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ANXIETY RELIEF THROUGH COGNITIVE TRAINING: INSIGHTS FROM A SHORT-TERM INTERVENTION STUDY

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ABSTRACT **Background & Purpose:** Anxiety is an uncontrollable disposition to worry about one's welfare & includes manifestations like arousal, tension, disturbed sleep, irritability. Cognitive training is a process of brain remediation through learned practice. Anxiety has developed among young adults in the recent times owing to the social pressures they are subjected to. The purpose of this study was to find out if application of cognitive training for a short duration reduces the anxiety in healthy individuals. **Methods:** 32 healthy subjects randomly allocated into two groups ;experimental and control. underwent baseline measurements with anxiety assessment scales & Ruler drop test. Group 1 was given cognitive training twice daily for 1 week. Group 2 was given 15 minutes of meditation training twice daily for 1 week. After the treatment, both groups were tested with the GAD7, HMARS & Ruler drop test used during baseline measurements. **Results:** After 1 week of cognitive training group 1 showed significant reduction in anxiety scores in GAD7 from 13.31±4.8 to 3.63±3.5 , HMARS scores from 15.6±11.6 to 7.94±9.2 & ruler drop test scores from 12.8±1.3 to 2.88±0.7. **Conclusion:** Short term cognitive training is found to reduce anxiety in healthy subjects.

KEYWORDS : Anxiety, cognitive training, healthy subjects

INTRODUCTION

Anxiety is a psychological state characterized by fear of certain physical symptoms, such as sweating, increased heart rate, and trembling (Stonerock et al., 2015). According to Davis et al, anxiety is a state of heightened arousal and apprehension that occurs without the presence of danger. Common but may become a mental disorder if it persists and hinders daily activities (Hoehn-Saric & McLeod, 2000). The World Mental Health Survey (WHMS) reports prevalence rates of 3%-19% worldwide, with anxiety being the 6th leading contributor to disability (Aguilar-Gaxiola et al., 2009.

Anxiety disorders are a major contributor to illness and poor health, and they are also significant risk factors for alcoholism and depression. These conditions not only cause personal suffering for individuals but also impose a substantial economic burden on society, including healthcare utilization, absenteeism, and reduced productivity [Chisholm et al., 2016; Greenberg PE, 1999; Sanderson K, 2002]. The high prevalence of anxiety in India, particularly among the 18-29 and 30-39 age groups, has a significant impact on the country's economy, with females being more affected than males [Rao et al., 2022]. Despite the prevalence of anxiety, the current literature lacks clear explanations of its management. Traditional anxiolytic drugs have limited effectiveness and adverse side effects [Zoellner & Foa, 2016; LeDoux & Pine, 2016.

Anxiety symptoms have been found to be closely linked to the amygdala/temporal lobe and prefrontal cortex regions of the brain, as revealed by research conducted by Butcher et al. Studies also show a positive correlation between grey matter volume and anxiety symptoms. The left superior temporal gyrus, right inferior parietal gyrus, paracentral lobule, right precentral gyrus, and postcentral gyrus are among the several regions of the brain that anxiety activates in the grey matter. In addition, anxiety has been found to be related to cognition, with some studies demonstrating that it is associated with cognitive rigidity, impaired decision-making, and decreased performance in behavioral tasks. However, other studies conducted by Park and Moghdham have found that disturbances in neural conduction in the prefrontal amygdala pathway can affect both anxiety and cognition. Akirav and Marun discovered that stimulating the prefrontal-amygdala pathway can improve cognitive capacity and reduce anxiety. Furthermore, various alternative treatments, including virtual reality, art therapy, cognitive behavioral therapy, deep breathing exercises, and physical exercise, have been shown to reduce anxiety, in addition to anxiolytic drugs.Cognitive training has been demonstrated to enhance cognitive efficiency in healthy individuals, as shown in a study by Chen et al. (2016). Various cognitive test batteries are employed in cognitive therapy, and web-based versions have been developed to facilitate cognitive training. However, these trainings typically span 6 to 12 weeks in duration.

This study aimed to determine whether improving cognition can reduce anxiety in anxious individuals, given the established relationship between anxiety, cognition, and cognitive efficiency.

MATERIALS & METHODS

In a randomized controlled trial, 32 healthy individuals, comprising both males and females aged 18-40 with a MMSE score greater than 24, were recruited and screened for inclusion and exclusion criteria. Participants with other neurocognitive disorders, conditions associated with pain, or those taking anxiolytic drugs were excluded.

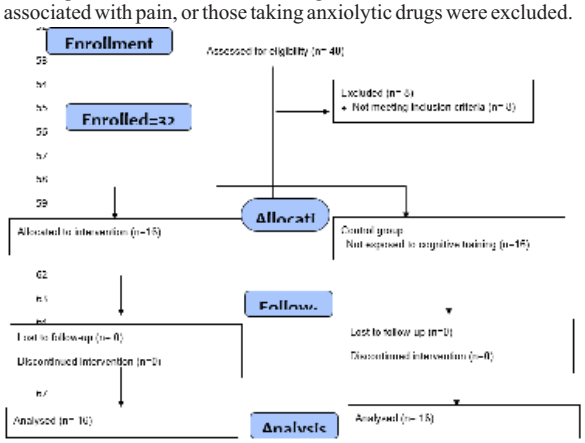

Fig.1 CONSORT 2010 Flow Diagram

Fig 2: Participant training with MeMo Software

Intervention

The study's sample size was determined using G power software based on previous research, and it was non-invasive with no reported adverse reactions. Group 1 received cognitive training for 1 week using the MeMo web app after completing the GAD7, HMARS questionnaire and ruler drop test. The MeMo software (Robert et al., 2020) can be accessed at <https://www.memory-motivation.org/home.2/> and includes memory and attention training exercises.

The control group in this study received meditation training for 15 minutes twice daily for a week. They were instructed to sit in a quiet and calm environment and breathe normally for 15 minutes. Pre- and post-intervention data were collected for the GAD 7, HMARS & ruler drop test.

The participants were assessed using the GAD 7 Questionnaire, which measures anxiety levels, and has a reliable score of 0.93. The questionnaire has 7 domains, and scores range from 0-21. The MCID value for this questionnaire is 1.5-3.8. The participants completed the questionnaire before and after the intervention.

The Hamilton Anxiety Rating Scale is a self-administered questionnaire that assesses psychic and somatic anxiety. It contains 14 items, each scored on a 0-4 scale, with a total score ranging from 0-56. The scale categorizes scores as follows: <17 for mild, 18-24 for mild to moderate, and 25-30 for moderate to severe anxiety. Participants completed the questionnaire before and after the intervention, and the reliability of the scale is 0.92 (Maier W, 1988.

Anxiety can cause an increase in reaction time. To measure this, a ruler-drop test was conducted, as demonstrated by Gianluca Del Rossi in 2014. In this test, a 60 cm long ruler with 1 mm markings was used, and participants sat in a chair with their forearm resting on the platform and their fingers hanging off the edge. The investigator then dropped the ruler, and the participant attempted to catch it. The location of the markings on the ruler was noted, and baseline measurements were taken before and after a practice test. Reaction time was determined by the point on the ruler where it was caught. (Figure 3).

Fig 3: Reaction time testing using Ruler drop test

Data Analysis

Participants for the study were recruited based on power calculation, with a sample size of 24, and an estimated effect size of 0.80. Data analysis was performed using IBM SPSS Ver 29.0, with an independent t-test conducted to determine any significant differences in mean change in score. Thirty-two participants were recruited to account for potential dropouts

RESULTS

Participants' demographic information is presented in Table 1.

Table 1 Demographic details

Variables	Group 1 (n=16)	Group 2 (n=16)	P value
Age(in years)	24±1.93	24±3.64	0.61
Gender	Male- 37%	Male-62.5%	
	Female- 63%	Female -37.5%	
Height(in cm)	160±6.4	168±10.4	0.85
Weight(in Kg)	68.1±12.7	67.5±17.2	0.9

The within-group analysis of the both groups are presented in table 2.

Table 2: pre and Post test scores of Group 1 & group 2

VARIABLES	GROUP 1				GROUP 2			
	PRE	POST	t	p	PRE	POST	t	p
GAD 7	13.31±4.8	3.63±3.5	12.36	<0.05	10.25±1.6	9.38±1.8	3.6	<0.05
HMARS	15.6±11.6	7.94±9.2	4.90	<0.05	11.0±4.6	10.19±4.1	1.4	<0.05
RDT	12.8±1.3	2.88±0.7	29.66	<0.05	12.8±1.6	11.44±1.03	5.05	<0.05

Between Group Analysis

Analysis of post-minus pre-scores for GAD 7, HMARS and ruler drop test revealed significant dissimilarities between the two groups (Table 3).

Table 3 Comparison of mean change scores in Group 1 & Group 2

Variables	Group1 Post- pre mean	Group 2 Post- pre mean	t value	Degrees of freedom	P value
GAD 7	8.69±3.4	0.88±0.9	8.75	30	<0.001
HMARS	7.63±6.2	1.31±1.99	3.868	30	<0.001
RDT	9.94±1.34	1.38±1.08	19.843	30	<0.001

DISCUSSION

The current study observed decreased anxiety, measured by reduced GAD-7 and HMARS scores, alongside improved reaction time after one week of cognitive training. (Rossi G D,2014).Prior research on two-week cognitive training in healthy individuals showed enhanced cognitive efficiency,(Linares et.al, 2019) especially in visuospatial tasks. Earlier studies also noted reduced anxiety symptoms following 12 weeks of cognitive-behavioural training. To date, no research has investigated short-duration cognitive training's impact on anxiety in healthy populations.

Anxiety in healthy population has shown decreased firing of neurons in the prefrontal cortex.(Park & Moghaddam, 2017). The prefrontal cortex & amygdala pathway neurocircuit is transiently activated during anxiety states, facilitating threat detection & is a potential target for treatment (Grillon et.al. , 2019).

The results of this study also showed reduction in anxiety scores of GAD 7 & HMARS & improvement in reaction time after cognitive training which could have been due to user dependent neuroplasticity & possible increase in gray matter volume (Akirav & Maroun, 2007). Cognitive training enhances efficiency depending on the trained domain. Visual task exercises may improve visuospatial functions, potentially reducing anxiety by inhibiting intercalated cell activation in the prefrontal cortex, supported by Linares et al.'s (2019) 'near transfer effect (Linares et al., 2019), (Moustafa et al.,2013), Rezavi et al.,2023).

The improvement of the reaction time following cognitive training could be attributed to the direct relation between anxiety & reaction time.

This study also showed significant improvement in GAD 7, HMARS scores & ruler drop test in the control group. Meditation may have enhanced focused attention, potentially improving anxiety scores, as supported by previous research linking meditation to reduced reaction time (Lohot et al. 2017).

Cognitive training has been shown to control overgeneralization of negative thoughts, a major contributor to anxiety. The game-based cognitive training helps subjects distract from automatic thoughts and disengage from worries. Our study showed that one week of cognitive training reduced the fear component of the GAD-7 questionnaire. Previous research by Linen et al. (2019) found that mindfulness-based stress reduction (MBSR) is a successful adjunct treatment for anxiety and improves insomnia and quality of life. Our study also found improved sleep patterns following one week of cognitive training, as measured by the HMARS scale.

31% of participants got relieve in the respiratory symptoms post cognitive training which may've resulted from increased dopamine production in the striatum, triggered by extensive brain changes stimulating the parasympathetic nervous system, lowering anxiety. Literature confirms parasympathetic stimulation reduces anxiety

(Borza et a., 2017), (Lin J et al., 2019), (Lin F et. al., 2017).

In Conclusion, short duration cognitive training is effective in reducing anxiety in healthy individuals. The findings of our study can be implemented in students, industrial workers & professionals who work under a lot of mental stress.

The major limitations of this study were no cognitive test battery was used, cognitive changes in brain were not observed by any scan, follow-up was not taken.

Ethics approval & Consent for publication:
Ethics approval and consent for publication were obtained from the institutional review board of Abhinav Bindra Sports Medicine and Research Institute (Reference No: ABSMARIIRB/O2/2022), CTRI/2023/02/057004.The study was conducted in accordance with ethical standards set by the institutional review board, the 1964 Helsinki Declaration, and its subsequent amendments or comparable ethical guidelines. All participants provided informed consent.

Data Availability Statement:
The data that support the findings of this study are available from the corresponding author upon request.

Competing interest:
The authors declare they have no competing interest

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Authorship contribution:
1st author SS: Conceptualization, Methodology, Software, Validation, Investigation 2nd Author TG.: Visualization, ,Supervision, Software, Reviewing. 3rd author BMDP: Data curation, Writing- Original draft preparation, Editing

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