

## ESTIMATION OF LEMON INHALATION AROMATHERAPY ON SALIVARY CORTISOL LEVELS AND DENTAL FEAR & ANXIETY IN CHILDREN

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### ABSTRACT:

**BACKGROUND:**Dental fear and anxiety are a typical deterrent and possibly stressful issue that jeopardizes children's and adolescents' access to dental care. Children are extremely sensitive to olfactory stimuli, making the aroma of hospital medications a trigger for dental anxiety and terror. Through non-pharmacological action, aromatherapy is extremely important in resolving this problem.

**AIM:** To evaluate the effect of aromatherapy on salivary cortisol level and dental fear and anxiety in children

**MATERIALS & METHODS:**50 children aged 6 to 12 constituted the sample size for this clinical trial. Saliva samples were collected from the patient before and after aromatherapy as part of the pre- and post-treatment processes, respectively. ELISA Cortisol test was used to determine the salivary cortisol in the salivary samples in both study and control group. After aromatherapy, it was seen that the salivary cortisol values significantly decreased. The results of the paired t test showed a statistically significant change (p value 0.05) in the salivary cortisol levels in the study group compared to the control group following aromatherapy.

**RESULTS:**It was observed that the salivary cortisol values reduced significantly after aromatherapy. The paired t test values showed a significant change in the salivary cortisol levels after aromatherapy (statistically significant; p value<0.05). Considerable decrease in salivary cortisol scores was observed after aromatherapy. A significant difference in anxiety scores of lavender groups, a significant decrease of anxiety scores with an increase of age.

**CONCLUSION:** Aromatherapy can be commonly added as one of the non-pharmacological strategies for behaviour guidance in children. Lemon scent decreased the current anxiety scores of patients effectively

**KEY WORDS:** *Aromatherapy, Salivary Cortisol level, Dental Fear and Anxiety*

## **INTRODUCTION:**

One of the key elements affecting how children and teenagers respond to dental treatment is dental fear and anxiety. Anxiety over going to the dentist before getting dental work done is a major factor in why some people postpone getting dental work done, which is typically related to the concept of visiting the dentist for preventive care instead of for dental operations. Generally, children are extremely sensitive to olfactory stimuli, particularly the smell of drugs at the dental hospital. Because the various aromas of common oils can be used to produce a beneficial physiological or pharmacological effect through the sense of smell, alternative treatment modalities like aromatherapy, which entails the application of essential oils of aromatic plants, have recently gained attention in medical and dental settings.<sup>1</sup>

By soaking gauze in these oils or using a humidifier, the oils can be inhaled. The inexpensive cost and little side effects are what encourage medical professionals to choose this procedure. Due to significant anatomical links between brain regions like the limbic system and hypothalamus, which are involved in emotion and memory, there is a strong association between smells and memories, especially those from the past that are charged with emotional significance. The child will remember this fragrant effect of structured memory for a very long time, and it is also good for their mental, psychologic, spiritual, and social development. When compared to traditional medications, aromatherapy is said to be quite safe with regard to side effects.<sup>2</sup>

Odors have the power to alter emotional states in people because they contain the crucial. Oils have pharmacological characteristics that cause emotional effects.<sup>3,4,5,6</sup> The traditional use of essential oils in aromatherapy aids in easing patients' anxiety before any dental procedure. Aromatherapy which is a trustworthy and beneficial therapy that has a relaxing effect in patients undergoing dental treatment has been assessed only in few studies and reported improved mood and lesser anxiety mainly in females; also reported that odors are capable of reducing anxiety and altering emotional states in patients.<sup>7,8</sup>

One of the most traditional herbal oils and one that is regarded as safe is lemon essential oil (Citrus lemon). Dental anxiety could be soothed and relieved simply putting one or two drops of lemon essential oils to an oil lamp or diffuser in the bedroom. Due to the rising popularity of herbal supplements, the year-round availability of lemons, and the wide variety of applications for which they are used in Indian culture.<sup>9,10</sup> Thus, the literature on lemon inhalation aromatherapy in children undergoing dental treatment is meagre. The main aim of this study is to evaluate the effect of lemon inhalation aromatherapy on salivary cortisol levels in pediatric patients in reducing dental fear and anxiety in children undergoing dental treatment.

## **MATERIALS AND METHOD:**

The study was conducted in the Department of Pedodontics & Preventive Dentistry, Saveetha Dental College & Hospital after getting the institutional ethical clearance (Ref no: SDC/PEDO/2021-15) from the institutional ethical committee.

### **SAMPLE SIZE SELECTION**

The adequate sample size was determined to be 50, considering  $\alpha = 0.05$  and power = 80%. Considering the salivary cortisol as the primary outcome, the sample size was calculated based on a previous study in which mean  $\pm$  SD in intervention groups was  $12.51 \pm 1.34$  (nmol/lit) respectively.<sup>11</sup> A total of 50 children aged 6 to 12 years were selected according to the following inclusion criteria among children attending the Pediatric Dental Clinic of Saveetha Dental College & Hospital

### **SELECTION CRITERIA**

#### **INCULSION CRITERIA**

- All children attending their first dental visit.
- Children between the ages of 6 and 14 who require a dental class 1 restoration for a carious tooth in the mandibular arch that requires a cavity to be prepared.
- Children accompanied by parents only.
- Parents from all sociodemographic status.

#### **EXCLUSION CRITERIA**

- Children who had previous dental treatment
- Children who had significant behavioural management problems.
- Children who are having respiratory illness (asthmatic, chronic obstructive pulmonary disease and cancer) and associated or non-associated systemic diseases
- Children who had previous negative dental experience and
- Medically, mentally and physically compromised children.
- Children not accompanied by parents and not willing for an informed consent form.

The children were randomly divided based on table of random numbers, with 10 patients in each age group, for allotment. At baseline the operative salivary samples were collected for salivary cortisol assessment and dental fear and anxiety were recorded using children fear survey schedule dental subscale. The children were isolated in a separate room and aromatherapy was infused. Aroma oil used was of lemon extract. The aroma was diffused using the ceramic oil diffuser which disperses essential oils into the air and fills the area with a lemon fragrance. The aromatherapy was given for 30 minutes and post operative salivary samples were collected. The samples were run in ELISA cortisol test to estimate the salivary cortisol levels.

### **COLLECTION AND ANALYSIS OF SALIVA**

Stimulated saliva was collected using the passive drool method [23] into sterile collection tubes (Greiner BioOne GmbH, Austria) and were stored in a vaccine box (Saveetha Dental College, Chennai, India) at  $\approx 5$  °C for half an hour before being transferred to a deep freezer at -80 °C where they were stored until analysis. Saliva was collected when the child enters OPD before the patient undergoes aromatherapy, post saliva sample was collected after the treatment procedure

was completed. The saliva cortisol levels were then normalized for diurnal variation using standard protocols. The salivary cortisol was measured using commercially available Cortisol Saliva ELISA kit (DiaMetra Srl Unipersonale, Immunodiagnostic Systems (IDS) Ltd, Boldon, UK)



Fig1&2: Pre op sample collection kit and patient seated for sample collection



Fig 3&4: Post op sample collection kit and Cortisol saliva ELISA kit

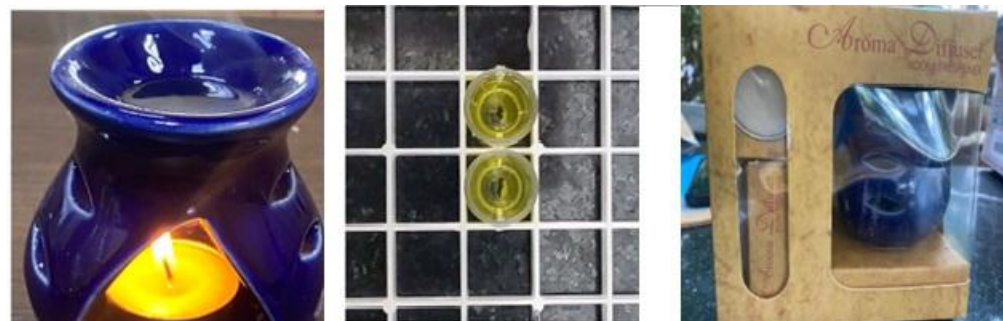


Fig 5,6&7: Aromatherapy inhalation kit

## ADMINISTRATION OF QUESTIONNAIRE AND DATA COLLECTION

The children anxiety level was assessed by using questionnaire which utilizes anxiety measuring parameters comprising of:

1. Clinical anxiety rating scale (CBFSS)
2. Physiologic parameters (Pulse rate).

The Children's Fear Survey Schedule-Dental Subscale was employed to record the children's dental anxiety during the procedure. Cuthbert and Melamed created a psychometric tool to assess

children's dental anxiety. The scale has 15 items that are all related to different dental procedures, like drilling, injections, and needing to open the mouth. Each answer was accorded a 5-point Likert grading. Scores of 38 or above signified specific phobia. The scale ranged from 15 to 75.

#### Monitoring of the pulse rate

Pulse rate was measured using a pulse oximeter (Beurer, PO30, Beurer GmbH, Uttenweiler, Germany) and recorded in beats per minute (bpm). Pulse rate was recorded in the waiting room prior to the commencement of treatment. Pulse rate was recorded over a 5-min period at 30 s intervals and the mean was used for the analyses before and after the application of salivary cortisol levels.

## RESULTS

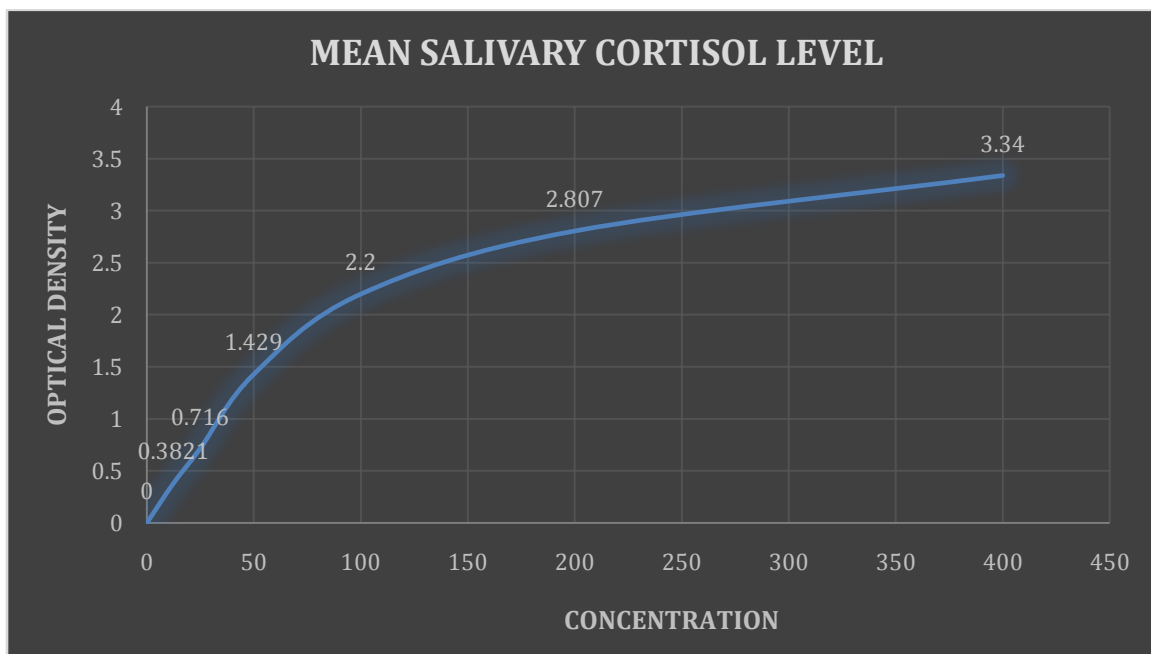


Fig.9: Graphical representation of mean salivary cortisol level.

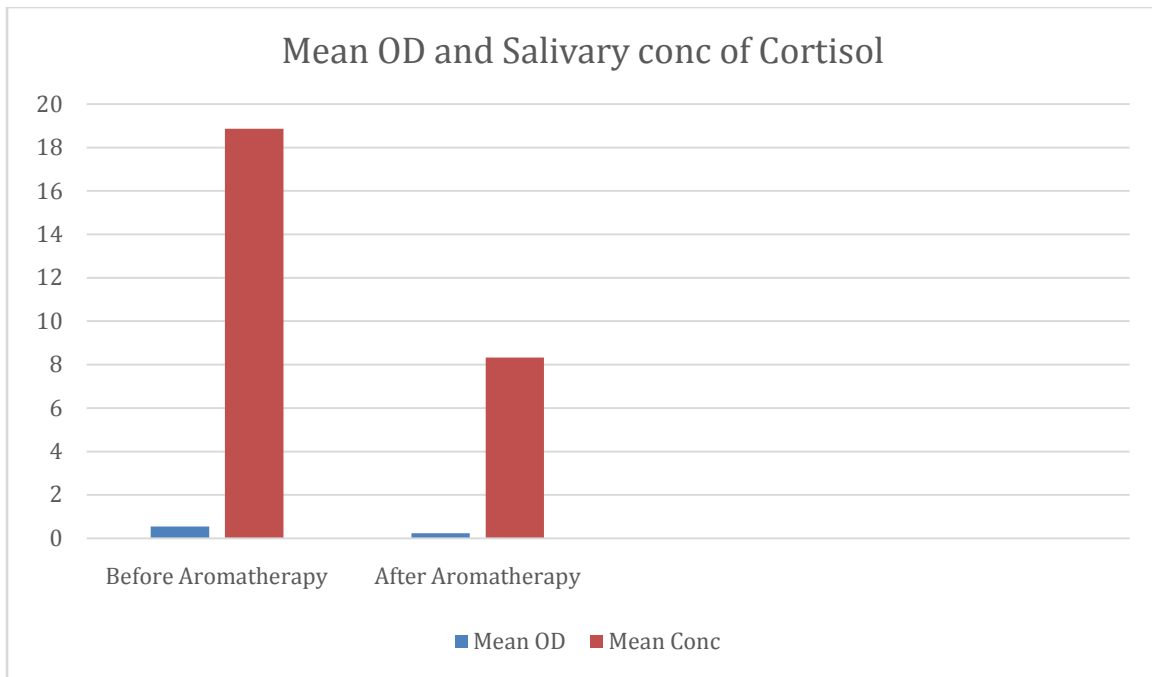


Fig.10: Graphical representation of mean optical density and salivary cortisol level before and after aromatherapy.

In the figure 1 and 2, the salivary cortisol levels varied significantly with respect to the base level optical density before and after aromatherapy. The group before aromatherapy had the highest levels of salivary cortisol and the patients was classified as dental anxiety or phobic. The group after aromatherapy had the lowest levels of salivary cortisol levels. The cortisol level concentration steadily increased and remained high. The peaked curve flattened at a value of optical density 3.34 and salivary cortisol 400mcg/l.

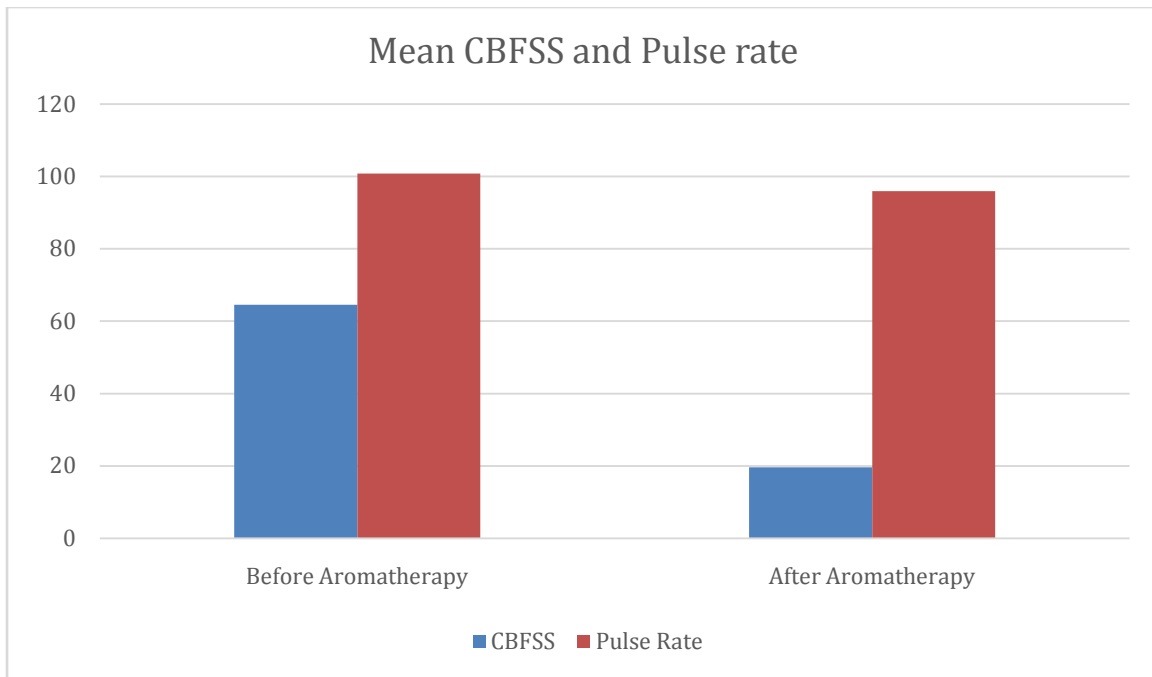


Figure 11: shows Mean CBFSS and Pulse rate

In the figure 3: CBFSS values shows child’s dental fear and anxiety in the pre aroma group, children dental fear survey schedule subscale scores were  $64.54 \pm 2.75$  and post aroma group the scores were  $19.66 \pm 1.90$ ; : Pulse rate y in the pre aroma group, children dental fear survey schedule scores were  $100.84 \pm 2.75$  and post aroma group the scores were  $95.94 \pm 1.90$ .

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
gp1aromabef - gp1aromaaftr	10.120	3.826	.541	9.033	11.207	18.703	49	.000

Figure12: showsthechi-squareanalysis

Fromtheresultsobtained,itwasobservedthatcortisollevelsweresignificantlyreducedafteraromatherapy.Apairedt-testshowedsignificantdifferencesbetweengroupsbothbeforeandaftertreatment.Cortisollevelsingroupbwerealsosignificantlylowerthanthosein anxietyandphobiapatient( $p < 0.05$ ).Aftersurgery,therewasasignificantdifferenceinsalivarycortisollevelsbetweenanxiousandnon-anxiouspatients.Thep-valueforthepairedt-testislessthan0.000,demonstratingtheimportanceofthestudy.

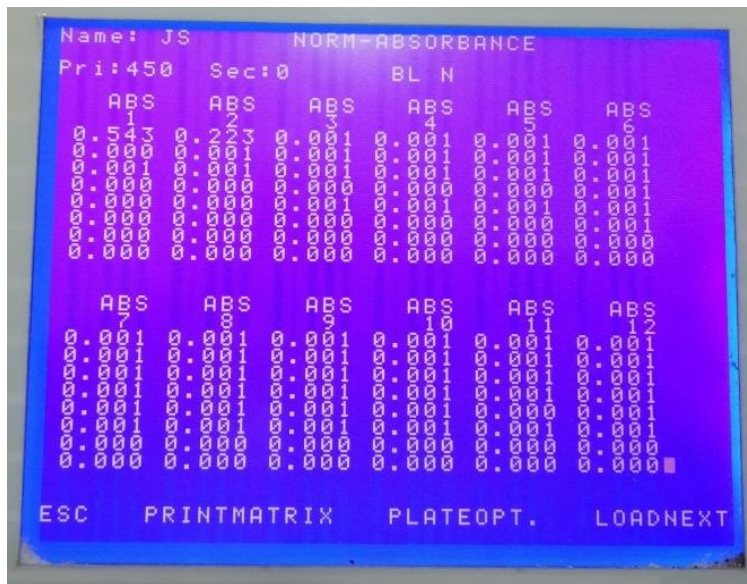


Figure 13 shows readings of the polymerase chain reaction test values for various samples

## DISCUSSION:

The study used aromatherapy, specifically the scent of lemon, in combination with pediatric dental care to investigate its calming effects and found that using aromatherapy resulted in statistically significant decreases in salivary cortisol levels and pulse rate.<sup>11-15</sup> It also suggests that the mechanism behind the calming effects of aromatherapy may involve the rapid diffusion of volatile aroma oil molecules into the bloodstream, which may activate the brain through systemic circulation. Inhaled oils use their volatile molecules to quickly diffuse into the blood and circulate through the body to activate the brain.<sup>16,17,18</sup> When this odour diffuses through the air, the chemicals react with the olfactory receptors in the nose, causing an electrophysiological response that spreads to the brain. This physiological response affects the sense of smell and reaches areas of the limbic system such as the amygdala and hypothalamus, where hormone levels and emotional states are controlled, likely activating the neocortex. This physiological response affects the sense of smell and reaches areas of the limbic system such as the amygdala and hypothalamus, where hormone levels and emotional states are controlled, likely activating the neocortex.<sup>19</sup>

Aromatherapy is a commonly used non-pharmacological strategy. Using essential aroma oils to stimulate the olfactory system, promote relaxation and reduce anxiety. Many authors have demonstrated that aromatherapy with lavender, orange oil in children during dental treatment can lead to significant reductions in pulse rate which also points to the effect of reducing pain perception during dental injections and is used as a method of



stress and pain control in dental environments.<sup>20-25</sup> In the present experiment, water and volatile oil were vaporized and diffused into the air, facilitating their inhalation into the lung in major quantities which are further transported through the alveoli into the blood, so that a pronounced effect can be expected. However, as these effects arose relatively slowly, this arrangement corresponds to the above-mentioned pathway, which may explain why the significant effects on the pulse rate, CBFSS and salivary cortisol values after the aromatherapy. Also, the child anxiety was reduced significantly while receiving fissure sealant therapy by using lemon aromatherapy which in accordance with studies done by Jafarzadeh et al. and Pradopo et al wherein they used orange and lavender.<sup>24,25</sup>

In this study the children pre aroma group had significantly higher mean salivary cortisol, CBFSS and pulse rates scores than the children in post aroma group, and the mean values were in accordance with study from New Zealand on 15-yr-old children. However, children with anxiety had severe symptoms of hyperactivity/impulsivity had significantly with higher mean CBFSS. Thus, it reveals that dental anxiety might be related to hyperactivity/impulsivity in children which can be correlated to impulsivity, in combination with dental fear, was more common in uncooperative child dental patients.<sup>26-34</sup>

Dental procedures including oral prophylaxis and fissure-sealant therapy were seen as a stressor because of their efficiency, non-intrusiveness, and ethical quality. It was seen that any changes in salivary cortisol and pulse rate following these two painless procedures changed significantly which is not in accordance with studies by Toet et al. wherein it was seen that neither apple nor orange odor was effective in reducing anticipatory anxiety in patients waiting in large dental clinics. The outcome may have been affected by additional distraction sources, such as great noises and crowding.<sup>1,35</sup>

The safety of long-term use of lemon oil aroma inhalation is unknown, particularly concerning toxicity or sensitization. Lemon oil may induce a stimulating effect rather than a calming effect when used in large amounts. Also, like lavender contact dermatitis can also occur following lemon oil exposure.<sup>36</sup> Nevertheless, lemon oil is one of the oldest and safest essential oils with a broad therapeutic action

Like the study by Shirtcliff et al, in this research the saliva samples was collected by asking the child to expectorate directly into the plastic vials, since it has been reported that the use of cotton-based materials to collect the saliva can be a source of systematic and unsystematic errors in measurements<sup>37</sup>

The majority of the studies<sup>38</sup> lacked relatively limited certainty of the evidence, found that the provision of aromatherapy reduced the physiological responses associated with dental anxiety and even reduced pain during dental procedures. Molecular medicine research suggests that essential oils used in aromatherapy have pharmacological properties that may contribute to the physiological and psychological effects reported in these studies. Therefore, further investigations could be performed on evaluating the effect of orange or other aromas during anxiety-provoking dental procedures. The results of the current study might have been influenced by individual's age and scent preferences.

In the present study, gas chromatography was not performed for determining the main components of the lemon essential oil. Another limitation of this study was the lack of a control

odor; hence it is possible that lavender scent might have simply masked odors in the dental clinic. This is while the smell of the dental office (such as fragrance eugenol, endodontic irrigants and of the floor detergent) may play an important role in developing dental anxiety and fear.<sup>39</sup> Therefore, some part of the anxiolytic effect of lemon scent could be due to masking of dentistry-related odors rather than its therapeutic effect. Although the narrow age range of 6 to 12 years was considered as inclusion criteria in our study, it is suggested to use the accurate amount of essential oil regarding age or weight in future studies.

## CONCLUSION:

Inhalation aromatherapy proven to have positive effects in reducing salivary cortisol level and dental fear and anxiety which can be recommended as a new and easy alternative to reduce anxiety in the paediatric patients during dental treatment. The lavender oil had an positive impact on the dental anxiety and pain of children undergoing dental treatment and also reduced the pulse rate in children thereby reducing the dental anxiety. Aromatherapy can be considered as method for behaviour guidance in children.

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