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Original Article

Effect of psychological stress on the salivary alpha amylase and cortisol levels in EFL teachers

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Abstract

Background: Job stress threatens teachers' well-being and health. Identifying physiological factors that underline job stress is crucial for teachers' health and students' learning. This cross sectional study examined the cycle of stress biomarkers (salivary cortisol and alpha amylase) over the course of teaching among Iranian English teachers. **Materials and Methods:** 59 English teachers from two foreign language institutes in Bushehr province, southern Iran volunteered to participate in this study. The participants' saliva samples were collected three times over the course of a usual teaching day (before class, during class, and after class). Salivary alpha amylase and cortisol levels were analyzed in the biomarker Sina Lab in Bushehr using commercially available and research-based kinetic reaction (sAA) (Pars Test) and immunoassay (cortisol) kits (IBL). **Results:** A significant pattern was found for alpha amylase while cortisol did not show any significant change over the course of teaching. **Conclusion:** The findings highlighted the usefulness and importance of measuring physiological biomarkers in studying teachers' stress.

Keywords: Stress, EFL teachers, salivary cortisol, salivary alpha amylase

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Introduction

It is widely accepted that teaching is a highly stressful profession. Among a database of 26 jobs, teaching is ranked as one of the most stressful jobs (1). That's why almost half of the teachers who enter the profession tend to leave it after a while (2, 3). They usually show high commitment and enthusiasm in the beginning accompanied by idealism to make a difference in students' lives; however, their initial strong enthusiasm fades away due to high work-related stress and heavy workload. Research indicates that nearly all teachers have considered teaching to be "stressful" or "very stressful" (4, 5, 6). Teachers' stressful condition does not only originate from strict educational discipline, students' lack of

motivation to learn (7, 8), and intense pressure of evaluation (9), but also from emotional and mental health disorders such as psychological distress, anxiety, clinical depression, somatization disorder, and lack of self-regulation (10, 11, 12).

So far, most of the studies have primarily relied on self-report measures and survey methods in their investigation of teachers' stress. Physiological biomarkers have recently been taken into account by researchers in exploring psychological and mental wellbeing because they provide a more reliable account of the body's response to stressors and they also lend themselves to non-invasive examination (6). Given that the majority of previous studies have focused their attention on the self-report measures,

understanding how physiological biomarkers indicate the level of stress could help develop strategies in order to reduce stress and promote wellbeing. It is clear that stress causes a change in the behavioral responses in the central nervous system. When that happens, two main systems are involved in responding to the stressor: sympathetic-adrenal-medullary (SAM) system and hypothalamus-pituitary-adrenocortical axis (HPA). The activation of the former system results in the release of salivary alpha amylase (sAA) (13) and the activation of the latter causes the secretion of cortisol (CT) (14).

In the recent literature, self-report measures have been often used to evaluate teachers' stress and wellbeing; however, neuroendocrine stress markers have offered a new method to develop our understanding of teachers' physiological health (6). Biomarkers can also enhance our interpretation of research and clinical contexts in order to respond to stress and promote overall well-being (15). Since stress biomarkers have enabled researchers to indicate the underlying physiological stress-causing mechanism more clearly than self-reports measures, measuring stress biomarkers has received a lot of attention in research on teachers' well-being and health. Although previous studies have demonstrated that teachers suffer from high levels of stress, very few, if any, reports have raised concerns about the role of physiological biomarkers in measuring teachers' levels of stress. In fact, no studies have yet investigated salivary alpha-amylase and salivary cortisol activities during teaching practice among EFL teachers.

The goal of the present study is to examine the time course of salivary sAA and CT levels across English teaching practice in class and to investigate whether there are differences between sAA and CT levels 5 minutes before class starts, 30 minutes after the start of class (during the process of teaching), and 5 minutes after class.

Methods

Participants. Sixty eight English teachers from two foreign language institutes in Bushehr province, southern Iran volunteered to participate in this study. In order to avoid any confounding biased data, one of the participants was excluded from analysis because her mother had died one day before sampling. Seven subjects also withdrew from participating in the study at the time of sampling. Therefore, the final total sample consisted of 59 participants whose saliva samples were collected at three data collection waves. As a result, 177 saliva samples were collected (each teacher with three saliva samples). The English teachers involved in the study included 44 women and 15 men with a mean age of 26.5 years old (SD = 10.5). Almost all the teachers were married (95%). The average of their teaching experience was almost 8 years (SD = 7.5). The purpose and the whole procedure of the study were explained to the participants before sampling and the participants provided us with a signed informed consent. The ethical research committee of Bushehr University of Medical Sciences approved the study protocol.

Saliva sample collection. Prior to the experimental session, the participants were asked to complete a demographic questionnaire. In order to minimize the effect of diurnal effect and promote reliable data, the sampling sessions were limited to the hours between 4:00 p.m. to 8:00 p.m. in the evening. Additionally, teachers were also instructed to refrain from following activities 30 minutes before collecting samples: having a large meal, having heavy exercise, drinking lemonade or caffeinated beverage, and smoking.

Concerning saliva collection, three research assistants were present at the language institutes providing the participants with oral instructions. For example, the participants were instructed to collect the saliva in the floor of the mouth. The participants were then asked to collect their saliva three times over the course of a usual teaching day (before class, during class, and after class). At each time of sample collection, the participants spat the saliva into a clean pre-weighed glass or plastic vial. The flow of saliva was accounted in mg of saliva in per min (mg/min). Finally, the research assistants collected samples and took them to the lab. Upon arrival, the saliva samples were stored in a freezer at -20°.
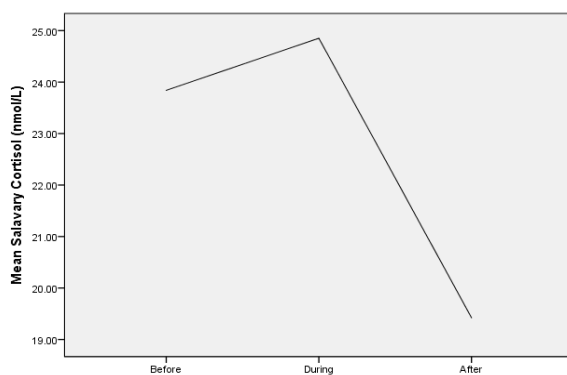
Salivary and statistical analysis. The total 177 samples were analyzed for measuring the levels and patterns of CT and sAA. Salivary CT and sAA levels were analyzed in the biomarker Sina Lab in Bushehr

Table1: Descriptive analysis for physiological measures.

	N	M	SD
Cortisol (nmol/L)			
T-before	58	23.839655	19.701117
T-during	58	24.851724	22.129557
T-after	58	19.422414	15.996283
alpha-amylase (U/mL)			
T-before	57	77.098039	13.363016
T-during	57	84.450980	13.749638
T-after	57	15.996283	12.952795

using commercially available and research-based kinetic reaction (sAA) (Pars Test) and immunoassay (cortisol) kits (IBL). The volumes of the sample tests for sAA and CT were 10 and 25 ul, respectively. Each participant's sample was tested in a single assay batch. The CT and sAA values were converted to nmol/L (ug/ml X 27.6) and U/mL (units of activity/ml) respectively in order to be accurately compared with published reports. The average intra and inter-assay covariances (%) were less than 5% and 10% respectively.

Statistical Package for the Social Sciences (SPSS, Version 21) was used for statistical analysis. Different repeated measurement analyses of one-way variance (RMANOVAs) were run to examine the patterns of CT and sAA. In these analyses, the concentrations of CT and sAA at each time were dependent variables while time was the independent variable. Statistical significance was accepted at $p < .05$.

Results

Separate RMANOVAs were run for CT and sAA with time as the repeated measure (before, during, and after). The resulting sample size for the analysis of salivary biomarkers ranged from 57 to 58. Table 1 shows the means and standard deviations for physiological measures at different times (T).

Salivary cortisol. There was no significant effect of sampling time on cortisol. However, as Fig.1 shows, the mean cortisol values changed over the course of teaching in the expected pattern with the cortisol levels increasing after base-line and declining at the end of class [F=.460, p = 624, Partial Eta Squared = .008, Observed Powera =.122]. Pairwise comparisons showed that each time point was not significantly different from one another ($p < 0.05$).

Salivary alpha-amylase. Unlike cortisol, there was a significant change in sAA concentration during

Figure 1. Salivary cortisol pattern across the course of teaching using untransformed data.
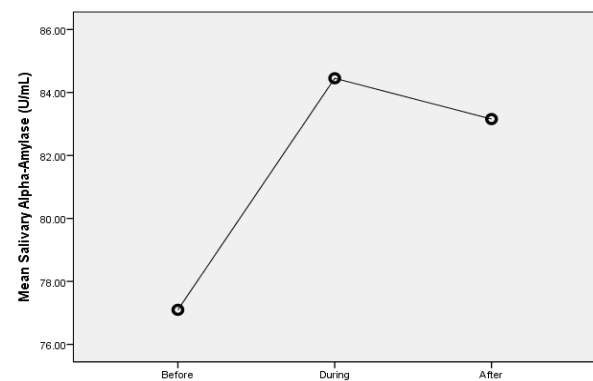
Figure 2. Salivary alpha-amylase pattern across the course of teaching using untransformed data.

the teaching practice [F=4.132, p = .02, Partial Eta Squared = .078, Observed Powera = .689]. Pairwise comparisons showed that the mean difference at time 2 was not significantly different from time 3 (p= .79) while other time points were significantly different from each other. As the mean differences show, sAA levels increased sharply during class and slightly declined at the end of class (see Fig.2). The ANOVAs used the Greenhouse-Geisser correction to account for sphericity related to the repeated measures.

Discussion

The present study examined the profile rhythm of CT and sAA of EFL teachers during teaching practice in class. Our hypothesis was partially supported by the data. That is, although the concentrations of cortisol did not significantly change over the course of teaching, the analysis of sAA showed significant changes. Overall, according to the figures, both physiological biomarkers revealed modest relationships with the expected patterns over the course of teaching.

What is obvious is that the two important stress biomarkers statistically did not show identical patterns of concentration over the English classes. This finding is in agreement with previous studies (16, 17, 18, 19) where the two biomarkers asymmetrically reflected different concentrations in the stress paradigms. This result suggests that sAA shows the reaction of a stress-sensitive system different from cortisol. According to the evidence that sAA is the indicator of physiological changes in the activities of the sympathetic-adrenal-medullary (SAM) system, it is surprising that sAA and CT did not have the same levels of concentration in an identical stressful setting (English class), since HPA axis and SAM system are closely related (20).

In our time-course experiment, sAA levels, according to pairwise comparisons, significantly changed between time 1-2 and time 1-3 while cortisol levels did not show any significant changes among time points. We are able to show the quick short-term reaction of sAA compared to cortisol. In line with other results (21, 22), the present findings suggest that cortisol has a longer latency to the peak level than sAA. These results clearly indicate that

sAA has higher sensibility and specificity and shows a quicker response to the stressors than cortisol. One explanation for these results is that major stress responses occur in two stages: a slower acting glucocorticoid component representing HPA axis (cortisol as the indicator) and short latency catecholamine response system representing SAM system (sAA as the indicator). The cortisol secretion in HPA in a normal stress response is the last step and lasts longer than the secretion of catecholamine in SAM system (23). Hence, the differences between cortisol and sAA in response to stress reactions are attributable to the time latency between stress responses of HPA axis and SAM system. The present findings reinforce the suggestion made by former stress-related studies (16, 24, 25) that sAA is more precise and more responsive than cortisol in measuring stress responses. Then, we clearly showed that sAA levels reacted more rapidly and increased significantly in response to the stressor than cortisol, suggesting that sAA is a better and more powerful index in measuring stress.

As displayed in both figures, EFL teachers experienced an increase in CT and sAA levels during class, indicating their stress responses to the possible stressors in class. As mentioned above, unlike other teaching subjects, teaching English as a language is a multifaceted phenomenon involving a distinct atmosphere with its own major stressors. Approaches and methods in teaching English have been constantly changing over last decades introducing new roles for teachers and students, new textbooks, new techniques, new assessment procedures, and so on. Furthermore, concerning teachers' stress, diverse sources have been identified including students' misbehavior, disrespect, and unruliness, students' poor motivation for class work, physical condition of class, heavy workload and time restraints on teachers, teaching at different levels, class sizes and noisiness, curriculum demands, role ambiguity, and pressure and criticisms from administrative authorities, parents, and students (26, 27, 28).

Due to innovations in language teaching methods and fierce competitions among language institutes in attracting more customers, teachers have received rather new roles in mainstream education and discarded their traditional role as a mere transferor of

knowledge. Their multiple roles have caused a sense of diffusion and ambiguity. For example, they have to play the role of a teacher, a mentor, and a counselor. This has increased the level of frustration, stress, and burnout within the teachers in the classroom (29). In other words, the teacher's understanding of what is expected and what should be done in each situation is related to teachers' stress.

As the results confirmed, EFL teachers experience a high level of stress in English class in different ways. Teachers, for example, are confronted with physical and verbal aggression (5). In English classes, students sometimes use taboos and swears in English, which is very disruptive to class. Therefore, students' misbehavior is considered as one of the most commonly reported stress contributors (26). Lack of sufficient time is also considered to be a stress contributor during class (30). It has been reported that Iranian EFL teachers suffer from time pressure in English class (31). EFL teachers have reported an imbalance between curriculum and educational demands on the one hand and allocated class hours on the other hand.

Conclusion

This study demonstrated that physiological measures can help us gain a better understanding of teachers' stress condition. The unique aspect of the present study was the measurements of salivary cortisol and sAA behavior over the teaching process. The findings indicated that multiple systems are required in studying teachers' stress in order to provide a better understanding of a complex construct such as stress. This study intensifies the need of conducting more studies on physiological measurements in exploring teachers' stress. Examining teachers' stress patterns is a critical step in understanding teachers' efficiency and wellbeing in class. There are a number of interventions disturbing the teachers' social-emotional wellbeing in classroom; however, the mechanism underlying these interventions is not clear. Studies like the present one can help address these interventions in order to improve teachers' overall wellbeing. For example, providing teachers with appropriate coping strategies in stressful situations and with opportunities to express their emotions rather than

suppressing them can significantly increase their long-term health.

Conflicts of Interest

The authors declare that there is no conflict of interest in this study.

Acknowledgment

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