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IMPACT OF COGNITIVE-MOTOR EXERCISES ON ACADEMIC STRESS AND SIMPLE REACTION TIME IN COLLEGE GOING STUDENTS

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ABSTRACT

Academic stress is highly prevalent among college students and can negatively affect cognitive performance, including reaction time. Cognitive motor exercises (CME), which integrate simultaneous cognitive and motor tasks, may offer combined psychological and cognitive benefits. This study aimed to determine the impact of cognitive motor exercises on academic stress and simple reaction time (SRT) in college-going students.

A randomized controlled experimental design was used. Participants aged 18–25 years were allocated into an experimental group (CME) and a control group (general exercise). The intervention was conducted for four weeks, three sessions per week. Academic stress was assessed using the Student Stress Inventory (SSI), and simple reaction time was measured using a computerized reaction time assessment tool. Pre- and post-intervention assessments were performed. Statistical analysis included within-group and between-group comparisons.

The experimental group demonstrated a highly significant reduction in stress levels ($p < 0.001$) and a significant improvement in simple reaction time ($p = 0.005$) following the intervention. The control group showed a statistically significant reduction in stress ($p = 0.003$) but no significant improvement in reaction time ($p = 0.118$). Between-group comparison revealed

significantly greater stress reduction in the CME group ($p < 0.001$), while reaction time differences were not statistically significant ($p = 0.148$).

Cognitive motor exercises were more effective than general exercise in reducing academic stress and showed potential to improve cognitive responsiveness in college students.

Keywords: Cognitive motor exercise, Academic stress, Simple reaction time, College students, Dual-task training

INTRODUCTION:

College students undergo a lot of stress from schoolwork, exams, assignments which has a direct influence on their mental health and academic performance. This period between late teens and early twenties signify a huge transformation in a person's life. This time period comes in with a lot of challenges both, in college and personal lives. This change often means more independence, self-control, and ability to adapt to a competitive school environment, which makes it easier to get stressed **[1, 2]**.

Academic stress is defined as the mental pressure that students experience when they believe that the academic challenges, they encounter surpass their ability to cope. These expectations involve severe coursework, frequent tests, pressure to excel, submission deadlines, self-doubt and the constant urge to balance academic duties with personal and social obligations.[1] When students begin to consider academic situations as challenging rather than manageable, stress responses are activated, which has a direct effect on their emotional and mental functioning.[3]

The sources of academic stress are multifactorial. Students often report stress which arise from high academic expectations, competitive classroom environments, large volumes of study material, limited time for preparation, and continuous assessment methods.[4] Additional stressors such as financial difficulties, separation from family, adjustment to hostel or independent living, and uncertainty regarding future career prospects further intensify academic stress levels. All of these stressors together place considerable psychological demands on students, particularly those with limited coping strategies **[3]**.

Many research studies have demonstrated an inverse relationship between academic stress and academic performance. High stress levels are associated with decreased motivation, impaired learning, and increased academic disengagement, which may ultimately lead to poor grades and higher dropout rates **[4]**. Furthermore, psychological distress has been identified as a possible indicator of academic difficulties, which highlight the importance of addressing stress early in the academic journey **[5]**.

Academic stress and a decline in the cognitive performance have been proven to be interconnected. Stress related factors such as examination pressure, fear of failure, and continuous academic evaluation have shown to reduce attention, slow processing speed, and decrease cognitive flexibility. Reaction time has been proven to be a strong indicator of stress-related cognitive changes in student populations **[6, 7]**.

Simple reaction time (SRT) is defined as the time interval between the presentation of a single sensory stimulus and the initiation of a predetermined motor response, without the involvement of stimulus discrimination or decision-making processes **[8, 9]**. It is known as the most basic form of reaction time and indicates the efficiency of sensory perception, central processing, and motor task execution within the human nervous system.[9] From a neurophysiological perspective, simple reaction time is considered a primary indicator of the time taken by the sensory information processing by the central nervous system and its translation into motor output **[8, 10]**. Reaction time performance depends on nerve conduction velocity, synaptic transmission, attention, and sensorimotor integration, making it an important marker of cognitive efficiency **[9]**.

Reaction time is widely accepted as a reliable measure of cognitive processing speed, as it provides appropriate, time-based data that is not influenced by any bias **[8, 10]**. Its high reliability has led to its use in research examining cognition, stress, exercise, and neuroplasticity **[10, 11]**. Evidence suggests that simple reaction time is responsive to interventions that involve cognitive and sensorimotor functioning. Studies have shown significant reduction in reaction time post physical exercise, proprioceptive training, and meditation, which in turn suggests improvements in central processing speed and attention **[8, 10]**.

Physical exercise is widely recognized as an effective non-pharmacological intervention for reducing mental stress and improving mind-body balance **[12]**. Regular engagement in physical activity has been proven to regulate the hypothalamic–pituitary–adrenal axis, which thereby reduces stress hormone secretion and improves adaptability to stress **[13]**. Such activities involving stress regulation, are acceptable particularly for populations exposed to repeated cognitive and emotional demands, including college-going students who constantly undergo higher cognitive demands leading to increased academic stress **[14]**. Stress reduction through the practice of physical exercise is associated with improved autonomic nervous system regulation, which is characterized by improved parasympathetic activity and reduced sympathetic dominance **[13]**. These physiological adaptations contribute to enhanced emotional regulation, decreased stress perseverance and better cognitive regulation during tasks demanding higher mental interference. Physical exercise serves as a crucial factor against stress-related cognitive and behavioural impairments **[14]**.

Cognitive motor exercise (CME), also known as motor–cognitive or dual-task training, is a treatment approach that requires a motor activity and cognitive processing, simultaneously. This training approach is based on the principle that motor performance in everyday situations is rarely performed in isolation and mostly occurs along with activities involving cognitive demands such as attention, working memory, and decision making. The relationship between cognition and movement has been proven to have an influence on task performance, increasing cognitive load leads to changes in motor control and reaction time **[15, 16]**. The simultaneous engagement increases task complexity and requires appropriate functioning of neural resources, thereby stimulating higher order cognitive networks alongside motor pathways. Research suggests that such integrated training protocol more closely reflects daily functional and academic challenges, where individuals must manage cognitive loads while performing physical actions **[17]**.

To summarize, cognitive motor exercise represents to be a multidimensional intervention that integrates physical movement with cognitive engagement which targets motor performance, cognitive efficiency, and psychological well-being simultaneously. Evidence from the existing studies supports its potential to improve reaction time, reduce dual-task interference, and modulate stress-related outcomes through enhanced cognitive–motor integration **[15, 18]**.

MATERIALS AND METHODOLOGY:

This Experimental study was conducted on 40 patients (N=40). A type of informed consent was given to the individuals who were participating in the study. Data was collected from Ahmedabad physiotherapy college, Gujarat. All the individuals were recruited according to the inclusion and exclusion criteria. The inclusion criteria was; 1) Full time registered undergraduate/ postgraduate students 2) Both male & female students. 3) Age between 18 – 25 years. 4) Subjects willing to participate. 5) Ability to follow instructions and perform basic physical and cognitive tasks. The exclusion criteria was; 1) Students with any known neurological, musculoskeletal or psychiatric conditions. 2) Unwilling to participate and sign in the informed consent.

Student stress inventory and Human benchmark reaction time test were used as outcome measures to assess Academic stress and Simple reaction time before and after the intervention. 40 patients were recruited and randomly allocated into 2 groups; Cognitive-motor exercise group (n=20) and Control group (n=20). The intervention was given to the individuals for the duration of 3 days per week for 4 weeks.

COGNITIVE-MOTOR EXERCISE GROUP: [20, 21]

COMPONENT	DURATION	EXERCISES	COGNITIVE TASK
Mental Gymnastics	10 minutes	Cross crawl, Calf pumps, Neck rolls, Complicated finger motions.	
Resistance Training + Cognitive Task [2 sets x 15 reps/ exercise]	20 minutes	Bridging, Squats, Push-ups, Plank, Biceps curls, Shoulder press, Donkey kickbacks	Performed concurrently- Simple arithmetic's like addition/subtraction, ball toss, counting backward by intervals, word-chain game.
Aerobic Exercise + Cognitive Task	10 minutes	WEEK 1: Retro-walking WEEK 2: Step up-down WEEK 3: Static cycling WEEK 4: Jogging	Performed concurrently- Simple arithmetic's like addition/subtraction, ball toss, counting backward by intervals, word-chain game.
Stretching	5 minutes	Stretching for large muscle groups	

CONTROL GROUP: [22]

COMPONENT	DURATION	EXERCISES	SETS x REPETITIONS
Warm-Up	10 minutes	Light jogging in place; Static cycling	
Exercise Protocol	25 minutes	Bodyweight squats; Wall push-ups; Calf raises; Bridging	2 sets × 15 reps for each exercise
Cool down	10 minutes	Stretching for major muscle groups	30 seconds hold x 3 reps for each muscle group

RESULTS:

Demographic profile

1. **Age distribution:**

Table 1 shows Distribution of Participants According to Age in Experimental and Control Groups, In the experimental group, the mean age was 24.05 years with a standard deviation of 0.94. In the control group, the mean age of participants was 24.75 years with a standard deviation of 1.29.

2. **Gender distribution:**

Table 2 shows Sex-wise Distribution of Participants in Experimental and Control Groups, In the experimental group, the majority of participants were female, accounting for 17 (85.0%), while 3 (15.0%) participants were male. While, in the control group, 12 (60.0%) participants were female, whereas 8 (40.0%) participants were male.

Table 1

Age	Minimum	Maximum	Mean	Std. Deviation
Experimental	22.00	26.00	24.05	0.94
Control	23.00	27.00	24.75	1.29

Table 2

SEX	Experimental		Control	
	Frequency	Percent	Frequency	Percent
Female	17	85.0	12	60.0
Male	3	15.0	8	40.0
Total	20	100.0	20	100.0

3. For within group comparison:

Table 3: Comparison of Pre-Test and Post-Test Scores Within Experimental and Control Groups

<table>
<tr><th colspan="2">Group</th><th>Mean</th><th>Std. Deviation</th><th>t test</th><th>P Value</th></tr>
<tr><td rowspan="4">Experimental</td><td>Pre Human Benchmark Reaction time (milliseconds)</td><td>398.30</td><td>57.54</td><td rowspan="2">3.178</td><td rowspan="2">0.005</td></tr>
<tr><td>Post Human Benchmark Reaction time (milliseconds)</td><td>366.55</td><td>37.73</td></tr>
<tr><td>Pre Student stress inventory score</td><td>104.15</td><td>17.01</td><td rowspan="2">10.382</td><td rowspan="2"><0.001</td></tr>
<tr><td>Post Student stress inventory score</td><td>61.60</td><td>13.20</td></tr>
<tr><td rowspan="4">Control</td><td>Pre Human Benchmark Reaction time (milliseconds)</td><td>371.15</td><td>57.80</td><td rowspan="2">1.637</td><td rowspan="2">0.118</td></tr>
<tr><td>Post Human Benchmark Reaction time (milliseconds)</td><td>385.05</td><td>60.16</td></tr>
<tr><td>Pre Student stress inventory score</td><td>81.50</td><td>16.64</td><td rowspan="2">3.428</td><td rowspan="2">0.003</td></tr>
<tr><td>Post Student stress inventory score</td><td>77.00</td><td>17.77</td></tr>
</table>

In the experimental group, the calculated *t* value was 3.178 with a p value of 0.005, indicating a statistically significant improvement in reaction time following the intervention. Regarding Student Stress Inventory scores, the obtained *t* value was 10.382 with a p value < 0.001, showing a highly statistically significant reduction in stress levels after the intervention.

In the control group, the calculated *t* value was 1.637 with a p value of 0.118, indicating that the change in reaction time was not statistically significant. For Student Stress Inventory scores, the calculated *t* value was 3.428 with a p value of 0.003, indicating a statistically significant reduction in stress.

4. For between group comparison:

Table 4: Comparison of Mean Change Scores Between Experimental and Control Groups

<table>
<tr><th colspan="2">Group</th><th>Mean</th><th>Std. Deviation</th><th>t Test</th><th>P Value</th></tr>
<tr><td rowspan="2">Human Benchmark Reaction time</td><td>Experimental</td><td>41.45</td><td>35.38</td><td rowspan="2">1.478</td><td rowspan="2">0.148</td></tr>
<tr><td>Control</td><td>26.00</td><td>30.55</td></tr>
<tr><td rowspan="2">Student stress inventory score</td><td>Experimental</td><td>42.55</td><td>18.33</td><td rowspan="2">8.764</td><td rowspan="2"><0.001</td></tr>
<tr><td>Control</td><td>5.20</td><td>5.23</td></tr>
</table>

In the experimental group, p value was 0.148, which is greater than the level of significance ($p > 0.05$). This indicates that the difference in improvement in reaction time between the experimental and control groups was not statistically significant.

With respect to Student Stress Inventory scores, the obtained p value < 0.001, indicating a highly statistically significant difference between the two groups.

DISCUSSION:

This experimental study discusses the impact of cognitive motor exercises (CME) on academic stress and simple reaction time (SRT) in college students over 4-week treatment protocol (3 sessions/week). Where, an experimental CME group was compared to a control group performing general exercise protocol.

The CME group demonstrated a large and highly significant reduction in Student Stress Inventory (SSI) scores following the intervention ($p < 0.001$). In contrast, the control group showed a small but statistically significant reduction ($p = 0.003$). The between-group comparison of mean change scores showed the CME group improved significantly more than the control group ($p < 0.001$).

The improvement in the control group suggests that physical activity by itself can reduce perceived stress, but adding a cognitive component appears to produce a much larger stressmodulating effect. Similar results were showed in systematic review by Martín-Rodríguez *et al*. (2026) which focused on university students reporting that physical activity is consistently associated with lower perceived stress and improved mental health, and that interventions can reduce stress with clinically meaningful effects **[23]**. This aligns with the study's finding that even the control group showed a statistically significant decrease in stress, although smaller than CME.

A longitudinal study was conducted by Teuber M (2024) in university students; found that physical activity breaks during studying were associated with better stress-related profiles and recovery experience, supporting the idea that repeated movement exposure improves stress handling in academic contexts **[24]**. The CME protocol includes repeated sessions with coordinated movement and cognitive engagement, which may function not only as exercise but also as structured attentional breaks from academic stress cycles.

While many studies examine exercise alone, evidence from structured psychological programs by Chen (2025) shows that training attention control and cognitive-emotional regulation can significantly reduce academic stress and burnout. CME shares a related principle: it forces attention allocation, task switching, working memory use, and inhibition during movement. This repeated practice may improve cognitive control of stress responses, not only provide physiological stress relief **[25]**.

CME constantly needs dividing attention between cognitive tasks and physical tasks. Over repeated sessions, students may develop improved attentional control, task prioritization, and reduced dual-task interference, which can support the idea where students juggle multiple demands. Dual-task training research by Surkar SM *et al*. (2025) shows improvements in cognitive-motor performance with evidence consistent with reduced interference and improved resource allocation.[26] Better resource allocation may reduce the subjective feeling that academic demands exceed coping ability, which is central to academic stress.

On the other hand, within-group analysis showed that the CME group's reaction time significantly improved ($p = 0.005$). The control group did not show a significant improvement; reaction time slightly increased ($p = 0.118$). However, between-group comparison of mean change scores was not statistically significant ($p = 0.148$). The experimental group started with slower reaction times (mean ~398 ms) than controls (~371 ms). The experimental group therefore had more room to improve, and part of the improvement may reflect regression toward the mean.

A pilot study by Pastor-Vicedo JC *et al*. (2024) in undergraduates reported that a 10-minute moderate-intensity active break improved vigilance performance measured by a Psychomotor Vigilance Task, which is strongly reaction-time dependent **[27]**. This supports the concept that movement can improve response readiness, likely via arousal and attention regulation. Another study published on dual-task training in healthy young adults paired balance tasks with auditory reaction-time tasks and found significant improvements, with evidence dependable on improved neural efficiency **[26]**. This is aligned with CME improving reaction time through reduced cognitive-motor interference.

Although the CME group demonstrated significant within-group improvement in reaction time, the between-group comparison of mean change scores did not reach statistical significance. Several physiological factors may explain this finding. First, baseline inequality was present, the experimental group demonstrated slower reaction times at pretest when compared to the control group. This created greater scope for improvement in the CME group and introduces the possibility of regression toward the mean. Second, the intervention duration of four weeks may have been insufficient to produce large neurocognitive adaptations that clearly differentiate groups; longer interventions may yield more robust effects. Additionally, simple reaction time (SRT) tasks are less cognitively demanding than choice reaction time paradigms and may be less sensitive to detecting executive control changes induced by cognitive-motor training. Since CME primarily targets attentional switching, inhibition, and working memory processes, its effects may be more pronounced in complex reaction tasks rather than basic SRT measures. Overall, CME group showed significant reduction in stress and some improvement in reaction time, while the control group showed more steady results in both measures.

CONCLUSION:

College students can improve their academic well-being and reaction performance by practicing cognitive motor exercises along with regular physical activity, according to the findings of the present study. However, when comparing the two approaches, cognitive motor exercises are more effective for reducing academic stress, while their effect on simple reaction time is positive within the CME group but not clearly superior to general exercise in the between-group comparison. Therefore, CME can be recommended as a practical training method in college settings, especially for stress management, with potential benefits for reaction speed as well.

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