Lab: The Stress Response

Background Information

What Causes Stress on the Body?

Not all stress is negative. The body has a mechanism to deal with stress in place to assist the body in escaping a physical confrontation or threat. "Good" stress is normally associated with an acute, or immediate, threat or condition. Chronic, or long-term stress, is not good for the body and can result in physical symptoms and damage to the body. Stress causes an upset in homeostasis or balance is not healthy.

Stress can be caused by many different types of stressors, or stress-causing agents. Stressors can be psychological (mental), physical, environmental, or related to life events or lifestyle. Some of these stressors can be controlled and/or managed while others are outside of our control.

- **Psychological** stressors may include depression, anxiety, emotional trauma, and any other factors that may negatively impact mental health.
- **Physical** stressor may include injuries, illness, infection, pain, surgery, overexertion, or strain on the body
- **Environmental** stressor may include temperature extremes, poor sanitation, pollution, lighting, noise, and extreme weather conditions
- **Life event** stressors may include birth, death, weddings, purchases, relocation, etc...
- **Lifestyle** stressors may include work, daily hassles, poor time management, overspending, sleep deprivation, etc...

The Physiological Response to Stress

Stress results in body stimulating a response through the endocrine system, nervous system, and/or immune systems. The stimulation of these body systems causes physical changes that can have acute and chronic effects on the body.

Acute stress causes a flood of cortisols to be released from the adrenal glands, preparing the body to deal with the perceived stress or threats to the body. The pathway by which the body releases these hormones is actually quite complex.

Once the body perceives a stressor, the brain releases a neurotransmitter that stimulates the hypothalamic-pituitary-adrenal axis (HPA). The
The hypothalamus acts as the connection between the nervous system and endocrine system in this pathway. The neurotransmitter stimulates the hypothalamus, which then releases corticotrophin-releasing hormone (CRH) through a vein that leads directly to the anterior pituitary gland to produce and release adrenocorticotropic hormone (ACTH) that is released into the bloodstream and finds its way to the adrenal glands. ACTH stimulates the adrenal glands to produce adrenaline and other cortisols. These hormones allow the body to access energy stores within the body quickly.

The hypothalamus is also capable of quickly stimulating the adrenal glands to release adrenaline when needed quickly in the "fight or flight" response. As the stressor decreases, the body will signal the adrenal glands to discontinue producing these hormones and the levels will return to normal. A body that is exposed to a long-term will continue to produce these hormones, which may lead to symptoms of chronic stress.
**Procedure**

Today you will be observing the acute effects on heart rate and breathing rate caused by a few simple stressors.

First, make a hypothesis or hypotheses on the effect that the following variables will have on your heart rate and breathing rate: temperature, orthostatic hypotension (dizzy spell), pain, and environmental/mental stress.

***Write hypothesis or hypotheses here:***

**BEFORE TESTING EACH VARIABLE**, do the following steps.

1. Have the test subject sit quietly, eye closed, and NO talking for 3 minutes.

2. After the 3 minutes, record the subject’s heart rate (counting number of pulses for 15 seconds and then multiple by 4) and breathing rate (# of breaths for 30 seconds). Remember for breathing rate, one breath = 1 inhale and 1 exhale. Record these numbers in Table 1.

**Part A: Environmental Stress: Temperature**

3. Have the test subject place one hand into the bucket of water.

4. Record the test subject’s heart rate and breathing rate every minute for 3 minutes. Record results in Table 1.

5. Once the 3 minutes is up, have the test subject sit quietly, with their eyes closed, and no talking for 3 minutes. After the 3 minutes, record the test subject’s heart rate and breathing rate. Record results into Table 1.

**Part B: Physical Stress: Orthostatic Hypotension (Dizzy spells)**

6. Repeat steps 1 and 2. Record results into Table 1.

7. Have the test subject stand upright leaning on a wall and continuing to relax as much as possible.

8. Record the heart rate and breathing rate immediately when the test subject stands. Then again after 2 minutes and 4 minutes. Record results into Table 1.

9. Once the 4 minutes is up, have the test subject sit quietly, with their eyes closed, and no talking for 3 minutes. After the 3 minutes, record the test subject’s heart rate and breathing rate. Record results into Table 1.
Part C: Physical Stress: Pain

10. Repeat steps 1 and 2. Record results into Table 1.

11. Have the test subject place the clothespin on the tip of the pinky finger. The test subject should feel discomfort, but not extreme pain. Refer to the Pain Rating Scale to the right. The test subject should be between a 2 and a 4. Adjust clothespin so that the pain is between those numbers.

12. Measure heart rate and breathing rate every minute for 3 minutes. Record results in Table 1.

13. Once the 3 minutes is up, have the test subject remove the clothespin, sit quietly, with their eyes closed, and no talking for 3 minutes. After the 3 minutes, record the test subject’s heart rate and breathing rate. Record results into Table 1.

Part D: Environmental and Mental Stress: Noise and Test Taking

14. Have the test subject complete as many of the following “Pre-stress” math problems as possible in a 2 minute period. No calculators but scratch paper may be used.

15. Repeat steps 1 and 2. Record results into Table 1.

16. If the test subject has headphones and iPod, have the test subject turn on music and place the headphones on their head. If headphones and iPod are not available, your teacher will be playing music for this section. Have the test subject complete as many of the following “Trial Period” math problems as possible in 2 minutes. No calculators but scratch paper may be used.

17. After the two minutes, record the heart rate and breathing rate. Record in Table 1. Remove the headphones and turn off the music.

18. Now have the test subject complete as many of the “Post-Stress” math problems as possible within 2 minutes. No calculators but scratch paper may be used.

19. After the two minutes, record the heart rate and breathing rate. Record in Table 1.

Table 1: Heart Rate (HR) and Breathing Rates (BR) Under Stress

<table>
<thead>
<tr>
<th>Stress Test</th>
<th>Pre-Stress</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Post-Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>HR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>BR</td>
<td></td>
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<td></td>
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<tr>
<td>Physical</td>
<td>HR</td>
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<tr>
<td>Orthostatic</td>
<td>BR</td>
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<tr>
<td>Physical: Pain</td>
<td>HR</td>
<td></td>
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<tr>
<td>Noise</td>
<td>BR</td>
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</tbody>
</table>
Analysis Questions:

1. Why was it important to take the test subject’s heart rate and breathing rate while sitting quietly with eyes closed?

2. Why did was the “Post-Stress” heart rate and breathing rate taken?

3. Was/were your hypothesis/ hypotheses correct? Use your data as evidence.

4. Explain what was occurring in the body to increase the heart rate and blood pressure of the test subject during the stress tests.

5. What outside factors may have affected the results?
Review Questions

1. Define homeostasis.

2. How does stress cause an “upset” in the homeostasis of the body?

3. Is all stress negative? Explain your answer.


   b. List 3 chronic physiological effects of stress.

5. Using the figure to the right titled “Causes of Stress by Generation”
   a. What is the biggest stressor for Millennial? Why do you think this is?

   b. What causes the least stress in the Mature age group?

   c. Why do you think Boomers are most worried about the economy?

   d. From this list, what do you think the biggest stressor affecting teenagers (14-18 yrs. old) would be?