The Effects of Cortisol and Catecholamines to Acute Stress Exposure

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Introduction
Bio psychologists have attempted to understand how stress affect humans behaviorally by developing surveys which assess the degree of stress experienced both acutely and chronically. Measures which attempt to validate stress surveys by correlation with psychological measurements of stress hormones have reported high correlation with salivary cortisol, but little is known about the correlation of salivary alpha-amylase, a measure of catecholamines on dispositional stress.

The release of cortisol, and catecholamines (epinephrine and norepinephrine) from the adrenal are the two major endocrine responses to stress (Stein et al. 2007).

Both cortisol and catecholamine levels can vary regardless of whether the stress is emotional or as a result of strenuous activity, an infection, or injury (Mills et al. 1991). During periods of stress, cortisol and catecholamines are detectable in the blood, urine and saliva (Patrick et al. 2000).

Study shows that cortisol is easily detectable in saliva and correlates well with stress as indicated by the limbic hypothalamic-pituitary-adrenal (HPA) response. In contrast, catecholamine levels are not detectable in saliva. However, salivary alpha-amylase has been found to correlate well with catecholamine levels (Patrick et al. 2000).

Purpose
The purpose of this study was to compare and validate cortisol and catecholamines as markers of stress, and determine if correlations exist between the stress survey measurements and salivary cortisol and alpha-amylase data.

Methods and Materials
After approval from the Brigham Young University-Hawaii Human Subjects Committee, saliva samples from a class of 22 students were taken at 1400 hours in a normal classroom setting. A second saliva sample was taken approximately one month later, right before an exam. The exam was considered a stressor. In addition, participants took a Stress Attribution Survey (SAS) and the Perceived Stress Scale (PSS) survey.

Saliva samples were collected by placing a small salivette (cotton roll) into the mouth of each participant for one minute. Salivettes were collected, labeled and stored in a -20°C freezer. Initial samples served as a baseline for resting cortisol and salivary amylase (catecholamine) levels for each participant.

Saliva samples were sent to Salimetrics for an analysis of cortisol and salivary amylase by immunoassay. Data were analyzed by repeated mean ANOVA and Pearson’s correlation.

Results

<table>
<thead>
<tr>
<th>Substance</th>
<th>Cortisol</th>
<th>Alpha-Amylase</th>
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<tbody>
<tr>
<td>Mean</td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td></td>
<td>0.20 (± 0.05)</td>
<td>0.16 (± 0.06)</td>
</tr>
<tr>
<td>P(T&lt;0.05) two-tail</td>
<td>0.26</td>
<td>0.06</td>
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</table>

The mean (± SO) cortisol concentration before the stressor was 0.20 µg/dL, after exposure to the stressor the mean was 0.16 µg/dL. The mean (± SO) salivary alpha-amylase also showed a higher concentration before the stressor of 60.24 U/mL and after the stressor a concentration of 50.29 U/mL. Results from a paired T-test performed on cortisol and salivary alpha-amylase levels before and after the exam were not significant.

Discussion
The exam used as the stressor in this experiment did not illicit a significant (p<0.05) change in cortisol or alpha-amylase concentrations. Thus, there was not sufficient data to determine which would be a better marker for acute stress, cortisol or catecholamines.

Possible reasons for suppressed cortisol and catecholamine concentrations are that they both tend to follow a circadian rhythm. Cortisol tends to peak early morning and decrease toward mid-day however; catecholamines are the opposite, low in the morning and peak toward mid-day. Even though the before and after saliva samples were taken at the same time of day this rhythm can be offset as a result of little or no sleep, increased caffeine consumptions, physical exercise (Pollard 1997) and emotionally charged events (Flinn and England 1995).

Conclusion
Although there was not sufficient information to determine which hormone, cortisol or catecholamines, would be a more accurate marker for acute stress, Pearson’s correlation coefficient indicated that the SAS and PSS surveys can be used as an indicator for chronic stress when comparing SAS and PSS data to base levels of cortisol but not alpha-amylase. If an individual has a high score on the stress survey, indicating they are under chronic stress, they will tend to have an higher base-level concentration of cortisol.

These results may be used clinically to validate the use of stress surveys as a marker of stress as determined by a correlation with a biological stress marker.

References

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