Quantification and Measurement of Changes in Anxiety Level in Preschool Children and Their Mothers through Multiple-visit Dental Treatment

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INTRODUCTION

The word emotion is often wrongly held synonymous with joy, anger, fear, or sympathy; rather, it encompasses a whole lot of feelings and their interactions.[1]

The physical side of emotion involves the coordinated activity of both autonomic and somatic nervous system. The autonomic features of emotion take place through hypothalamus which in turn sends impulses to bulbar autonomic centers. Somatic features of emotion take place through reticular formation of brain stem which modifies motor neuron activity.[2]

Fear is one of the primary emotions, and possibly the most pervading one in its implications to the development of the individual. Fear is not specific in the first half year of life. With the acquisition of perceptual differentiation, the fear response begins to take shape.[3]

Anticipation of any unpleasant situation evokes a sense of fear which can be categorized as anxiety. In other words, it is a conditioned fear evoked by a conditioned stimulus. Thus, anxiety arises because of the anticipation of fear and has the adaptive function of avoiding or preventing the recurrence of painful stimuli.

Aim: The aims of the present study were to quantify anxiety and find the level of anxiety in the very 1st day of dental treatment and the pattern of change in the following visits and to find possible impact of maternal anxiety during dental treatment of their wards.

Materials and Methods: The study was conducted on 297 children aged 3–6 years visiting the Department of Pedodontics and Preventive Dentistry of Dr. R. Ahmed Dental College and Hospital for treatment. In addition, accompanying parents were also included in the study. The blood pressure and heart rate of the participants were recorded at three visits with a digital blood pressure and heart rate monitor with wrist cuff (Omron; Japan). The same instrument and the same procedure were employed for the mothers also. Blood pressures and pulse rates so recorded were tabulated according to age and were made ready for statistical analysis using the SPSS version 12 (Statistical Package for Social Sciences, SPSS Inc., Chicago, Illinosis, USA) software.

Results: There was a significant difference in blood pressure and heart rate of children in the subsequent visits.

Conclusion: The majority of the children suffered from anxiety on the 1st day of treatment which gradually diminished in the subsequent visits. Maternal anxiety was also highest in the initial visit which gradually came down in the subsequent visits.

Keywords: Anxiety, blood pressure, heart rate, physiological.
Anxiety is an abstract thing which needs to be quantified before proceeding to select the most suitable method to modulate the behavior when required.

Physiological changes in the body such as changes in the heart rate and blood pressure are inevitable results of anxiety. The stressful stimuli are carried by the afferent fibers from any of the five sense organs to the central nervous system. From there, the preganglionic sympathetic fibers directly stimulate the adrenal medulla which results in the release of several stress hormones such as adrenaline. This raises the blood pressure. Increased heart rate is the direct result of sympathetic stimulation.[2]

Till date, a number of studies have been conducted on anxiety-related dental treatment, which are authentic enough on their inclusions. Most of them are in their opinion that anxiety is an unavoidable nuisance, at least in the initial dental treatment visit of a patient. Several renowned workers have confirmed the fact that stress and anxiety-related physiological changes do occur during the dental procedures.[4-6]

A child’s response to dental treatment in multiple visits has also been studied.[3-7]

Most research workers have found improved child response with subsequent visits, but some researchers had different findings, that is, Venham et al. found that the change in response pattern in multiple visits is quite complicated.[6,7]

Mothers have always been blamed for the anxious behavior of a child. The impact of the maternal anxiety on a child’s behavior has been studied and reviewed extensively.[8]

This study is an effort to look into the changes in the anxiety pattern of children in three sequential dental treatment visits. Like all previous studies, maternal influence has also been looked into. One additional feature here is the study of the outline of maternal anxiety in successive visits. This may help give an idea how far the maternal influences extend along the course of the treatment of their children. The necessity to quantify anxiety has been served by the measurement of blood pressure and heart rate. This will help grade behavior according to the anxiety level.

**AIMS AND OBJECTIVES**

A total of 297 healthy children of ages ranging from 3 to 6 years were studied. Their blood pressures and heart rates were recorded in three visits. The same was done for their mothers.

The aims of the present study are:

1. To quantify anxiety and compare the anxiety level in three successive visits

2. To find possible impact of maternal anxiety during dental treatment of their wards.

Behavior modulation is an integral part of pediatric dentistry. Grading of behavior pattern becomes easier with anxiety quantification.

The objective of the study is that it may help to be more methodical in selection of techniques to modulate behavior of children in the dental operatory when required.

With proper knowledge about the maternal influence on children’s behavior, preoperative counseling of mothers becomes easier. They can be motivated to discard their own anxiety and help build a proper behavior modulation regime for their children.

**MATERIALS AND METHODS**

**SURVEY GROUP**

Two hundred and ninety-seven children visiting the Department of Pedodontics and Preventive Dentistry of Dr. R. Ahmed Dental College and Hospital for treatment were the subjects for this study. The sample size was calculated using the formula: 

\[ n = \frac{z^2pq}{d^2} \]

where 

- \( n \) = sample size,
- \( p \) = prevalence of disease,
- \( q \) = free from disease,
- \( d \) = allowable error, and
- \( z \) = point on the normal deviation.

Upon calculating, “\( n \)” was found to be 297. In addition, accompanying parents were also included in the study. Those children coming with guardian other than mothers were not included in the study.

The ethical clearance was obtained from the Institutional Review Board, Dr. R. Ahmed Dental College and Hospital (DCH/1453) and informed consent was obtained from the study participants. The study was conducted over a period of 10 months.

Treatments that require multiple visits needed the patients to come several times to the hospital. Only those patients who required multiple-visit treatments were taken into consideration.

Proper medical histories of the children were taken to exclude patients with chronic systemic illnesses which especially include those diseases that may affect the blood pressure or heart rate of a child. Only those children who except for the dental problems were otherwise healthy and normally stay so were subjects of this study.

Likewise, brief history of the mothers was also taken. Those with cardiac problems, diabetes mellitus, chronic hypertension, and renal problems were excluded from the study. All those included in the study appeared in good health.

Care was exercised to eliminate those treatment procedures that required injection of local anesthetic...
solutions. The participants who would require simple restorative procedures or supragingival scaling were taken into consideration.

Finally, consent was taken from the parents for the procedures and all were informed of the study or the survey work.

Totally 297 children were included in the study. Of these 297 children, there were 150 girls and 147 boys. Care was taken to keep parity in the number of boys and girls as much as possible. The children were of age group 3–6 years [Table 1].

**Materials used**

To record the blood pressure and the heart rate of the participants, a digital blood pressure and heart rate monitor with wrist cuff was used (Omron; Japan). The cumbersome procedure of blood pressure recording with conventional sphygmomanometer and stethoscope was avoided which may unnecessarily lead to production of anxiety in children.

**Methods**

The children were readily agreed to cooperate and most of them showed some curiosity about the instrument on their first visit. This proved that the instrument itself did not arouse any fear in children.

To check the reliability of the instrument, it was checked alongside conventional sphygmomanometer before the initiation of the study. The range of error was found to be around ±2 mmHg. The figure matches with the range of error mentioned in the manual booklet of the instrument. To minimize this range of error, blood pressure and pulse rate were recorded 3 times at a row for each case. Then, the average was calculated which was taken as the accepted value for consideration. The same instrument and the same procedure were employed for the mothers also. Before checking the blood pressure and pulse rate, the patients were made to sit in a calm and quiet room for 10 min along with their parents. Next, they were made to sit on the dental chair. The blood pressure–pulse rate monitor was fitted on their hands and blood pressure and pulse rate were recorded as mentioned above. Later, simple oral examinations were done using mirrors and probes. Caries and oral hygiene status were recorded in the hospital tickets. Treatment for each patient was started with a simple amalgam restoration. While the treatments were going for the children, mothers’ blood pressures and pulse rates so recorded were tabulated according to age and were made ready for statistical analysis.

**Results and Observations**

A total of 297 healthy children [Table 1] and their others visiting the Department of Pedodontics and preventive dentistry of Dr. R. Ahmed Dental College and Hospital, Calcutta, were the subjects of this study. Their blood pressures and pulse rates were recorded in the three visits. Only the systolic pressures were taken into consideration as the changes in diastolic pressures were observed to be negligible in three visits [Tables 2-5].

**Discussion**

Anxiety in children is a well-studied yet poorly understood subject. The present study is a humble effort to quantify anxiety from its physiological point of view.

The cause of anxiety can be studied from two different angles, namely, the psychoanalytical and the physiological angles. While the first one is beyond the scope of this discussion, the second one has been studied from time to time by different renowned physiologists. They concluded that anxiety produces stress which ignites a cascade of physiological reactions ultimately culminating in changes in heart rate and blood pressure which can be measured.

The chain of reaction can be initiated through any of the senses. It may be sight, smell, sound, touch, or taste sensation. The sensations from sensory receptors of the respective sense organs are carried through afferent fibers to the central nervous system. The preganglionic sympathetic fibers stimulate the adrenal medulla (which is actually modified postganglionic fibers) to secrete stress hormones. This has profound effect on increasing of blood pressure.[5]

Different behavioral changes, expressed as different somatic reactions, are associated with emotion[9] in man. A variety of autonomic responses are associated with emotional outbursts. Ranging from change in blood pressure and heart rate to frank fainting or even death may take place with emotional outbursts associated with fear. Anxiety can be classified as an emotion that invariably causes changes in heart rate and blood pressure.

**Table 1: Distribution of the children by age group and gender**

| Age (years) | Male | Female | Total |
|------------|------|--------|-------|
| 3          | 30   | 39     | 69    |
| 4          | 36   | 45     | 81    |
| 5          | 39   | 33     | 72    |
| 6          | 42   | 33     | 75    |
| 3-6        | 147  | 150    | 297   |
The present study tried to gauge this change and tried to find out how this change takes place through a series of visits to the dental clinic. When the blood pressure and heart rate changes in children are taken into consideration, the results clearly show a significant change in most of the children from the first visit to the third visit. Moreover, another finding is that the systolic pressure change is much significant and the diastolic pressure change is insignificant.

According to Best and Taylor,[10] “emotional excitement tends to increase arterial blood pressure, particularly the systolic phase and heart rate is also increased.”

The above average systolic pressure and heart rate in the first visit of the child to the dental clinic is probably due to fear of unknown. Anxiety produced due to a new environment with enough “instruments of pain” can be easily understood. Maternal anxieties impart some form of fear to their children which are manifested as changes in blood pressure and heart rate.

Venham and Quatrocelli[11] have also suggested that fear of unknown is responsible for the child’s initial response to the dental visit.

Venham et al.[6] found that negative response of a child is high during the initial visits. The initial dental experience sensitizes the child to dental procedures.

Ripa[11] was of opinion that especially the preschool children tend to exhibit “some degree of apprehension and anxiety” in their visit to the dentists.

Taylor et al.[12] blamed separation anxiety and fear of unknown for the negative behavior of preschool children in the initial phases of treatment.

Many research workers declared that anticipation of pain is one of the causative factors of fear before any dental procedure, especially during the first visit.[6,7] Fear

| Table 2: Blood pressure (average value ± standard deviation) for genders of different age groups at three dental visits |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Age group       | Sample size     | BP at three visits | Differences in BP between visits and their significance |
|                 | I   | II   | III  | I-II | I-III | II-III | t   | P  |
| 3-6 years (boys)| 147 | 112.92±3.95 | 110.92±3.32 | 107.86±1.73 | 2.00±1.97 | 7.11* | 5.06±3.45 | 10.26 | 3.06±2.86 | 7.49* |
| 3-6 years (girls)| 150 | 111.64±4.47 | 110.00±4.05 | 106.62±2.74 | 1.64±2.06 | 5.63* | 5.02±3.84 | 9.24  | 3.38±2.86 | 8.36* |

*All the t-values are highly significant (P<0.001). BP=Blood pressure

| Table 3: Heart rate of genders at three different dental visits |
|-----------------|-----------------|-----------------|-----------------|
| Age group       | Sample size     | HR (AV±SD) at three visits | Changes in HR between visits and their significance |
|                 | I   | II   | III  | I-II | I-III | II-III | t   | P  |
| 3-6 years (boys)| 147 | 105.81±5.31 | 104.02±4.63 | 99.45±3.16 | 1.79±1.74 | 7.21* | 6.36±4.22 | 10.56* | 4.57±3.38 | 9.45* |
| 3-6 years (girls)| 150 | 107.38±4.66 | 105.32±4.79 | 100.92±3.47 | 2.06±2.42 | 6.02* | 6.46±4.64 | 9.85*  | 4.40±3.53 | 8.81* |

*All the t-values are highly significant (P<0.001). AV=Average value, SD=Standard deviation, HR=Heart rate

| Table 4: Blood pressure of mothers accompanying boys and girls of different age groups at three visits with statistical significance of the differences in average blood pressure between visits |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Age group of boys | Sample size     | BP (AV±SD) at three visits | Changes in BP between visits and their significance |
|                 | I   | II   | III  | I-II | I-III | II-III | t   | P  |
| 3-6 years (boys-mother) | 147 | 125.06±5.61 | 122.67±4.45 | 119.47±3.25 | 2.56±1.68 | 11.35* | 4.42±2.95 | 11.11* | 1.85±1.86 | 7.39* |
| 3-6 years (girls-mother) | 150 | 127.34±5.78 | 124.18±4.68 | 120.66±3.74 | 3.16±2.32 | 9.65* | 6.68±4.47 | 10.56* | 3.52±3.12 | 7.70* |

*All the t-values are highly significant (P<0.001). AV=Average value, SD=Standard deviation, BP=Blood pressure

| Table 5: Heart rates of mothers accompanying boys and girls of different age group at three visits with statistical significance of the difference in average heart rates between visits |
|-----------------|-----------------|-----------------|-----------------|
| Age group of boys | Sample size     | Mothers HR (AV or SD) | Changes in BP between visits and their significance |
|                 | I   | II   | III  | I-II | I-III | II-III | t   | P  |
| 3-6 years (boys-mother) | 147 | 81.67±7.19 | 77.65±6.73 | 72.51±5.67 | 4.12±4.15 | 6.95* | 9.16±6.44 | 9.96* | 5.04±4.84 | 7.29* |
| 3-6 years (girls-mother) | 150 | 85.40±7.50 | 81.08±5.56 | 75.76±2.64 | 4.32±3.21 | 9.52* | 9.64±6.47 | 10.54* | 5.32±4.10 | 9.18* |

*All the t-values are highly significant (P<0.001). AV=Average value, SD=Standard deviation, HR=Heart rate
of unknown is actually a fear of pain from unknown sources in an unknown surrounding. In a dental setting, unknown sources include the instruments and the unknown surrounding is of course the dental office with all its characteristics.

Hence, in this study, the anxiety, as manifested physiologically, is present till the initial visit of most of the children of 3–6 years age groups. This result is in sharp contradiction with the study of Taylor et al.,[12] where they found insignificant change of behavior in the initial visit of the older age groups. The contradiction can be explained from the fact that fear of unknown is rather uncommon in Western children as they get sensitized from regular dental checkups from the early age.

It was also observed that the presence of parents in the dental operatory had significant effects on lowering of heart rate of children. This is consistent with the findings of Pani et al.[13]

Another study shows that children undergoing dental procedures have shown variations in behavior with type of dental procedures, frequency of visits, and also during the treatment procedure.[14]

The next significant finding of the present study was the gradual lowering of blood pressure (especially systolic) and heart rate from the first visit to the third visit in most of the children. The first visit consisted of the introductory session followed by oral examination and simple operative procedures. Through all these procedures, the children probably got sensitized, and as the children got accustomed to the dental setting, their fear of unknown gradually diminished and was almost expunged in the final visit which showed the physiological parameters nearing normal. The restoration of normalcy in the final visit was accompanied with cooperative behavior.

The present study did not include any painful treatment procedure in the initial visit. Subsequent visits also consisted of simple procedures of drilling and scaling, respectively. As the treatment part remained more or less same in all three visits, and the blood pressure and heart rate gradually lowered to normalcy in the third visit from the first visit, the hypothesis of sensitization in the initial visit becomes all the more stronger.

The physiological changes in the mothers also showed the same pattern as the children. Most of the mothers had a high systolic pressure and increased heart rate in the initial visit. These levels higher than normal physiological parameters gradually became near normal or normal in the third visit, in most of the mothers.

The anxiety in mothers in the initial visits was probably in the anticipation of the gravity of the disease. Anxiety in the mother of sick children is a common finding. When they are explained the course of disease and the treatment procedure, they feel anxious about the behavior of their children. Whether the children will help the dentist to finish the entire procedure safely and successfully remains the major concern for the mothers.

The maternal anxiety in the initial visit can thus be explained as fear of unknown. However, in mothers, there is no question of getting sensitized. What cools them down is their children’s improving attitude toward the operative procedures. The subsequent visits thus reveal lower blood pressure (especially systolic) and heart rates.

Although the maternal anxiety may have some role in influencing the children’s anxiety in the first visit, the influence seems to be in the opposite direction in the subsequent visits. That is, as the children’s behavior improves and anxiety diminishes, the maternal anxiety also comes down. Maternal anxiety has very little role to play after the child is sensitized and accustomed to the dental setting.

Klorman et al.[15] in their study negate the hypothesis of maternal influence on child’s behavior in dental treatment. They felt that “there is a need for re-evaluating the popular belief that the child's dental anxiety is acquired through imitation of his mother’s attitudes or by direct maternal reinforcement of such fears”.

No significant difference was found between sexes. Males and females showed same pattern of anxiety from the very 1st day to the final visit. This result is consistent with the findings of Johnson and Baldwin.[9] Bailey, Talbot and Taylor[16] and Rodrigues and Damle.[17]

Limitations of the present study include generalizability of the results due to smaller sample size, and the participated population belong only to the rural population which might produce a somewhat biased result.

CONCLUSION
1. Majority of the children exhibits high anxiety in their first visit
2. The anxiety gradually diminishes in the subsequent visits
3. Maternal anxiety is also highest in the initial visit which gradually comes down in the subsequent visits
4. Maternal anxiety does have some impact on the child’s anxiety at least in the initial visit.

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There are no conflicts of interest.

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