the genders (p>0.05). Pain threshold and pain tolerance were found to be significantly higher in males whereas pain rating was found to be significantly higher in females (p<0.01). Pulse reactivity showed a negative relationship with pain threshold and pain tolerance whereas a positive relationship with pain rating, however no statistically significant relation was found between these measures. Conclusion: Females display greater pain sensitivity than males. Different pain perception might account for gender difference in pulse reactivity.

Keywords: Sex, Pain, Pain threshold, Pulse, Blood pressure (Source: MeSH-NLM).

Introduction

Pain is the most common complaint that significantly contributes to patient suffering. Pain is an unpleasant feeling often caused by an intense or damaging stimuli, such as stubbing a toe, burning a finger, or putting alcohol on a cut. Pain is a complex neuro-physiological and psychological process that differs enormously among individual patients, even those who have similar injuries or illnesses.1

Gender plays an important role in how pain is experienced, coped with and treated.2 Even young males and females often differ in how they perceive and cope with pain.3 In recent years gender differences in response to pain have received increased attention and multiple studies have investigated these differences using a wide variety of noxious stimuli.4 A number of studies have demonstrated a higher prevalence of chronic pain among females compared to males.5 The expansive body of literature in this area suggests that females have lower pain threshold and tolerance to a range of pain stimuli when compared to males. Additiona-lly, females generally report experiencing more recurrent pain, more severe pain and longer lasting pain than males.6 Many of the observed gender differences in pain prevalence (i.e., headache, abdominal and visceral pain) appear to reduce beyond the reproductive years.7 Males and females respond differently to various classes of pain medications, suggesting that physical pain relieving systems may differ in the two genders.8 There is a growing body of literature that indicates females are more likely than males to be undertreated for their pain. It appears that gender affects not only pain perception, pain coping, and pain reporting, but also pain-related behaviors, including use of healthcare and the social welfare system.9

Gender differences in pain perception can vary across different cultures.10 There are not many studies regarding gender differences in pain perception from healthy individuals in India. We sought to illuminate whether gender differences exist in response to experimental noxious stimulus in young healthy medical students from a western state of India.

Methods

Prior approval for this study was obtained from Sumandeep Vidyapeeth Institutional Ethics Committee (SVIEC). It was an interventional study design with the cold pressor test being...
the intervention. Data collection occurred before and after the cold pressor test. The study was conducted in the clinical laboratory, department of Physiology, S.B.K.S. medical institute and research centre. A total of 150 medical students (86 males and 64 females) from the S.B.K.S. medical institute and research centre participated as subjects. Written informed consent was obtained according to the ethical committee policy. Before testing, a detailed history was taken, followed by a general and systemic examination of subjects.

Young healthy students between 17-20 years of age, who were willing to give informed consent for participation, right handed (for selection of uniform study population, as handedness may affect sensitivity to pain), and females who were in pre-ovulatory phase of menstrual cycle (for selection of uniform study population, as pain perception may vary during different phases of menstrual cycle) were included in the study.

Students with a history of local/bone injury in the right hand (as this hand will be immersed in cold water), who were on any form of diet or exercise regime for weight loss or gain, who were taking any analgesics (as analgesics will reduce pain perception), and who were taking medications which may affect the Autonomic Nervous System were excluded. Students suffering from any known illness affecting or involving the Autonomic Nervous System e.g. Diabetes Mellitus, Thyroid disorder, any cardiovascular or neuropsychiatric disorder, any menstrual irregularities or disorders were also excluded from the study.

As showed in the CONSORT (Consolidated Standards of Reporting Trials) diagram, out of a total of 186 students who were approached for study, 150 were selected for study according to the inclusion and exclusion criteria.

Statistical analysis was done using SPSS version 17®. Unpaired students t-test and Pearson’s correlation were applied, p-values < 0.05 were considered significant.
Results
The study population included 86 male students and 64 female students (Table 1). The mean age of male students was 18.57 years and of female students was 18.37 years (p=0.33). The mean height of male students was 1.57 meters and of female students was 1.58 meters (p=0.43). The mean body mass of male students was 53.42 Kg and of female students was 52.65 Kg (p=0.50). The mean Body Mass Index of male students was 21.79 Kg/m² and of female students was 21.14 Kg/m² (p=0.11).
Thus, the anthropometric parameters of both the study groups were fairly uniform with p>0.05 for all the parameters.

Table 1. Age and anthropometric data of the study population (Unpaired student’s t-test).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Male (n=86) [Mean ± SD]</th>
<th>Female (n=64) [Mean ± SD]</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>18.57 ± 0.77</td>
<td>18.37 ± 0.81</td>
<td>0.33</td>
</tr>
<tr>
<td>Height (in meters)</td>
<td>1.57 ± 0.05</td>
<td>1.58 ± 0.06</td>
<td>0.43</td>
</tr>
<tr>
<td>Weight (in Kg)</td>
<td>53.42 ± 3.79</td>
<td>52.65 ± 4.80</td>
<td>0.50</td>
</tr>
<tr>
<td>Body Mass Index (Kg/m²)</td>
<td>21.79 ± 1.61</td>
<td>21.14 ± 1.49</td>
<td>0.11</td>
</tr>
</tbody>
</table>

*p<0.05-statistically significant.

Table 2 shows gender differences in cardiovascular parameters in response to experimental pain. Mean pulse reactivity was found to be higher in females (15.04 beats/minute) as compared to males (12.91 beats/minute), but this difference was not significant (p=0.054). Mean systolic blood pressure reactivity was found to be higher in females (9.26 mmHg) as compared to males (8.9 mmHg), but this difference was not significant (p=0.7). Also, mean diastolic blood pressure reactivity was found to be higher in females (6.3 mmHg) as compared to males (5.35 mmHg), but this difference was not significant (p=0.26).
Thus, there was no difference in cardiovascular response to experimental pain in both the genders with p>0.05 for all the parameters.

Table 2. Gender differences in cardiovascular parameters in response to experimental pain (Unpaired student’s t-test).

<table>
<thead>
<tr>
<th>Parameter (Post test value minus Pre test value)</th>
<th>Male (n=86) [Mean ± SD]</th>
<th>Female (n=64) [Mean ± SD]</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse reactivity (beats/minute)</td>
<td>12.91 ± 8.69</td>
<td>15.04 ± 6.76</td>
<td>0.054</td>
</tr>
<tr>
<td>Systolic blood pressure reactivity (mmHg)</td>
<td>8.9 ± 7.1</td>
<td>9.26 ± 6.28</td>
<td>0.70</td>
</tr>
<tr>
<td>Diastolic blood pressure reactivity (mmHg)</td>
<td>5.33 ± 5.81</td>
<td>6.3 ± 6.26</td>
<td>0.26</td>
</tr>
</tbody>
</table>

*p<0.05-statistically significant.

Table 3 shows gender differences in pain sensitivity parameters in response to experimental pain. Males showed higher pain threshold (mean 22.57 seconds) as compared to females (mean 19.21 seconds) with p<0.05. Males showed higher pain tolerance (mean 77.68 seconds) as compared to females (mean 57.92 seconds) with p<0.05. Pain rating during experimental pain was found to be higher in females (mean 6.34) as compared to males (mean 5.45) with p<0.05. Thus, females were found to be more sensitive to pain than males.

Table 3. Gender differences in pain sensitivity parameters in response to experimental pain (Unpaired student’s t-test).

<table>
<thead>
<tr>
<th>Parameter (Post test value minus Pre test value)</th>
<th>Male (n=86) [Mean ± SD]</th>
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<th>p value</th>
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</thead>
<tbody>
<tr>
<td>Pain threshold (seconds)</td>
<td>22.57 ± 7.93</td>
<td>19.21 ± 5.84</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Pain tolerance (seconds)</td>
<td>77.68 ± 9.72</td>
<td>57.92 ± 7.68</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Pain rating</td>
<td>6.34 ± 1.58</td>
<td>5.45 ± 1.49</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

*p<0.05-statistically significant.

Pulse reactivity showed a negative relationship with pain threshold and pain tolerance while a positive relationship with pain rating (Table 4), however no statistically significant relation was found between these measures (p>0.05 for all correlations).

Discussion
Pain threshold and pain tolerance during experimental pain were found to be significantly higher in males, whereas pain rating was found to be significantly higher in females. Thus females displayed greater pain sensitivity than males, a finding similar to Fillingim et al.,15 and Riley et al.14 However Nie H et al.,13 found that females showed lower pain thresholds than males, but this difference was not significant and was likely due to small sample size (12 males, 12 females). The mechanisms underlying these differences remain unclear. One possible explanation suggests that males are more motivated to tolerate and suppress expressions of pain because of the masculine gender role, whereas the feminine gender role encourages pain expression and produces lower motivation to tolerate pain among females.15 Other mechanisms have been proposed to explain the differing response to experimental pain between the genders, including hormonal factors, differences in pain modulatory systems, and genetic factors. From a more psychosocial perspective, another potential explanation for the gender difference in pain responses involves social role expectancies. Different pain perception might account for gender difference in pulse reactivity. Hormonal influences may play a minor role.19

Sex hormones have effects throughout the nervous system and their plasma concentrations change on a regular basis among both females and males. Also, hormone levels change throughout the menstrual cycle, during pregnancy, and after menopause in females. These differences may have major consequences for the pain perception.20 For example, a correlation between elevated estrogen levels and perception of experimental heat pain has been shown in some studies where elevated estrogen levels were associated with a lower heat tolerance threshold and heat pain.21 In females, the pain modulatory system shows menstrual variation with more effect in the ovulatory phase of cycle compared to the menstrual and luteal phase.22,23 Whereas males, in spite of a significant decrease in their testosterone levels with advancing age, appear to be less vulnerable to changes in sex hormone levels during their entire lifespan.24

In this study, we found an inverse trend between pulse reactivity and pain sensitivity as indicated by pain threshold and
Table 3. Gender differences in Pain sensitivity parameters in response to experimental pain.

<table>
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<tr>
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<tr>
<td>Pain threshold (seconds)</td>
<td>22.57 ± 6.81</td>
<td>19.21 ± 6.95</td>
<td>&lt;0.01**</td>
</tr>
<tr>
<td>Pain tolerance (seconds)</td>
<td>77.68 ± 18.62</td>
<td>57.92 ± 14.47</td>
<td>&lt;0.01**</td>
</tr>
<tr>
<td>Pain rating (0 to 10)</td>
<td>5.45 ± 1.18</td>
<td>6.34 ± 1.16</td>
<td>&lt;0.01**</td>
</tr>
</tbody>
</table>

*p<0.05-statistically significant, **p<0.01-highly significant.

Table 4. Correlation of Pulse reactivity with Pain Threshold, Pain tolerance and Pain rating (Pearson’s correlation).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pain Threshold</th>
<th>Pain tolerance</th>
<th>Pain rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td>f = -0.045, p = 0.7533</td>
<td>f = -0.066, p = 0.5794</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>f = -0.164, p = 0.1373</td>
<td>f = -0.086, p = 0.9522</td>
</tr>
</tbody>
</table>

*p<0.05-statistically significant.

Pain causes sympathetic stimulation and elevates blood pressure levels which stimulates baroreceptors. These activated baroreceptors, in turn, initiate a signaling cascade that causes modulation of descending pain pathways to inhibit pain. The theory of hypertensive hypoalgesia suggests that elevated resting blood pressure levels will allow for a quicker stimulation of this baroreceptor mediated pain inhibitory activity with pain induced sympathetic arousal causing decreased pain perception in hypertensive individuals.30,31

Many other factors that may be held responsible for gender differences in pain perception include race and ethnicity of person, endogenous and exogenous pain modulation, gonadal hormones, cognitive or affective parameters such as coping processes, and catastrophizing, the RIII reflex, pain related behaviors, social role expectancies, past painful experiences and genetic factors.32

Table 5. Correlation of Pain sensitivity parameters with cardiovascular response.

<table>
<thead>
<tr>
<th>Parameter</th>
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*p<0.05-statistically significant, **p<0.01-highly significant.

In conclusion our study suggests that gender of the subject plays a significant role in response to experimental pain with females being more sensitive to pain than males. There is a need for further research to investigate physiological, psychological, and socio-cultural influences on response to experimental pain.
References

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