Examining the relationship between physiological measurements and self-reports of stress and wellbeing in middle school teachers over one school year

By Deirdre A. Katz, Alexis R. Harris, Rachel M. Abenavoli & Mark T. Greenberg

Introduction
- Educators are exposed to a variety of stressors, which can lead to poorer teaching performance, burnout, and increased student misbehavior (Jennings & Greenberg, 2009).
- Physiological measures of stress may contribute to our understanding of educators' stress, and response to interventions. These measures are gaining popularity in many types of research because of their assumed objectivity.
- Chronic stress can lead to detrimental health outcomes (McEwen & Stellar, 1993).
- Understanding where these measures diverge or overlap could help educational researchers determine whether costly physiological measures are worthwhile to incorporate into studies related to educators' stress, and response to interventions. These measures are important for understanding whether the physiological measures are an accurate representation of stress.

Table 1: Sample characteristics of participating teachers from one middle school in central Pennsylvania.

<table>
<thead>
<tr>
<th>Sample</th>
<th>N=30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Years Teaching</td>
<td>14.24 9.09</td>
</tr>
<tr>
<td>Age</td>
<td>44.7 12.5</td>
</tr>
<tr>
<td>Gender</td>
<td>M=5, F=25</td>
</tr>
</tbody>
</table>

Measures
- Self-reported measures of stress and wellbeing via an online survey
- Saliva samples at 4 time points (waking, 30 minutes later, lunchtime, bedtime) during a typical work day in the Fall.
- Salivary cortisol and alpha amylase were assayed from the samples.

Research Questions
Do Fall physiological measures of stress predict Spring self-reports of stress and burnout?

Hypothesis 1: Fall self-reports of stress and burnout will be negatively associated with the fall cortisol awakening response (CAR) (Puressner et al., 1999).

Hypothesis 2: Blunted CAR in the Fall will predict increased burnout and perceived stress in the Spring.

Results

Diurnal Rhythms
- Both salivary cortisol and sAA levels reflected a typical diurnal course with clear awakening responses after waking and reciprocal relationship.
- We detected a significant change in cortisol and sAA concentration over TIME (p<0.001).

Table 2: Partial Correlations between fall physiological and self-reported measures of stress.

<table>
<thead>
<tr>
<th></th>
<th>sAA Awakening Response</th>
<th>sAA Area Under the Curve</th>
<th>Cortisol Area Under the Curve</th>
<th>Cortisol Awakening Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>-.348</td>
<td>-.085</td>
<td>.081</td>
<td>-.276</td>
</tr>
<tr>
<td>Depressive Symptoms</td>
<td>-.322</td>
<td>-.015</td>
<td>.080</td>
<td>-.139</td>
</tr>
<tr>
<td>Time Urgency</td>
<td>-.508**</td>
<td>-.125</td>
<td>-.084</td>
<td>-.393**</td>
</tr>
<tr>
<td>Reappraisal</td>
<td>.261</td>
<td>.042</td>
<td>-.321</td>
<td>.040</td>
</tr>
<tr>
<td>Suppression</td>
<td>.435</td>
<td>.077</td>
<td>.525**</td>
<td>.295</td>
</tr>
<tr>
<td>Personal Exhaution</td>
<td>-.308</td>
<td>-.044</td>
<td>.227</td>
<td>-.223</td>
</tr>
<tr>
<td>Personal accomplishment</td>
<td>.075</td>
<td>.153</td>
<td>-.179</td>
<td>.089</td>
</tr>
<tr>
<td>Depersonalization</td>
<td>-.232</td>
<td>.151</td>
<td>.187</td>
<td>-.138</td>
</tr>
<tr>
<td>Personal Stress</td>
<td>-.199</td>
<td>-.080</td>
<td>.094</td>
<td>-.069</td>
</tr>
</tbody>
</table>

Notes: Controls: medication use and gender.

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Discussion
- Results show that salivary markers of stress show a modest relationship to self-reported measures of stress and burnout in the fall.
- Predictive relationships between Fall salivary measures and Fall self-report measures indicated in the partial correlation analyses did not persist into the Spring.
- Lack of predictability between fall physiological measures and spring psychological measures may indicate that the physiological measures are not trait characteristics but may be related to self-reported psychological wellbeing.
- Knowledge that high time urgency is associated with less steep awakening responses in both sAA and cortisol could help professional development coordinators design specific interventions around time management in order to decrease chronic stress.
- Small sample size leads to issue of both power and generalizability.

Conclusion
- These results add to a growing literature on teachers' stress and burnout, which will be important in informing future professional development efforts aimed at supporting teacher wellbeing.
- Incorporating physiological measures could give professional development leaders increased knowledge about how to target educator burnout to reduce chronic stress.
- Despite limitations, this study shows the usefulness and feasibility of incorporating salivary biomarkers into studies of educator health and wellbeing.
- Future analyses will examine the predictive value of fall physiological measures of stress with those in the spring.
Background / Context:

Teachers report some of the highest levels of occupational stress (Johnston, et al., 2005). Educators are exposed to a variety of stressors, which can lead to poorer teaching performance, burnout, and increased student misbehavior (Jennings & Greenberg, 2009). Although self-report measures of stress are most commonly used in education research, physiological measures of stress may also contribute to our understanding of educators’ stress, as well as their responsiveness to interventions designed to reduce stress and promote well-being. Physiological measures of stress are gaining popularity in psychosocial research because of their assumed objectivity (Granger, 2007). However, self-report and physiological measures of health and stress are not always consistent with one another. This inconsistency is noteworthy, given that the field of education currently relies primarily on self-report. Understanding where these measures diverge or overlap could help education researchers determine whether physiological measures that are costly, are worthwhile to incorporate into studies related to well-being. There is a need for research directed towards understanding the physical and psychological effects of teaching and how to facilitate optimal functioning.

Some studies show a relationship between self-reported burnout and cortisol levels. For example, the cortisol awakening response is positively associated with job stress and negatively associated with burnout (Chida & Steptoe, 2009). Grossi et al., (2005) found that in their sample of 154 workers, those in the high burnout group had higher cortisol concentrations at waking and 30 minutes later as well as greater area under the curve for salivary cortisol.

Salivary alpha amylase (sAA) research indicates that it is a highly sensitive indicator of changes caused by psychological stressors (Granger, Kivlighan, El-Sheikh, Girdis & Stroud, 2007). Many studies have measured change in sAA in response to acute stress stimuli (Nater & Rohleder, 2009), but few have reported associations with stress and diurnal patterns of sAA. Also not all studies reporting on sAA patterns are consistent since it is a relatively new biomarker in psychological research. A study of nurses found no association between sAA with work stress or burnout (Wengenfeld, Schuls, Dandekroger, Philipse, Rosek & Driessen, 2010). However, other studies have shown that the daily secretion pattern of sAA is altered in individuals reporting chronic stress (Nater et al., 2007), in young women experiencing chronic shame (Rohleder, Chen, Wolf & Miller, 2008) and in caregivers for cancer patients (Rohleder, Marin, Ma & Miller, 2009).

Studies incorporating salivary measures and self-reports of stress and burnout in teachers are rare and findings are inconsistent. One study showed that teachers with high levels of burnout showed blunted cortisol levels after waking (Pruessner, Hellhammer & Kirschbaum, 1999). In two other studies, neither Bellingrath, Weigl and Kudielka (2008) nor Moya-Albiol, Serrano and Salvador (2010) found associations between cortisol and burnout. No studies are available that investigate salivary alpha amylase’s association with burnout in teachers.

Purpose / Objective / Research Question / Focus of Study:

This study employs an innovative measurement design to facilitate the examination of associations between physiological indicators and self-reported measures related to stress and health. We examine associations between salivary biomarkers of teachers at the beginning of the school year and their self-reported levels of stress and burnout both concurrently and in the spring of that school year. We hypothesize that self-reports of burnout will be negatively and significantly associated with salivary measures the cortisol awakening response similar to the Pruessner et al. (1999) finding. We also hypothesize that blunted cortisol awakening responses in the fall will be predictive of higher rates of burnout and perceived stress in the spring.

Findings / Results:

Diurnal cortisol and sAA:

Diurnal cortisol and sAA. 30 participants were asked to collect saliva samples and one did not. Some participants were missing the appropriate data to compute variables and one did not return a saliva sample. Therefore, the sample size for analyses involving salivary biomarkers was 24.

Separate RM ANCOVAs for cortisol and sAA, Time (waking, 30 minutes later, lunchtime and bedtime) controlling for gender and medication use. There was a significant main effect of sampling time for both biomarkers. Cortisol changed in the expected diurnal pattern with cortisol levels increasing 30 minutes after waking and declining over the remainder of the day (p<0.05) for each time point was significantly different from one another (p<0.05). There was also a significant change in sAA concentration over time (F(3,168) = 32.82, p<0.00) (see Figure 2). Consistent with Glicic and colleagues (2011), sAA levels sharply declined 30 minutes after waking indicating an awakening response (p<0.05). A paired t-test comparison showed that the mean differences at time 4 were not significantly different than time 1, all other time points were significantly different from one another (p<0.005).

Before lunch and bedtime sAA levels were higher than the 30 min after waking sample of the day, but were similar to the waking sAA level (p>0.05) (see Figure 2).

Associations between physiological and psychological measures of stress. Partial correlations controlling for medication use and gender were calculated for salivary biomarkers and self-reports of stress and burnout from the fall (Table 2). Fall sAA awakening response showed significant correlations with educators’ reports of time urgency (r = -0.51, p=0.068), the suppression subscale of the emotional regulation questionnaire (r = 0.435, p=0.026), as well as trend level associations with symptoms of anxiety and depression (r = 0.35, p=0.08 and r = 0.33, p=0.07, respectively). Increased reports of emotional suppression was also significantly associated with higher levels of cortisol area under the curve (r = 0.53, p=0.006). This may indicate that participants who report suppressing their emotions in the fall are showing physiological signs of increased stress. Lastly, participants with higher reports of time urgency had less steep cortisol awakening response, which can be an indication of chronic stress. Unexpectedly, the fall perceived stress scale scores showed no association with any of the physiological measures. Further analyses examined the predictive value of fall physiological measures on spring psychological measures. These regressions controlled for fall self-reports, medication use and gender. Results indicated that the predictive relationship between fall salivary measures and fall self-report measures indicated in the partial correlation analyses did not persist into the Spring.

Conclusions:

Results show that salivary markers of stress show a modest relationship to self-reported measures in this sample but that measures of cortisol and sAA are not predictive of self-reported burnout or stress as was hypothesized. The data did not support the hypothesis that self-reported measures of burnout would be associated with physiological measures of stress. However, these unexpected outcomes were consistent with Bellingrath, Weigl and Kudielka (2008) and Moya-Albiol, Serrano and Salvador (2010) who found no associations between cortisol and burnout and a meta-analysis of 31 studies by Danilo Pons, Van Veen, and Zitman, (2011) that shows no associations between the cortisol awakening response and burnout.

Results did reveal that fall reports of high time urgency were associated with less steep awakening responses in both sAA and cortisol. With cortisol, a blunted awakening response can be associated with chronic stress (Fries, Dettenborn & Kirschbaum, 2009). Though there were no associations between the cortisol awakening response and self-reported stress or burnout, this finding could be an early indication of mounting chronic stress. A person’s feeling of time urgency is closely related to their feelings of stress in the workplace (Landy, Huleh, Thayer & Colvin, 1991). Professional development coordinators could use this information to design specific interventions around time management in order to decrease stress and prevent burnout.

Overall, this study demonstrated the feasibility of using salivary measures to assess biomarkers of teacher stress in school-based research, with middle school educators assessed on a typical day of work, cortisol and sAA showed their typical awakening responses and diurnal patterns. Results also indicated that neither physiological measures nor self-report measures alone capture the full picture of educators’ stress and burnout, as evidenced by measures that were unexpectedly unassociated such as self-reported perceived stress and physiological measures of stress. Further research incorporating physiological and self-report measures are needed to bring a deeper understanding about the health and well-being of educators.

These results add to a small but growing literature on teachers’ stress and burnout, which will be important in informing future professional development efforts aimed at supporting teacher efficacy and wellbeing. Limitations of this study include a small sample size leading to decreased generalizability and power for statistical analyses. Despite such limitations, this study shows the usefulness and feasibility of incorporating salivary biomarkers into studies of educator health and well-being.