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Teacher Cortisol Levels and iLEAP Testing

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Cover Page Footnote

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Introduction

Research has well established the debilitating effects of stress as it relates to chronically high levels of cortisol (Agorastos & Chrousos, 2021; Castro-Vale & Carvalho, 2020). Without interventions for sufferers of high levels of the inflammatory hormone cortisol, resultant health responses may be seen in increased susceptibility to irritability, intestinal irregularity, headache, weight gain, and an increase in mood disorders (Peters, et al., 2017). The long-term impact of abnormally high levels of cortisol due to long term stress may lead to abnormal levels of cholesterol, increased blood pressure, and dangerous levels of triglycerides, which are all precursors of heart disease (Sackett-Lundeen & Cornelissen, 2019).

Studies of workplace stress for public school teachers have progressed since the early 1970s. Researchers have constructed theoretical models that encompass correlations between individual characteristics, workplace conditions, and multiple indicators of health and wellness (Baker, 1985). A common biological indicator of stress and hypothalamic-pituitary adrenal axis (HPAA) activity is found in salivary cortisol levels which can be collected at various points in a day or at various points in a work cycle, such as a school year. Wolfram and associates (2013) found that student teachers had a significantly higher cortisol awakening response (CAR) on performance evaluation days than on control days.

Whereas studies have investigated various factors associated with the public-school teachers and stress, to these researchers' knowledge none have looked at the stress levels of teachers during the administration of state standardized testing such as iLeap (Mooney, Carter & Schraven, 2010). Some school districts determine teacher compensation based on the results of standardized testing. School sites often receive monetary contributions and allocations based on the school site "report card" (Kogan, Lavertu & Peskowitz, 2016). With so much riding on the student outcomes and teacher administration of the test, it is possible teachers feel more anxious and thus suffer from higher levels of cortisol secretion during standardized testing.

Due to the absence of studies associated with teacher stress and standardized testing, the research team chose to investigate whether there was a significant increase of stress during the time of standardized test administration. Since biomarkers are often used to measure stress levels in various occupational fields, it seemed logical and appropriate to do the same on this study (Strobel, et al., 2011). However, we did not want to rely simply on cortisol levels but chose to also administer paper surveys in parallel to the saliva study. It was our hypothesis that we would see a significant increase in stress during the time period of standardized test administration, both in increased cortisol, as well as in paper-based surveys.

Participants

Participants were recruited from public schools in the northeastern and southwestern region of the state of Louisiana. Selection criteria for the participants included (a) individuals working as a public-school teacher, (b) teachers who were tasked with administering the iLEAP test, (c)

individuals designated as test coordinator for the administration of the iLEAP test, and/or (d) an individual in the position of principalship or other administrative capacity directly related to the iLEAP testing. Due to the limited number of schools participating, as well as the small cohort of participants, there was no randomization sampling. Therefore, the results found in this endeavor may not be generalized to other regions of the state or country.

Individuals met exclusion criteria if the participant was taking herbal remedies, such as St. John's Wort, due to the possibility of the person experiencing artificially exacerbated anxiety. Further, individuals who were recent users of anxiolytic medications such as serotonin reuptake inhibitors (SSRIs) known to produce high anxiety levels in the first four weeks of use were excluded from the project (Greenwood et al., 2008). Eighty-seven potential participants were initially examined for inclusion in this study. The sample for the study included 71 participants (12 males and 59 females) which met inclusionary criteria.

Instruments

Participant anxiety levels were assessed using the Beck Anxiety Inventory (BAI), Zung Self-Rating Anxiety Scale (SAS) and the Salivary Cortisol Enzyme Immunoassay Kit. The BAI is a 21-item self-report instrument for measuring the severity of anxiety in adolescents and adults. The reliability of the BAI has an internal consistency that equals Cronbach's of a=0.92. It's test-retest reliability within a difference of one week for each test administration is 0.75 (Beck, Epstein, Brown, & Steer, 1988).

The scoring of the BAI is Not at all (0); Mildly - it didn't bother me much (1); Moderately – it wasn't pleasant at times (2), and Severely – it bothered me a lot (3). The total score is calculated by finding the sum of the 21 items. A score of 0 - 21 represents low anxiety experienced by the participant. A score of 22 - 35 suggests a level of moderate anxiety, whereas a score of 36 and above reflects a potentially clinical level of anxiety. A clinician should not make a diagnosis of clinical anxiety on the results of one test. Though, forming a clinical diagnosis was not the focus of this test.

The Zung Self-Rating Anxiety Scale (SAS) is a means to measure levels of anxiety in patients who manifest symptoms of anxiety. The SAS is based on the premise that coping with stress typically causes anxiety. The test is comprised of 20 Likert scale questions using a 4-point scale, from "None of the time (1)" to "Some of the time (2)" to "Good part of the time (3) to "Most of the time (4)." The total raw scores range from at least 20 to a maximum possible score of 80. A score ranging from 20 – 44 represents normal mood levels. Scores from 45 – 59 represent mild to moderate levels of anxiety, while scores of 60 – 74 suggest marked to severe anxiety levels. Finally, a score falling in the 75 and above range suggests an extreme level of anxiety. Cut offs for the SAS beginning in the 45 raw score range are identified as acceptable for research purposes (Dunstan & Scott, 2020). The Zung SAS was chosen based on its validity of a Cronbach alpha of .82 (Tanaka-Matsumi, & Kameoka, 1986).

The third instrument used in the research was the expanded range high sensitivity Salivary Cortisol Enzyme Immunoassay Kit produced by Salimetrics Laboratories. The purpose of the kit was to measure levels of the cortisol found in the saliva of the participants.

Cortisol (hydrocortisone) is the major glucocorticoid produced by the adrenal cortex (Boonen & Van den Berghe, 2016). The human production of Cortisol is normally based on circadian rhythm (Simons et al., 2017), but can increase during times of stress (Engert, et al., 2016). Unbound serum Cortisol enters saliva via intracellular mechanisms; in saliva, the majority of Cortisol remains unbound to protein. Salivary Cortisol levels are unaffected by salivary flow rate and are relatively resistant to degradation from enzymes (Ouanes & Popp, 2019). Studies consistently report high correlations between serum and salivary Cortisol, indicating that salivary Cortisol levels reliably estimate serum Cortisol levels (Debono, et al., 2016).

Methods

Investigators met with potential participants in six elementary and middle school sites in northeast Louisiana and one middle school site in southwest Louisiana. An explanation of the project's purpose and methodology was explained to each site, stressing the potential participants right to refuse participation at any time. Potential participants who indicated an interest in engaging with the project were given informed consents, which were explained. Those who signed the consent form then moved into the first round of saliva collection.

A demographic sheet was administered to those who agreed to participate by signing the consent form. The demographics requested gender designation, age, religious engagement, sense of spirituality and substance use (alcohol, anxiety reducing prescription drugs/herbs, nicotine and/or illicit drugs) in the prior 24 hours of saliva gather. Specimens were gathered after participants completed the demographic sheet.

Specimen Collection

Investigators were careful to inform participants of the restrictions associated with obtaining a "clean" saliva sample. Investigators set saliva collections during hours in which participants had not eaten a major meal within 60 minutes. Also, participants were requested to not consume any alcohol within 12 hours before a saliva draw. Acidic or high sugar foods can compromise assay performance by lowering sample pH and influencing bacterial growth. The researchers attempted to minimize negative factors by supplying sealed bottles of water to each participant at outset of gather and encouraging each of them to rinse mouth thoroughly at least 10 minutes before collection of saliva sample. Saliva was then collected by unstimulated passive drool. Donors would tilt the head forward, allowing the saliva to pool on the floor of the mouth, then pass the saliva through the SalivaBio Collection Aid (SCA) into a polypropylene vial, referred to as a cryovial.

In the event samples were visibly contaminated, a new sample was taken. Though participants were encouraged to remove any organic items from mouth before saliva collection, some kept gum in the mouth. The saliva would often be discolored due to the gum's dye. There were occasions when the saliva sample may become discolored due to a female's lip stick or other cosmetic. In such cases, a new sample was collected.

After collection of saliva samples, each cryovial of saliva was immediately placed on ice for transportation to a lab environment to keep samples cold to avoid bacterial growth in the specimen. Each saliva sample was refrigerated within 30 minutes and kept frozen at or below -20ºC within 4

hours of collection. Samples were stored in a freezer up to 6 months as separate waves were collected.

Wave 1 was the initial visit to each site. The first wave included consent form administration and explanation, completion of the demographic sheet by each participant, gather of saliva sample through passive drool technique and completion of both the Beck Anxiety Inventory (BAI) and Zung Self-Rating Anxiety Scale (SAS). Wave 2 occurred during the school system's designated time for administration of the state required iLEAP test to its students. During wave 2, participants contributed a saliva sample by way of passive drool into the supplied cryovial. They also completed the paper and pencil BAI and SAS. Finally, wave 3 occurred during the last two weeks of the school year, just before the beginning of the summer vacation. The participants completed the BAI and SAS directly after giving the final saliva sample for the project.

Results

Participants

Participants from all collection sites included a frequency of 12 males, comprising 17% and 59 females, making up 83% of the individuals in the test parameters. Site A had 2 males and 6 females meeting inclusionary criteria. Site B had 1 male and 9 females agreeing to participate, while Site C had 3 males and 8 females. Site D supplied 1 male and 10 females, whereas Site E contributed 1 male and 5 females. The largest participant site in Northeast Louisiana (Site F) had 2 males and 10 females supplying saliva and completing paper-based anxiety measures, as well as demographic information. Finally, Site G had 2 males and 11 females to work with the investigators. There was a loss of 8 participants from the study from inception to completion.

DEMOGRAPHICS TABLE				
Site	**Males**	**%**	**Females**	**%**
A	**2**	**25**	**6**	**75**
B	**1**	**10**	**9**	**90**
C	**3**	**27**	**8**	**73**
D	**1**	**09**	**10**	**91**
E	**1**	**17**	**5**	**83**
F	**2**	**17**	**10**	**83**
G	**2**	**15**	**11**	**85**
Total	**12**	**17**	**59**	**83**

Cortisol Levels

The effect of administering the standardized test known as iLEAP on cortisol levels in the saliva of those administering the test was examined using a one-way within-subjects ANOVA. Table 1 shows the mean and standard deviation of cortisol levels at each wave gather of saliva. The test indicated that the responsibility of administering the iLEAP test did not have a

significant effect of mean levels of cortisol in the saliva of the participants administering the test, $F(2, 104) = 2.86$, $p = .06$, partial $\eta^2 = .052$.

As seen in Figure 1, there was an increase in cortisol levels during the time of the administration of the iLEAP test but, not at the required level of significance. However, there was a significant increase of cortisol levels in the participants' saliva between the iLEAP administration and the end of the school year.

Table 1. Cortisol Change Over Time

Gather	Mean	Standard Deviation	N
Wave 2	0.1118	0.11	61
Wave 3	0.1293	0.13	60

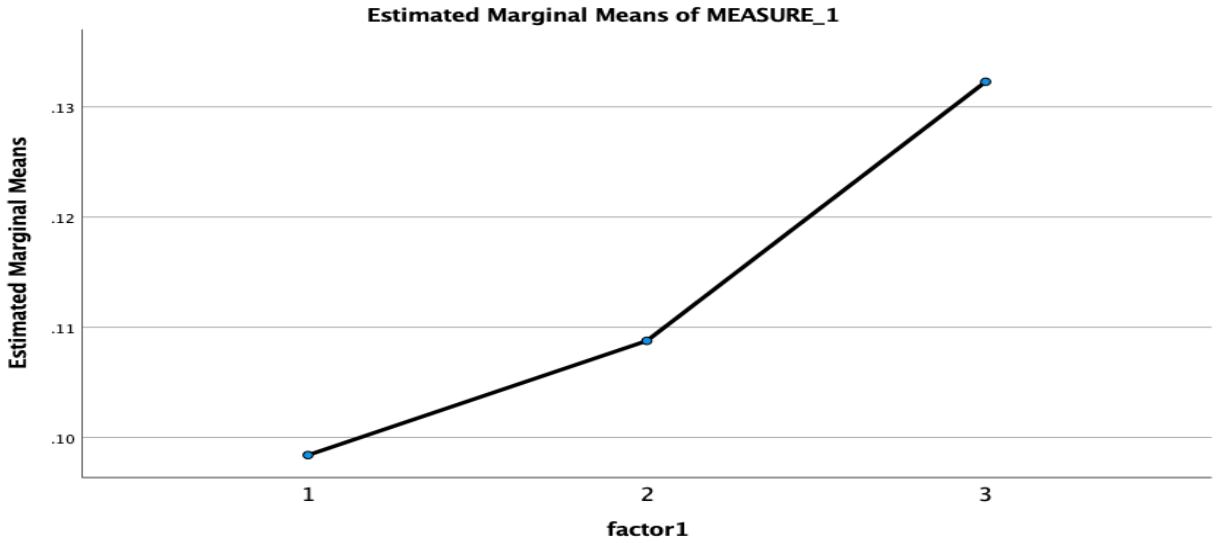

Figure 1. Repeated-Measures for Difference in Cortisol Levels Over Time

Table 2. Anxiety Change Over Time Through Paper Based Assessment (BAI)

Gather	Mean	Standard Deviation	N
Wave 1	2.02	1.05	68
Wave 2	1.81	1.02	61
Wave 3	1.70	1.05	60

The results of the paper-based Beck Anxiety Inventory (BAI) assessment support the findings of the laboratory results of cortisol levels in the administrators' saliva, as shown in Table 2. The BAI indicated that the administering of the iLEAP standardized test did not have a significant effect of mean levels of anxiety of the participant administering the test, $F(2, 104) = 4.32$, $p < .05$, partial $\eta^2 = .075$.

Table 3. Anxiety Change Over Time Through Paper Based Assessment (SAS)

Gather	Mean	Standard Deviation	N
Wave 1	2.02	1.05	68
Wave 2	1.81	1.02	61
Wave 3	1.70	1.05	60

The results of the paper-based Self-Rating Assessment Scale (SAS) assessment supports the findings of the laboratory results of cortisol levels in the administrators' saliva, as shown in Table 3. The SAS indicated that the administering of the iLEAP standardized test did not have a significant effect of mean levels of anxiety of the participant administering the test, $F(2, 104) = 4.32$, $p < .05$, partial $\eta^2 = .049$.

Discussion

We noticed an increase of cortisol levels between Wave 1 and Wave 2 which we expected, though the laboratory results of cortisol in the saliva samples did not meet significant levels. The continued rise in cortisol between Wave 2 and Wave 3, which was not anticipated, may be attributed to participants concern about low success rates among students on the standardized test, especially if the students' results impacted the test administrators' salary or school standing. Another possibility of increased cortisol rates post iLEAP testing may have been due to the extraneous effect of students nearing the summer break, causing higher impulsivity in the classroom and increased discipline problems.

We did not anticipate any significant change in teacher stress levels between Waves 2 and 3 measured with the BAI and the SAS. However, increases in stress were noted in the results of the BAI and the SAS. Again, the increase of public-school teacher participants may have been due to a restlessness and unruliness among classroom students, ready to begin summer vacation.

Future research with an increased sample set and within a larger geographic area may be beneficial in discovering higher levels of cortisol levels during standardized test administration. However, since the effect size is moderate simply increasing the sample size may not be the best option. Future investigators of the question may likely need around four times the number of participants to find significant changes. Improving the research design to increase the effect size may be a better option for future research.

Further studies may aid in increasing the health of individuals working in highly stressful situations, resulting in the development of stress reducing interventions. Increased training in stress reduction methods for public school teachers could be valuable for the total year of teaching.

Conclusion

Given the significance of the iLeap standardized test, it is appropriate to assume that all teachers, particularly those in grades 4 and 8, could experience anxiety, not only the teachers responsible for administering the tests. Though monetary concerns was not the primary variable in the

research, teachers not involved in administering the iLeap may experience an increase in stress, especially if their earnings are tied to the success rate of the students completing the test.

Although the within subjects design was appropriate for examining changes in anxiety over the course of the year, a mixed design might have included a better control. If we had compared the third and fourth grade teachers and/or seventh and eighth grade teachers across the three time periods we may have received more information. Following such a design in future research investigating teacher stress levels tied to a particular variable may show changes in anxiety between the saliva sample waves, and ultimately changes between testing and non-testing years.

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