

# Measurement of Salivary Cortisol Level and Selfreported Anxiety among Adults visiting Primary Care Clinic

Fahdah Aldahash<sup>1\*</sup>, Yara Al Buraidi<sup>2</sup>, Hiba Rajab<sup>2</sup>, Mashael Al Mohrij<sup>2</sup>, Alanoud Al Shatter<sup>2</sup>, Fadwa Al Thukeir<sup>2</sup>

Lecturer, Department of Oral & Maxillofacial Surgery and Diagnostic Oral Sciences Riyadh Elm University, Riyadh, Saudi Arabia<sup>1</sup> Student, Riyadh Elm University, Riyadh, Saudi Arabia<sup>2</sup>

Corresponding Author: 1\*



**Keywords:** 

Salivary Cortisol, Primary Care Clinic, Self-reported Anxiety

#### ABSTRACT

Dental anxiety remains an everyday difficulty for practicing dentists, as well as a barrier for many patients seeking quality dental care, despite rapid advancements in the area and innovations in dental techniques. The goal of this study is to determine the salivary cortisol level in adult patients receiving emergency treatment at REU's primary care clinic, as well as the anxiety level as measured by the Modified Dental Anxiety Scale (MDAS). A cross-sectional design was done using convenient sampling to achieve the required sample number. Saliva was collected between 9 a.m. and 12 p.m from 40 adult patients. The salivary cortisol was measured by means of the electro-chemiluminescence immunoassay "ECLIA" using the Cobas e411 analyzer. The mean (SD) VAS score was 5.15 (3.00) and the mean (SD) cortisol level was 53.78 (32.97), indicating moderate pain. The pain score and cortisol level had a non-statistically significant negative connection (p=0.893). The age and cortisol levels had a positive link (p=0.267). Females (p=0.221) and non-Saudi nationals (p=0.552) had higher mean (SD) cortisol levels. In conclusion, higher salivary cortisol was not shown to be linked with self-reported dental anxiety in the presence of pain.



This work is licensed under a Creative Commons Attribution Non-Commercial 4.0 International License.

#### 1. INTRODUCTION

The fear from dental treatment is a familiar source of anxiety among patients, which is usually expressed as a chain of thoughts linked to pain and discomfort, these chain of thoughts amplifies upon sitting on the dental chair in some patients which in turn could hinder proper treatment management. Despite the mass development in the dental field and the innovation in dental techniques, dental anxiety still remains an everyday obstacle for practicing dentists, as well as a barrier for many patients seeking quality dental care. Several studies have estimated the prevalence of dental anxiety in the general population, and had reported a range of 4-23% [1]. The Modified Dental Anxiety Scale (MDAS) is one of the indices used to assess dental anxiety and fear. MDAS is a self-finish reliable and valid instrument, comprising of five questions that are

used to deliver a diagnostic score ranging from 5 to 25. It is the most commonly used scale to measure dental anxiety because of its ease in administration, thus having high validity. Therefore, it is the chosen index selection as a measure of dental anxiety in this study.

As the stimulation of stress and anxiety increases, an accompanying cascade of physiological responses is initiated by one of the stress response systems (sympathetic/autonomic system and HPA axis). Among those responses is the secretion of the cortisol hormone by the adrenal cortex, which is seen in blood, urine and saliva. Multiple approaches have been anticipated to clarify the nature of provoked and spontaneous secretory episodes of cortisol to relate its hyper-secretion in response to cognition, mood, and behavior shown by the individual. Thus, different authors have conducted studies on MDAS and salivary cortisol levels to measure stress in the dental office [2].

A study was done to know the relation between response of stress and pain reaction to salivary cortisol levels in patients undergoing emergency dental care. With a sum of 73 patients enrolled in the study, accounting for 39 women, and 34 men, different variables and patient demographics were noted. However, the only positive relation was found was an increase in salivary cortisol level due to pain [1]. Another research was done by [3] to investigate correlations between salivary alpha-amylase together with salivary cortisol and Dental anxiety scale. Their study did not note an association between dental anxiety and increased levels of salivary cortisol nor salivary alpha-amylase.

Cortisol is a steroid hormone produced by the adrenal cortex. Its secretion is directly controlled by the release of adrenocorticotrophin (ACTH) from the anterior pituitary which is regulated by corticotrophin-releasing hormone (CRH), secreted by the hypothalamus. Cortisol exerts negative feedback on both ACTH and CRH secretion in other words the Hypothalamus pituitary adrenal axis (HPAA), while stress acts directly on the hypothalamus to stimulate CRH release and hence the release of the cortisol hormone which is considered and indicator of stress and has been studied extensively in relation to stress research [4]. Salivary cortisol is one of the several measures that have been used to assess anxiety in adults. Sampling of saliva is a noninvasive, simple, stress-free manner which can be easily collected. It is considered a good biological marker of stress reaction as it is unaffected by salivation itself [5]. The aim of this study is to investigate the correlation between self-reported anxiety, dental pain and salivary cortisol level. As well as examine whether individual variations such as age, race, gender, and, existing pain exhibit an effect on dental anxiety.

## 2. Materials and Methods

Ethical clearance was obtained from the research center's IRB (Institutional Review board) (February 28<sup>th</sup>, 2018). The IRB approval number is RC/IRB/2018/839 with the registration number (FRP/2018/88). The study took place at Riyadh Elm University (REU) hospital; it followed cross-sectional design using convenient sampling to achieve the required sample number.

## 2.1 Sample Selection

The power of the sample was calculated using the G-power 3.1.3 power analysis software (Universtät Kiel, Germany). The estimated number of subjects deemed to be included in the study was 40 adult patients. The inclusion criteria entail; Adult patients attending Riyadh Elm University, adults aged above 18 years old and the presence of pain.

The exclusion criteria were as follows; first, patients who exhibit drug or alcohol abuse problems, using medication that could impair the salivary production or salivary cortisol level; second, patients who have a medical illness that could influence the salivary production or salivary cortisol levels. Finally, patients who



exhibit psychological disorders were excluded as well.

Each subject signed an informed consent form for collecting saliva samples which state a detailed explanation of the research process; the research process was also explained verbally by the authors. A validated Arabic version of the modified dental anxiety scale (MDAS) was used to assess dental anxiety; each subject was asked to complete the MDAS scale to measure the anxiety level where a score of 19 or more indicated a highly anxious patient. Subjects rated their pain intensity according to their dental complaint using the horizontal visual analog scale (VAS). The demographic data such as age, gender and nationality collected through Riyadh Elm University electronic system and patient interview.

## 2.2 Saliva Collection and Analysis of Salivary cortisol

Saliva collection time was done between 9 am, and 12 pm to account for the diurnal rhythm of cortisol. It was confirmed with each subject the following at least 30 minutes had passed if any food or drink is consumed as well as if the subject had smoked.

Specialized sterile kits Salivette®, sample collection tube (Sarstedt, Nümbrecht, Germany, CAT. No. 51.1534.) was used on patient for collecting saliva samples. Saliva was collected using the passive drool method (Putnam SK et al., 2012) into the tubes provided in the Salivette® kit. Tubes were then stored in -60 °C freezer located in REU campus. Once the required sample was reached, the tubes were transported to the lab for analysis.

The salivary cortisol was measured by means of the electrochemiluminescence immunoassay "ECLIA" using the Cobas e411 analyzer. Test principle is a 1-step competitive assay based on the ECLIA principle under the following conditions; 37°C for 18 minutes. (Roche Diagnostics GmbH, Mannheim, Germany).

## 2.3 Statistical Analysis

The data were analyzed using IBM statistical package for sciences (SPSS) version, 22.0 (Chicago, Ilionis, USA). Data of salivary cortisol, MDAS scores and VAS scores are presented as means and standard deviations (SD). Correlations are presented by means of Spearman's rho test.

## 3. Results

The median age of the patients was 18-35 years. The majority were male (55%) and Saudi nationals (65%) (Table 1). Only 17.5% of the patients were smokers.

		Frequency	Percent
Age	18-35 years	21	52.5
	36-55 years	17	42.5
	56-70 years	2	5.0

	Table 1.	Demographic	characteristics
--	----------	-------------	-----------------

Gender	Male	22	55.0
_	Female	18	45.0
Nationality	Saudi	26	65.0
-	Non-Saudi	14	35.0

The majority (60%) reported a total MDAS score of  $\geq$  19 indicating a highly dentally anxious patient, possibly dentally phobic (Figure 1).



Figure 1. Modified dental anxiety scale total score

Half the patients (50%) reported extremely anxious sitting in the waiting room (waiting for treatment). On the other hand only 27.5% reported extremely anxious if they were about to have a local anesthetic injection in their gum above an upper back tooth. (Figure 2)





# ISSN: 03875547 Volume 45, Issue 01, February, 2022

# Figure 2. Modified dental anxiety scale

The mean (SD) VAS score was 5.15 (3.00) indicates moderate pain and the mean (SD) cortisol level was 53.78 (32.97). (Table 2) There was a non-statistically significant negative correlation between pain score and cortisol level (p=0.893). There was a positive correlation between age and cortisol level (p=0.267). (Figure 3) The mean (SD) cortisol level was higher in female (p=0.221) and non-Saudi nationals (p=0.552) (Figure 4 &5).



Figure 3. Visual analog scale

		Mean	SD
	Pain score	5.15	3.00
	Cortisol level	53.78	32.97
100.			Т
75.	T		
50.			
25.			
0.	Male		Female





Figure 5. Mean (SD) cortisol level by nationality

## 4. Discussion

The association of dental anxiety, salivary cortisol has garnered a lot of attention in research. Salivary cortisol levels are considered a reliable measure of the activity of the HPA axis which is increased by stress and anxiety. The present study aims at urgent care setting to assess the association between self-reported dental anxiety, pain measured using VAS, and salivary cortisol levels. In agreement with the previous literature [1], [3] the present study showed no significant correlation between cortisol levels, MDAS scores, and pain measurements using VAS; this could be because many patients who experience dental pain don't necessarily develop dental anxiety and vice versa. Moreover, [6] reported that salivary cortisol concentration reflects rapid changes in the plasma cortisol concentration which means that dental anxiety may induce long-term psychological changes rather than short-term which is in line with our study. It is important to note that there was a weak non-significant negative correlation. It could be because dental pain and emergencies are not life-threatening and in many cases, patients don't seek dental treatment upon experiencing a dental problem, that delay may decrease the cortisol output as a result of negative feedback to Hypothalamus-pituitary-adrenal cortex (HPA) axis. Furthermore, Brand HS did not find any significant correlation between DAS and urinary cortisol levels [5].

60% of our subjects were borderline extremely anxious/phobic as per MDAS with a score of equal and higher than 19, the prevalence of anxiety is higher than what is reported by [1], [7]. The MDAS also showed that 50% of our subjects are extremely anxious to be in the waiting room in wait for the commence of treatment which is a common source of anxiety among patients as reported by [8]. In regard to pain, we found no correlation with self-reported anxiety nor cortisol levels with pain measured by VAS, on the other hand, [3] reported a positive relationship between the two and [1] reported significant correlation between the presence of pain and cortisol levels but no significant correlation between pain measured by VAS and cortisol levels.

In accordance with previous literature [9], [10], dental anxiety is more common in females than in males. On the other hand, in one study [1] there was no significant difference between genders in which the authors justified the reason being the smaller sample size. Cortisol levels were also found to be higher in females than in males although not statistically significant, [1], [3] found no correlation.

In the present study, a positive correlation between age and cortisol levels was found. On the other hand, [1] reported no correlation in that respect while four other studies reported that younger age patients are more likely to be dentally anxious [9- 12]. Anxiety and stress may increase with age, Both [13], [14] concluded that negative feedback of the HPA-AXIS becomes impaired with aging. The impairment would lead to



increased cortisol secretion in response to stress for example. Therefore, we found the positive correlation in our study.

A study reported that salivary amylase could be a better predictor than salivary cortisol, the authors introduced a psychological stressor then a soother was introduced afterward, while unstimulated whole saliva was being collected every 3 min throughout the session [15]. Salivary amylase levels were more significantly increased and showed a more rapid reaction. Therefore, the authors concluded that salivary amylase maybe a better index of stress which bears more exploration under emergency dental care setting with the presence of pain [16].

# 5. Conclusion

Self-reported dental anxiety in the presence of pain was not found to be associated with increased salivary cortisol. Future research should explore the differences between salivary cortisol levels, urinary cortisol, salivary amylase and MDAS in an urgent care setting to further confirm the feasibility of cortisol as a measuring tool for dental anxiety and compare it to salivary amylase.

# 6. References

[1] Kanegane, K., Penha, S., Munhoz, C. and Rocha, R. (2009). Dental anxiety and salivary cortisol levels before urgent dental care. Journal of Oral Science, 51(4), pp.515-520.

[2] Kirschbaum, C. and Hellhammer, D. (1989). Salivary Cortisol in Psychobiological Research: An Overview. Neuropsychobiology, 22(3), pp.150-169.

[3] Sadi, H., Finkelman, M. and Rosenberg, M. (2013). Salivary Cortisol, Salivary Alpha Amylase, and the Dental Anxiety Scale. Anesthesia Progress, 60(2), pp.46-53.

[4] El-Farhan, N., Rees, D. and Evans, C. (2017). Measuring cortisol in serum, urine and saliva – are our assays good enough?. Annals of Clinical Biochemistry, 54(3), pp.308-322.

[5] Brand, H. (1999). Anxiety and Cortisol excretion correlate prior to dental treatment. International Dental Journal, 49(6), pp.330-336.

[6] Bonnin, R., Villabona, C., Rivera, A., Guillen, E., Sagarra, E., Soler, J. and A. Navarro, M. (1993). Is salivary cortisol a better index than free cortisol in serum or urine for diagnosis of Cushing Syndrome?. Clinical Chemistry, 39(6), pp.1353-1354.

[7] Locker, D., Liddell, A. and Shapiro, D. (1999). Diagnostic categories of dental anxiety: a populationbased study. Behaviour Research and Therapy, 37(1), pp.25-37.

[8] Horst and C. de Wit (1993) 'Review of behavioural research in dentistry 1987-1992: dental anxiety, dentist-patient relationship, compliance and dental attendance.', International dental journal, 43(3 Suppl 1), pp. 265-278.

[9] Humphris, G. M., Morrison, T., & Lindsay, S. J. E. (1995). The Modified Dental Anxiety Scale: Validation and United Kingdom norms. Community Dental Health, 12(3), 143-150.

[10] Hakeberg, M. and Cunha, L. (2008). Dental anxiety and pain related to dental hygienist treatment.

Acta Odontologica Scandinavica, 66(6), pp.374-379.

[11] Vassend, O. (1993). Anxiety, pain and discomfort associated with dental treatment. Behaviour Research and Therapy, 31(7), pp.659-666.

[12] Roy-Byrne, P., Milgrom, P., Khoon-Mei, T., Weinstein, P. and Katon, W. (1994). Psychopathology and psychiatric diagnosis in subjects with dental phobia. Journal of Anxiety Disorders, 8(1), pp.19-31.

[13] Otte, C., Yassouridis, A., Jahn, H., Maass, P., Stober, N., Wiedemann, K. and Kellner, M. (2003). Mineralocorticoid Receptor-Mediated Inhibition of the Hypothalamic-Pituitary-Adrenal Axis in Aged Humans. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 58(10), pp.B900-B905.

[14] Wilkinson, C., Peskind, E. and Raskind, M. (1997). Decreased Hypothalamic-Pituitary Adrenal Axis Sensitivity to Cortisol Feedback Inhibition in Human Aging. Neuroendocrinology, 65(1), pp.79-90.

[15] Karthikeyan, P. and Aswath, N. (2016). Stress as an etiologic co-factor in recurrent aphthous ulcers and oral lichen planus. Journal of Oral Science, 58(2), pp.237-240.

[16] Takai, N., Yamaguchi, M., Aragaki, T., Eto, K., Uchihashi, K. and Nishikawa, Y. (2004). Effect of psychological stress on the salivary cortisol and amylase levels in healthy young adults. Archives of Oral Biology, 49(12), pp.963-968.