



Comparative Assessment of Salivary Cortisol Levels and Dental Anxiety In Children With Autism and Attention Deficit Hyperactive Disorder

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ABSTRACT

Background: Autism and ADHD are neurodevelopmental disorders. Children with ADHD and autism face difficulty in interaction, remaining focused, and in communication with the dentist. Dental treatment is often stressful and anxiety-producing. Cortisol is the main indicator of anxiety. Hence the study was conducted to assess the Dental anxiety and Salivary Cortisol Levels in Autistic, ADHD and healthy children

Aim: To compare the salivary cortisol level and dental anxiety in Children with Autism and ADHD.

Methodology: The study population consists of sixty children divided into three groups which included twenty ADHD, autistic and healthy children. Pre and post-dental examination Salivary cortisol (SC) levels of all the groups were estimated using the Electrochemiluminescence immunoassay (ECLIA) method for which about 1-2ml of unstimulated salivary samples were collected. The children were asked to fill an MDAS questionnaire. Inferential statistics was applied to find the equality of means of all the three groups were tested by applying ANOVA followed by post hoc test after the verification of normality assumption. To find the correlation between salivary cortisol levels and anxiety Pearson's correlation coefficient was computed.

Results: There was no significant correlation between dental anxiety and salivary cortisol level. Autistic children had the highest MDAS score. ADHD children had an increase in the Post dental examination salivary cortisol level. The extremely anxious response was seen in all the three groups for local anesthesia.

Conclusion: No significant correlation is seen in MDAS and salivary cortisol in all the groups. Autistic children were found to be the most anxious.

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1. Introduction:

Autism is a severe lifelong neurodevelopmental disorder that appears during infancy and follows a steady course without remission. It is characterized by a triad of symptoms which includes social interaction impairment, impaired communication, and restricted interests and repetitive behavior. Hence, a dental visit may be of a great ordeal to an autistic child (Babu & Shah, 2017).

Autism is a neurodevelopment alteration characterized by severe damage in social interaction, language, behavior and cognitive function. Classic Autism profile presents severe challenges in the cognitive, social

and behavioral stages. Intellectual disability, limited verbal and nonverbal communication, Autistic children do not acquire spoken language easily. Their communication and language are characterized by repetition (Blomqvist et al., 2007).

Attention deficit hyperactivity disorder (ADHD) is a condition that is defined according to a specific set of symptoms – inattention, hyperactivity, and impulsivity. The child with ADHD faces difficulty in interaction, remaining focused, and in communication with the dentist. Children with ADHD experience increased anxiety in a



dental setting (Blomqvist et al., 2007; Bimstein, et al., 2008).

It has been observed that parents of children suffering from systemic disorders like Autism and ADHD focus mainly on the medical procedures and therapy required to improve the condition and in turn give low priority to oral health during early childhood. So, this poor oral health leads to further deterioration of systemic health in these children (Babu & Shah, 2017; Blomqvist et al., 2007).

Dental treatment is one of the main sources of anxiety and discomfort and. The pain usually increases anxiety. Dental anxiety is stable and advances with the procedure and equipment, procedures and preventive measures.

During the 1980's saliva as an alternative specimen for determination of hormones gained popularity. Endocrinology, psychobiology, behavioral medicine, and psychiatry researchers used saliva to measure steroids and emphasized the simplicity of this method over blood investigation. Various studies suggest that the measurement of cortisol, progesterone, testosterone present in the saliva is a stable reflection of plasma value (Kirschbaum & Hellhammer, 1994).

A dental visit is often associated with fear and anxiety which eventually increases the stress-related hormones like Adrenocorticotropic hormone (ACTH), corticotropin-releasing hormone (CRH) and cortisol are the main indicators for the response (Babu & Shah, 2017).

Cortisol is a 21-Carbon glucocorticoid secreted by the adrenal cortex. It maintains the carbohydrate, proteins, fat and water metabolic processes. It regulates vascular reactivity, the sensitivity of the nervous system, the number of blood cells and influences human stress response. The anterior pituitary gland secretes the Adrenocorticotropic hormone which is responsible to monitor cortisol (Miller et al., 1995). Cortisol measurements in blood samples had shown increased values due to the psychological stress of sample taking in children. The Biological range of salivary cortisol levels in a healthy individual is 0.37-0.99 nmol/l.

Stress and the diurnal rhythm are modifying factors that increase the production of cortisol, and the decreased output of cortisol is due to negative feedback and primary or secondary adrenal insufficiency.

A blood sample or urinary sample is routinely done for the estimation of cortisol (Kanegane et al., 2009). Collection of serum is usually stressful thereby, directly elevating free cortisol concentration and distorting the results. The collection of saliva is a simple, non-invasive, stress-free procedure. In contrast to serum, saliva collection and the storage of the sample is very simple.

Salivary sampling is another reliable, non-invasive and stress-free method. Salivary cortisol has a high correlation with the unbound ('free') cortisol concentration in plasma and is independent of the salivary flow (Babu & Shah, 2017).

Saliva is a clear, slightly acidic mucoserous exocrine secretion. Whole saliva is a complex mix of fluids from major and minor salivary glands and from gingival crevicular fluid, which contains oral bacteria and food debris. Saliva is known as the mirror of blood. Salivary cortisol is an indicator of the concentration of unbound cortisol in serum and a physiological marker of stress. Hence, saliva will be used for the estimation of cortisol levels, a collection of the saliva is easy to collect, stress-free and non-invasive, stable at room temperature.

So, considering the above aspects along with available scattered reports and the scarcity of available data, the present study was undertaken to Compare Salivary cortisol level in Autism and ADHD under dental anxiety.

2. Methodology:

The study population consisted of sixty children of both genders, aged between 11-15 years were included. Children were categorized into three groups. Group 1 consisted of 20 children with autism, Group 2 consisted of twenty children with ADHD attending school for special children in Bangalore. Group 3 consisted of 20 healthy children who visited the Department of Pediatric and Preventive Dentistry, V.S. Dental College, Bangalore for a routine dental check-up. Signed written informed consent was obtained from the school authorities and parents of the children before the commencement of the study.

Pre and post-dental examination Salivary cortisol (SC) levels of all the groups were estimated using the Electrochemiluminescence immunoassay (ECLIA) method for which about 1-2ml of unstimulated salivary samples were collected. All the children were given prior instructions not to eat or drink anything thirty minutes before the sample collection as it may affect the test results. Unstimulated salivary samples were collected prior and the other one immediately after the routine dental examination. The salivary samples were collected by asking the child to expectorate into disposable plastic containers. The sampling was done from 9 am to 11 am to maintain the circadian rhythm control of the cortisol level. Then the collected salivary samples were centrifuged for 15 minutes at 3000 rpm and the supernatant separated after centrifugation were transferred in screw-capped bottles and tested for salivary cortisol levels.

Modified dental anxiety scale MDAS introduced by Humphris et al. (1995) was used as a standard tool to measure dental anxiety. Questionnaires were distributed immediately after the pre-examination salivary sample collection. Children were asked to fill the questionnaire with the help of trained school teachers or parents/guardians. The questionnaire consisted of five multiple-choice questions dealing with the individual's reaction and anticipation of the treatment. Each question consisted of five responses, ranging from 1 (most calm) to 5 (extremely anxious), with a total score ranging from 5 to

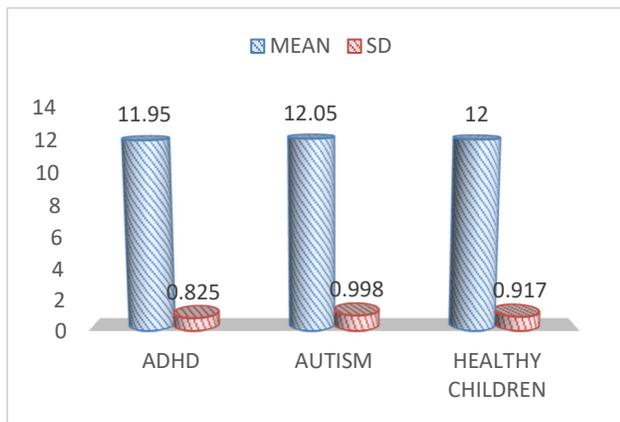


25. An MDAS score of ≥ 19 indicates high dental anxiety (Corah, 1969).

The data collected for this study were analyzed statistically using the statistical package SPSS19.0 (SPSS Inc., Chicago, IL) and the level of significance was set at $p < 0.05$ and presenting quantitative and qualitative measured variables into different categories in the form of tables and graphs wherever necessary. The inferential statistics were applied like the equality of means of all the three groups were tested by applying ANOVA followed by post hoc test after the verification of normality assumption. To find the correlation between salivary cortisol levels and anxiety Pearson’s correlation coefficient was computed.

3. Results:

The study population consisted of 60 cases which included 20 ADHD, 20 Autistic children, and 20 Healthy children. The age of the study population ranged between 11-15 years with the mean age being 11.95 for ADHD, 12.05 for Autism and 12 for healthy controls. (Graph 1)



Graph 1. Mean Age of The Participants

The study population consisted of 60% males and 40% females for Autism and control and 55% males and 45% females for ADHD group

Pre-examination and Post Examination Salivary cortisol levels were determined using the ECLIA method. In autistic children the Pre SC level was noted to be $0.518 \pm 0.051 \text{ nMol/L}$ (mean) which were higher when compared to the post SC levels $0.444 \pm 0.085 \text{ nMol/L}$ (mean), results were statistically significant (0.0019^*). Pre SC levels in ADHD children were observed to be $0.076 \pm 0.008 \text{ nMol/L}$ (mean) and the Post SC level was $0.24 \pm 0.035 \text{ nMol/L}$ (mean), the results were statistically significant (0.0001^*). In healthy children the Pre SC levels were noted to be $0.181 \pm 0.099 \text{ nMol/L}$ (mean) and post SC level was $0.153 \pm 0.054 \text{ nMol/L}$ (mean), the results were not statistically significant (0.273).

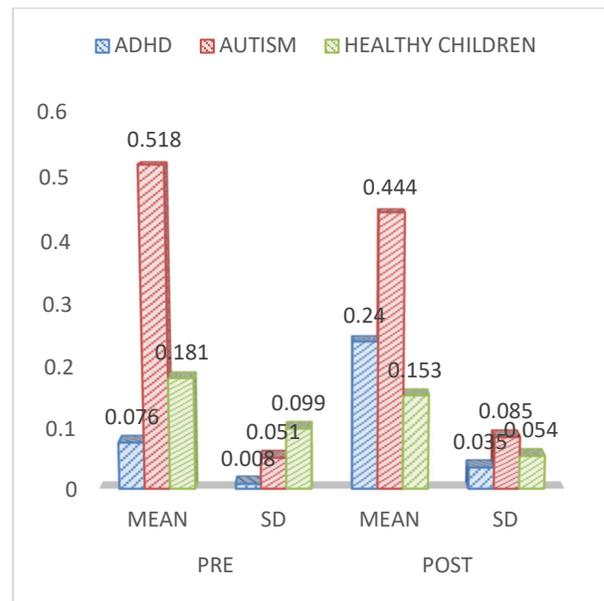
Statistically significant results were detected in all the three groups (Table 1, Graph 2).

Table 1. Cortisol Level Pre-Post Dental Examination.

	Cortisol Level			p-value
	ADHD	Autism	Healthy Children	
Pre Mean \pm SD	0.076 ± 0.008	0.518 ± 0.051	0.181 ± 0.099	0.0001^*
Post Mean \pm SD	0.24 ± 0.035	0.444 ± 0.085	0.153 ± 0.054	0.0001^*
p value (T Test)	0.0001^*	0.0019^*	0.273	

* $p < 0.05$ is statistically significant.

ADHD= Attention deficit hyperactive disorder.



Graph 2. Cortisol Level Comparison.

On Post HOC Tukey test analysis between the groups, the ADHD vs Autism P-value was $p = 0.0046$, ADHD vs CONTROL $p = 0.0000$, AUTISM vs CONTROL $p = 0.000$ in the Pre-examination cortisol level. Whereas regarding the Post Cortisol level the P-value was ADHD vs AUTISM, $p = 0.0000$, ADHD vs CONTROL $p = 0.0001$, AUTISM vs CONTROL $p = 0.0000$.

Statistically significant results were detected in all the three groups (Table 3, Graph 3).

Increased Pre SC levels were observed in autistic children ($0.518 \pm 0.051 \text{ nMol/L}$) when compared to that of healthy children and ADHD. Post SC levels were found to be decreased in both groups. There was an increase in the Post SC level in the ADHD group.

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Table 2: *Dental Anxiety Level (MDAS).*

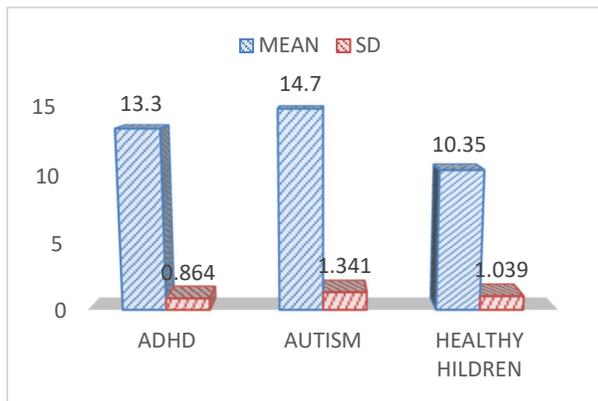
Modified Dental Anxiety Scale			
	ADHD	Autism	Healthy Children
Mean	13.3	14.7	10.35
SD	0.864	1.341	1.039
p value	0.0001*		

*p<0.05 is statistically significant.

Table 3: *Pearson Correlation Value between Cortisol Level and Anxiety Level.*

Modified Dental Anxiety Scale vs Cortisol Level						
	ADHD		Autism			Healthy Children
	r value	p value	r value	p value	r value	p value
Pre Value	-0.192	0.417	-0.074	0.756	0.040	0.867
Post Value	-0.017	0.943	-0.001	0.996	0.183	0.439

*p<0.05 is statistically significant.



Graph 3. MDAS Scale Comparison

The mean MDAS score was 13.3 in ADHD, 14.7 in autistic children and 10.35 in Healthy children with the Standard deviation of 0.864, 1.314 and 1.039 respectively. The results were statistically significant (Table 2, Graph 3)

Dental anxiety was measured using a modified dental anxiety scale MDAS. The MDAS questionnaire contained 5 questions and grading of dental fear. The children were asked to fill the MDAS questionnaire with the help of a teacher or parent.

On Pearson correlation value between cortisol level and the anxiety level, it was revealed that the pre and post cortisol level values were statistically significant. (Table 3)

When the ADHD children were questioned regarding their next dental visit tomorrow it was observed that 95% of them were not anxious, 5% was slightly anxious whereas 50% Autistic children were not anxious and the 50% were slightly anxious. In healthy children, 80% of them were not anxious and 20% of them were slightly anxious. Statistically, a significant result was observed (p=0.0001). (Table 4).

Concerning their feeling before the dental treatment in the waiting room. It was found that 70% of ADHD children were not anxious and 30% of them were slightly anxious, whereas 10% of Autistic children were not anxious whereas 55% of them were slightly anxious. In healthy children, 85% of them were not anxious and 15% of them were slightly anxious. Statistically significant results were seen (p=0.0001). (Table 4)

For MDAS Question No.3 regarding their perception of drilling tooth, it was found that 80% of ADHD children were fairly anxious and 20% of them were slightly anxious. Whereas, in autistic children, 40% of them were very anxious and 35% of them were fairly anxious. In the control group, 35% of them were not anxious, 45% were slightly anxious and 20% were fairly anxious. Statistically significant results were observed (p=0.0001) (Table 4)

When the children were asked about scaling and polishing it was found that, in ADHD Children 50% of them were very anxious and the other half were extremely anxious. In autistic children, 35% of them were slightly anxious and 65% of them were fairly anxious. In healthy children, 75% of them were not anxious and 25% of them were slightly anxious. Statistically significant results were detected (p=0.0001) (Table 4)

Question no.5 regarding local anesthesia, it was observed that 90% of the Autistic and healthy children were extremely anxious. Similarly, 85% of ADHD children were extremely anxious. 10% of the autistic, healthy children and 15% of ADHD children responded as very anxious. Statistically significant results were observed (p=0.991). (Table 4)

4. Discussion:

The study was conducted in sixty children, which included three different groups of twenty autistic, ADHD and healthy children. The age range of the study population 11-15 years with the mean age being 11.95 for ADHD, 12.05 for Autism and 12 for healthy children. The gender distribution was 60% males and 40% females for Autism and healthy children and 55% males and 45% females for ADHD respectively.

Kanegane et al. (2009) stated that the educational level and family income did not affect the dental anxiety level. In the present study, the Autistic and ADHD group were included who had learning disabilities when compared to healthy children. Brand, (1999) reported that younger children were more anxious than adults. However, in this study, the age and dental anxiety was not correlated due to three different groups and small sample size

In the present study, it was noted that the Pre SC level in ADHD Children was lesser than the Post SC level. Statistically significant results were observed (p=0.0001*). These results are in contrast to the findings of the study done by Blomqvist et al. (2007) who reported that the salivary cortisol level under dental examination was



Table 4. Responses to Modified Dental Anxiety Scale (MDAS) Questions by the study Population.

Questions	Groups	Not Anxious	Slightly Anxious	Fairly Anxious	Very Anxious	Extreme Anxious	X ² VALUE	p value
How would you feel if you went to your dentist for treatment tomorrow?	ADHD	19(95%)	1(5%)	0	0	0	56	0.0001*
	Autism	10(50%)	10(50%)	0	0	0		
	Healthy Children	16(80%)	4(20%)	0	0	0		
How would you feel if you were sitting in the waiting room for treatment?	ADHD	14(70%)	6(30%)	0	0	0	151.77	0.0001*
	Autism	2(10%)	11(55%)	7(35%)	0	0		
	Healthy Children	17(85%)	3(15%)	0	0	0		
How would you feel if you were about to have a tooth drilled?	ADHD	0	4(20%)	16(80%)	0	0	231.93	0.0001*
	Autism	0	0	12(60%)	8(40%)	0		
	Healthy Children	7(35%)	9(45%)	4(20%)	0	0		
How would you feel if you were about to have your teeth scaled and polished?	ADHD	0	0	0	10(50%)	10(50%)	512.53	0.0001*
	Autism	0	7(35%)	13(65%)	0	0		
	Healthy Children	15(75%)	5(25%)	0	0	0		
How would you feel if you were about to have a local anaesthetic injection in your gums?	ADHD	0	0	0	3(15%)	17(85%)	1.617	0.991
	Autism	0	0	0	2(10%)	18(90%)		
	Healthy Children	0	0	0	2(10%)	18(90%)		

*P<0.05 is statistically significant.

significantly lower than the healthy children. King et al. (1998) stated that poor response inhibition is the central feature of ADHD disorder. Quay (1988) adapted Gray's neuropsychological theory of anxiety disorders and proved that the deficit in response inhibition occurred as a result of under-functioning in the behavioral inhibition system (BIS), which is one of three interactive systems in Gray's model. Lackschewitz et al. (2008) stated that with regard to autonomic arousal, abnormal patterns in cortisol levels are detected in children with ADHD.

In the present study, it was observed that the Pre SC level was more when compared to the Post cortisol level in Autistic children and the results were statistically significant (p=0.0019*). Similar findings were observed in a study conducted by Babu and Shah (2017) who also showed significant increased pre-dental examination SC levels and decreased post-dental examination SC levels in Autistic children. These findings are in contrast to the study conducted by Corbett et al. (2006) who reported that the majority of children with autism demonstrated increased SC levels after exposure to mock MRI, a non-social stressor, whereas non-autistic children showed no response or reduction in SC levels.

However, in healthy Children, the Pre SC level was found to be more than the Post SC level. The results were not significant. These findings can be substantiated by the study conducted by Bolla et al. (2017). who also found that the pre-treatment anxiety level was higher in one-third of the healthy population. Our findings are in accordance

with the following studies. de Menezes Abreau et al. (2011). who investigated 302 children in the age group of 6–7 years and concluded that dental anxiety reduced after a dental visit. Interestingly, these findings are due to the increasingly higher levels of pre-examination SC levels and anxiety because of the anticipation of dental examination procedure and exposure to an unknown individual.

Kirschbaum & Hellhammer (1994) stated that a dental visit is often associated with fear and anxiety which eventually increases the stress-related hormones like Adrenocorticotrophic hormone (ACTH), corticotropin-releasing hormone (CRH) and cortisol are the main indicators for the response. The dental examination is done in a known environment and the acclimatization to the dentist might have decreased the anxiety level in the study population resulting in lower post SC level.

Few of our findings illustrate the capacity of the stressor which is the dental examination in the study to elicit HPA-related stress reactions. There were differences in cortisol levels before and after a dental examination. This indicates that the major stressor is the anticipation of interacting with the dentist. Similar findings were seen in the previous studies (Greabu et al., 2006; Majstorovic et al., 2014; Patil et al., 2015; Almaummar et al., 2019; Babu & Shah, 2017; Kanegane et al., 2009; Blomqvist et al., 2007; Sadi et al., 2013).

This is the first study on the HPA-axis function in children with ADHD and Autism in which response to a



real-life stressor (a dental examination) was investigated by measuring Salivary cortisol and also using the MDAS. The findings of this study illustrate the ability of the stressor or dental examination to elicit HPA-related stress reactions

The children filled the MDAS questionnaire. In the present study, it was observed that the Autistic children were the most anxious as they had the highest MDAS score when compared to ADHD and healthy children. Amaral et al. (2008) reported that individuals diagnosed with autism may present different combinations of signs and symptoms, and there is also a distinction of the severity of these characteristics that may involve intellectual impairment, seizures, anxiety, attention deficit, and hyperactivity. Each individual diagnosed with autism presents a unique set of behaviors and challenges.

In this study, there is no significant correlation between the MDAS score and the cortisol level in all three groups. These findings are comparable to the studies done by Babu and Shah (2017); Blomqvist et al. (2007); Greabu et al. (2006); Al Maummar et al. (2019). The first dental visit must be used primarily for the dentist and patient to be acquainted with each other and for the establishment of confidence and build a rapport

In this study, it was observed that the ADHD children were not anxious about the dental visit on the following day. These results are in accordance with a study conducted by Felicetti and Julliard (2000). who also reported that there are no significant behavior changes between children with ADHD and healthy children. These results are contradictory to the study done by Blomqvist et al. (2007). who demonstrated that the ADHD hyperactive children had slightly higher anxiety and dental score before the treatment.

Autistic children were found to be the most anxious with regard to the dental visit on the following day when compared to ADHD and healthy children. The results are in accordance with the study conducted by Babu and Shah, (2017). in which the Autistic children were more anxious than healthy children. Our findings appear to be well substantiated by Klein, U., & Nowak, A. J. 1998. who stated that Autistic children have an apprehension of meeting new people and prefer to avoid the group.

In this study majority of the Healthy children opted as not anxious for the dental visit on the following day. These findings are comparable to the study done by Babu and Shah, (2017) and Patil et al. (2015). These results are in contrast to the study conducted by Bolla et al. (2017). who reported a high level of pre-treatment anxiety in about one-third of the study population.

In this study regarding their feeling before the dental treatment in the waiting room, it was observed that the majority of the ADHD children were not anxious. Similar findings were seen in a study done by Blomqvist et al. (2007). who reported that the ADHD children are associated with dysfunction of the HPA axis which usually

results in a blunted response when compared to the Healthy children.

It was noted more than half the population of Autistic children were slightly anxious before the dental treatment in the waiting room. Similar findings were seen in a study conducted by Babu and Shah, 2017.

Most of the healthy children were not very anxious about the dental visit on a consecutive day. These findings are in accordance with the study done by Babu and Shah, (2017); Soares et al. (2016); Patil et al. (2015).

The perception of drilling the tooth results in sound and discomfort to the patient. It is common for the child to find it uneasy and painful. With regard to the perception of drilling teeth the results of the study revealed that most of the ADHD children were fairly anxious. These findings are comparable to the studies done by Blomqvist et al. (2007) who observed that children with ADHD react differently from other children in a dental treatment situation The child with ADHD experiences difficulties in interaction, staying focused, and in communication with the dentist. Children with ADHD may thus experience more anxiety and stress in a dental setting.

In this study majority of the autistic children responded most anxious about the drilling of teeth. These findings are in accordance with the study done by Babu and Shah, (2017) who also reported similar responses of drilling of teeth in autistic children. Patil et al. (2015). Observed anxiety and increased salivary cortisol level during the cavity preparation. This can be attributed to the atypical sensory responses, such as heightened perceptions of touch, smell, and sound and visual stimuli may overwhelm the autistic child's capacity to cope as stated by Marshall et al. (2008).

In the present study, the majority of the healthy children responded as slightly anxious to the drilling of teeth. This is in contrast to the findings of Babu and Shah, (2017) who observed the majority of the population was extremely anxious to the drilling of the teeth. Patil et al. (2015) observed that the cavity preparation procedure was stressful. Greabu et al. 2006. observed adrenal stress response associated with long and painful dental procedures greater than those associated with short and painless dental procedures such as dental examination and scaling.

Hakeberg & Cunha (2008) demonstrated that perceived pain is correlated with higher anxiety towards different aspects of dental hygiene treatment such as scaling. In the present study, it was noted that the majority of the ADHD children were most anxious about scaling. A child's expression of dental fear might be influenced by the child's difficulties to take in and understand the treatment situation. A child with ADHD has difficulties in anticipating what is going to happen so the child might have a problem using the information in the questionnaire to generalize an answer since the situation being described is one that was previously experienced.



Among autistic children, the majority of them were fairly anxious. The results of our study are in accordance with the study conducted by Babu and Shah (2017) who also reported that half of the study population was slightly anxious.

In our study, the majority of healthy children opted as not anxious about scaling. Kambalimath, H. V. et al., 2010. demonstrated in healthy children that stress is produced by different dental procedures. There was no difference in the Salivary cortisol level after oral prophylaxis and the children were cooperative and not anxious. Greabu et al. (2006) in her study observed stress response to different dental treatments in adults and observed that the scaling had the least cortisol level.

The overall response to the question about local anesthesia was that the ADHD, Autistic as well as healthy children responded as extremely anxious. The results were significant. These findings were supported by the studies conducted by Fayad, M. I., et al., 2017. who found that the anxiety towards Local anesthesia had the highest mean score. Brand (1999) also reported that the question regarding local anesthesia was the most anxiety-inducing. Shannon et al. (1961) have reported the anxiety of local anesthesia administration in healthy individuals and during oral surgical procedures can cause elevations in cortisol in patients undergoing dental procedures. Patil et al. (2015) found that stress is associated with the administration of local anesthesia and extractions that persists into the postoperative period are noteworthy. Interestingly as stated by Rachman, (1977) and Goldberg, (1990) this can be attributed to the fact that anxiety can be due to the fear of the needle, gagging and previous unpleasant visits created by a dental instrument; and previous unpleasant dental visits.

The findings were consistent with the work of Babu and Shah (2017) and Patil et al. (2015) who also observed no association in the correlation of MDAS score to salivary cortisol level in response to various dental procedures such as dental examination, cavity preparation, scaling and administration of local anesthesia and salivary cortisol level. The results are in contrast to the study done by Brand (1999) who reported a correlation between the score and urinary cortisol level. Salivary cortisol is a more reliable indicator when compared to serum or urinary cortisol. No significant correlation between the MDAS score and cortisol level is seen because a simple questionnaire was used to indicate self-perceived stress. Children may underreport or exaggerate their nature of stress. An in-depth questionnaire may be useful.

5. Conclusion:

Dental fear is acquired and influenced by others during childhood and may have a considerable impact on adult behavior. The clinical implication of this study is the behavioral expressions of anxiety in ADHD and Autistic

children are different than other children. It may be attributed to the characteristics of their disorder.

In conclusion, there is no significant correlation between the MDAS score and the salivary cortisol level in this study. Autistic Children were found to be the most anxious and had the highest MDAS score. The autistic children had the highest Pre-dental examination salivary cortisol level. The ADHD children had an increase in the post Salivary cortisol level.

Salivary cortisol serves as a predictor of dental anxiety and is instrumental in employing behavior modification techniques in special health care needs, thus helping us to provide better care and treatment. The Salivary cortisol analysis gives an accurate measurement of dental anxiety. It can be used as a tool to measure and evaluate anxiety. It is extremely useful in behavior modification in special children. Estimation of salivary cortisol is a more reliable and easy procedure devoid of undue stress when compared to blood and serum cortisol measurement.

ADHD and autistic children require behavior modifications due to their difficulty in communication. To minimize distress and optimize cooperation the pedodontist may need to devote more time to prepare the child before the dental examination. The pedodontist should be technically skilled and develop a plan to carry out care that promotes oral health without causing any distress to the children and parents. Salivary cortisol and MDAS serves as a useful tool to employ a suitable behavior modification technique.

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