

## RESEARCH ARTICLE

## Cognitive dysfunction among adolescent school children with an anxiety disorder

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## ABSTRACT


**Background:** Anxiety is a mental health disorder which is characterized by worry, fear that may be strong enough to affect the day-to-day activities. The children and adolescents group in the current generation is the most vulnerable group for anxiety disorder due to lifestyle modifications. Anxiety-prone children are likely to have decreased concentration, lack of attention and drive for academic and social activities. Hence, the present study was done to compare the cognition of normal subjects with cognition of mild, moderate, and severe anxiety disorders. **Aims and Objective:** The objective of the study was to assess the cognition in adolescent school children with anxiety disorder. **Materials and Methods:** This was a cross-sectional study conducted in 150 students. A questionnaire recommended by generalized anxiety disorder (GAD)-7 was administered to the students. Cognitive status was assessed using Stroop test and reaction time. **Results:** Out of the 150 participants, 19% were normal with GAD to score <5. 46% had mild anxiety, 19% had moderate anxiety, and 16% had severe anxiety. There was a statistically significant increase in reaction time and Stroop test in severe anxiety group ( $P < 0.05$ ). **Conclusion:** This study has presented an outline of the effects of anxiety on cognition. The study has demonstrated a decline in cognitive function when the severity of anxiety increases. Proper counseling along with cognitive therapy should be given at an early stage to the person who is diagnosed to be having anxiety.

**KEY WORDS:** Auditory Reaction Time; Visual Reaction Time; Stroop Test

## INTRODUCTION

Anxiety is a mental health disorder which is characterized by worry, fear that may be strong enough to affect the day-to-day activities. The most common mental health disorder is anxiety, depression, alcohol abuse, schizophrenia, and bipolar disorder.<sup>[1]</sup> As per the predictions of the World

Health Organization, depression will be the second biggest global health concern next to HIV/AIDS by 2030.<sup>[1]</sup> The children and adolescents group in the current generation is the most vulnerable group for anxiety disorder due to lifestyle modifications. Childhood anxiety is a most common condition affecting around 3%–14% of young children and adolescents.<sup>[2]</sup> 20% of Indian children suffer from some form of mental disorder, of which about 2–5% is serious disorders.<sup>[2,3]</sup> Children are more susceptible to mental disorders as adults.<sup>[4]</sup> <40% of the mentally ill are homeless. As a result, this will lead to adverse outcomes in adulthood including antisocial behavioral and learning associated disorders.<sup>[5-7]</sup> Interpretation paradigms have been used in children to successfully discriminate information processing biases related to self and other judgment in

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anxiety and depression.<sup>[8]</sup> Anxiety-prone children are likely to have decreased concentration, lack of attention and drive for academic and social activities. They also exhibit negative self-judgments and self-negative thoughts and lack of confidence which marks their performance.<sup>[9]</sup> It is very important to assess the cognitive function of the vulnerable population so that early detection and treatment can be initiated. Reaction time and emotional Stroop test can be used to assess the cognitive functions, while some studies considering anxiety linked differences in reaction time and errors in deciding with positive and negative emotion and yet others find no association with anxiety. This gave us an impetus to evaluate anxiety disorders in Puducherry school-going adolescents through questionnaire and to evaluate their cognitive function by reaction time analysis and emotional Stroop color and word test. Hence, the present study was done to compare the cognition of normal subjects with cognition of mild, moderate, and severe anxiety disorders.

## Objectives

The objectives are as follows:

1. To assess the anxiety scores using generalized anxiety disorder (GAD) questionnaire.
2. To compare the cognition levels among anxiety groups.

## MATERIALS AND METHODS

This cross-sectional study was carried out in 150 students of Government Girls Higher Secondary School Kathirkamam and Government Higher Secondary School Indira Nagar Puducherry. This study was approved by the Institutional Ethical Committee of Indira Gandhi Medical College and Research Institute, Puducherry. Informed consent was obtained from the study participants. Height and weight were measured using a stadiometer and weighing machine, respectively.

A questionnaire recommended by GAD-7 was administered to the students of the age group 13–16.<sup>[10]</sup> The GAD-7 score is calculated by assigning scores of 0, 1, 2, and 3, to the response categories of “not at all,” “several days,” “more than half the days,” and “nearly every day,” respectively, and adding together the scores for the seven questions. Scores of 5, 10, and 15 were taken as the cut off points for mild, moderate, and severe anxiety, respectively.

## Assessment of Cognitive Status

### *Stroop color and word test*

The age-matched version of the Stroop color and word test<sup>[11]</sup> was used to assess the cognitive function of the participants. The Stroop task measures voluntary control over the neuropsychological functions which are involved in both word and color naming responses. The test was in the form of a booklet which contains three pages. The first page assesses

how fast the participant can read words; the second page tests how fast the participants can name the colors on the page; and the third page, the participants were asked to name the color of the link words that are printed in, ignoring the word that was printed for each item. The task was administered individually. For any mistake, the participants were asked to stop and proceed after correcting the mistake. The participants was given 45 s for each page. Detailed instructions were given to the participants before starting the test. A stop-watch was used to record the time taken to complete the task.

A similar test was done using emotional Stroop words.

## Reaction Time

Reaction time task was carried out by providing two modes of stimuli- audio stimulus (low- and high-frequency sound) and visual stimulus (red and green lights). The dominant hand response time in seconds was estimated using reaction time apparatus. The auditory and visual reaction time was measured by “reaction time apparatus” manufactured by Anand Agencies, Pune with an accuracy of 0.001 s. The instrument is specially designed to measure response time in milliseconds.

Subjects were given 10 trials, and after repeated practice, three readings for each stimulus were noted. The average of three readings was taken as the value for the reaction time task.

Statistical analysis was done using SPSS software version 11.6. Data are represented as mean  $\pm$  standard deviation. ANOVA test was applied for comparing the variables between groups. Statistical significance was taken at 5% significance level.

## RESULTS

The age group of our study participants was in the range of 13–15 years with mean height ranging  $147 \pm 26.7$  cm and mean weight ranging  $41.7 \pm 10.4$  kg. Based on the GAD scores, the participants were grouped into no anxiety, mild anxiety, moderate anxiety, and severe anxiety. Out of the 150 participants, 19% were normal with GAD score  $<5$ . 46% had mild anxiety, 19% had moderate anxiety, and 16% had severe anxiety [Table 1].

Cognition levels assessed using reaction time and Stroop test. The time is taken by the participants to react to light (red

**Table 1:** Distribution of study participants based on GAD scores for anxiety

Variable	Percentage of participants
No anxiety (GAD score $<5$ )	19
Mild anxiety (GAD scores 6–10)	46
Moderate anxiety (GAD score 11–15)	19
Severe anxiety (GAD score $>15$ )	16

GAD: Generalized anxiety disorder

**Table 2:** Comparison of visual and auditory reaction time between mild, moderate, and severe anxiety group

Variable	No anxiety	Mild anxiety	Moderate anxiety	Severe anxiety	P-value
Auditory reaction time (ms)					
Low-frequency	125.60±37.30	162.70±22.30 <sup>#</sup>	173.90±21.80 <sup>s</sup>	176.0±38.08 <sup>s</sup>	<0.001
High-frequency	133.2±48	165±34.7 <sup>#</sup>	176±24.4 <sup>s</sup>	176.6±20.9 <sup>s</sup>	<0.001
Visual reaction time (ms)					
Red color	142.6±28.6	186.4±31.5 <sup>#</sup>	187.7±53.6 <sup>s</sup>	282.3±16.2 <sup>s</sup>	<0.001
Green color	144.7±44.1	181±30.2 <sup>#</sup>	191.6±75.4 <sup>s</sup>	215.7±47.8 <sup>s</sup>	<0.001

<sup>#</sup>compared with no anxiety, <sup>s</sup>compared with mild anxiety, Significant level fixed as  $P < 0.05$ . Values are in Mean±SD

**Table 3:** Comparison of Stroop test time between mild, moderate, and severe anxiety group

Variable	No anxiety	Mild anxiety	Moderate anxiety	Severe anxiety	P-value
Color Stroop test (ms)	77.1±19.4	85.3±25.8 <sup>#</sup>	106.7±20.9 <sup>s</sup>	217.1±28.6 <sup>s</sup>	<0.001
Emotional Stroop test (ms)	170.6±45.51	172.9±41.3 <sup>#</sup>	186.7±57.2 <sup>s</sup>	212.9±19.63 <sup>s</sup>	<0.001

<sup>#</sup>compared with no anxiety, <sup>s</sup>compared with mild anxiety, Significant level fixed as  $P < 0.05$ . Values are in Mean±SD

and green) and sound (low- and high-frequency) with severe anxiety was significantly higher when compared to participants with mild and moderate anxiety ( $P < 0.001$ ) [Table 2].

The time taken by the participants to respond for color Stroop test (both reading name and color) with severe anxiety was significantly higher when compared to participants with mild and moderate anxiety ( $P < 0.001$ ) [Table 3]. The time taken by the participants to respond for emotional Stroop test (both reading name and color) with severe anxiety was significantly higher when compared to participants with mild and moderate anxiety ( $P < 0.001$ ) [Table 3].

## DISCUSSION

This study conducted in the adolescent age group demonstrated the effect of anxiety on cognitive function of an individual. There was a statistically significant increase in reaction time in severe anxiety group when compared to other groups. The time taken for the Stroop test was also higher in severe anxiety group when compared to other groups.

This study has presented an outline of the effects of anxiety on cognition. The higher the level of anxiety, lesser is the cognition level.<sup>[3]</sup> When anxiety progresses, it changes the sensory-perceptual processes in the auditory and visual system.<sup>[12]</sup> All these may lead to impairment in threat detection which will lead to changes in behavior. Anxiety is associated with known disruptions in the cognitive domain. These disruptions are accompanied by facilitation in related fields such as visual threat detection.<sup>[13,14]</sup> This can be supported by modulation of early sensory processes in anxiety disorders. Theories on cognition propose biases in information processing play a crucial role in the etiology and progression of emotional disorders such as GAD and depression.<sup>[15]</sup> The predictions from general cognitive models of anxiety from a wide group of experiments explain that anxious individuals are more likely to interpret ambiguous stimuli negatively.

At the most basic level, this tends to be associated with improved perception of environmental changes irrespective of valence.<sup>[16]</sup> Anxiety disorder is due to genetically mediated hormonal dysfunction which leads to autonomic dysfunction. There will be a decrease in gamma-aminobutyric acid (GABA), polymorphism of the catechol-O-methyltransferase gene, increase in activity of adenosine receptor and raise in cortisol level. Norepinephrine, serotonin, dopamine, and GABA are the main cause of the symptoms of anxiety disorders.<sup>[17]</sup> The autonomic nervous system, a sympathetic nervous system to be more specific, mediates many of the symptoms. Increased flow in the right parahippocampal region and reduced serotonin Type 1A receptor binding in the anterior and posterior cingulate and raphe of patients are the diagnostic factors for prevalence of anxiety disorder. The amygdala is the center for processing of fear and anxiety which will be disrupted in anxiety disorders.<sup>[18]</sup> Anxiety is thought to affect working memory because the worries that people experience when they are anxious co-opt the working memory resources that would otherwise be allocated to the task at hand.<sup>[19]</sup> In the adolescent age group, anxiety plays a major role in modifying the behavior of an individual. The pathophysiology of the effect of anxiety in cognition is still unclear. Further studies are required to prove the effects of cognitive behavior therapy on anxiety affected individual so that proper treatment plan and behavior can be altered that may help the society and community.

This is the first ever study conducted in a school population with anxiety disorder in south India. Only females were included in the study. The effect due to hormonal changes on cognition during the menstrual phase was not taken into consideration.

## CONCLUSION

Our study has demonstrated a decline in cognitive function when the severity of anxiety increases. Proper counseling along with cognitive therapy should be given at an early stage to the

person who is diagnosed to be having anxiety. This may help in reducing the ill effect of anxiety in the vulnerable group.

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