International Journal of Research in Medical Sciences
Megha K et al. Int J Res Med Sci. 2025 Sep;13(9):3741-3746
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20252785

Original Research Article

An observational study examining the correlation between finger dexterity and attention in the dominant hand among young adults

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Received: 04 July 2025
Revised: 07 August 2025
Accepted: 20 August 2025

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ABSTRACT

Background: Finger dexterity and attention are essential components of cognitive-motor functioning, influencing daily activities such as writing, grasping objects and executing precise movements. While previous research has examined cognitive-motor relationships in older adults, studies focusing on young adults remain limited. Given the increasing demands on attention and manual coordination in academic, professional and sports-related domains, understanding their interdependence is crucial. To assess finger dexterity using the Nine-Hole Peg Board Test (NHPT), to evaluate attention regulation using the Attention Control Scale (ACS) and to determine the correlation between attention control and manual dexterity in the dominant hand.
Methods: A cross-sectional observational study was conducted with 100 healthy young adults aged 18–25 years at educational Institution, Mangalore. Participants' dominant hand was identified using the Hit-the-Dot Test, followed by assessments of attention (ACS) and dexterity (NHPT). Data were analysed using Pearson's correlation, with statistical significance set at $p<0.05$.
Results: Among participants, 38% were males and 62% were females, with a mean age of 19.04±1.46 years. Pearson's correlation analysis revealed a strong positive association between attention scores and dexterity performance ($r=0.878$, $p=0.001$), indicating that individuals with higher attention control exhibited superior finger dexterity.
Conclusions: This study establishes a significant correlation between attention and finger dexterity, reinforcing the cognitive-motor connection in young adults. The findings highlight the importance of attentional regulation in executing fine motor tasks, with potential applications in fields such as surgery, sports and rehabilitation field.

Keywords: Attention control, Cognitive motor integration, Finger dexterity, Manual coordination, Nine hole peg test, Young adults

INTRODUCTION

Manual dexterity is a fundamental skill that enables individuals to perform precise and coordinated movements with their hands and fingers. It is essential for daily activities such as writing, typing and grasping objects, facilitating interactions with the physical environment.[1] As individuals age, their dexterity often diminishes, affecting motor efficiency and overall quality of life. Additionally, certain neurological disorders, including multiple sclerosis, stroke and Parkinson's disease, can further impair dexterity, leading to difficulties in performing routine tasks (Maes et al, 2017).[2] Dexterity is classified into gross and fine movements. Gross movements involve larger muscle groups, such as those in the shoulder and arm, enabling broad actions like reaching for an object. Fine movements, on the other hand, require the coordination of smaller muscle groups in the fingers and hands, allowing for precise actions such as gripping a pen or manipulating small objects.[3] Dexterous movements can also be divided into unimanual and bimanual tasks, where unimanual movements require a single hand for execution

(e.g., writing), while bimanual tasks involve coordination between both hands, as seen in sewing or playing musical instruments. Assessing dexterity is crucial in clinical and research settings, with the Nine Hole Peg Test (NHPT) being widely recognized as a standard measure. Occupational therapists frequently use this test due to its simplicity, reliability and effectiveness in evaluating fine motor skills.[4] Originally developed in 1971, the NHPT provides a quantifiable measure of finger dexterity and is applicable across diverse age groups and populations. Previous studies have identified gender-based differences in dexterity, noting that females often exhibit greater proficiency in fine motor tasks, potentially due to anatomical variations in finger size and hand structure.[5]

Dexterity is intricately linked to cognitive function, particularly attention, which governs focus, concentration and sensory regulation. Attention is a crucial component of cognitive control, allowing individuals to filter out distractions and maintain efficient task execution. According to Hommel et al, attention involves the conscious selection of relevant information while excluding nonessential stimuli.[6] This process is mediated by the anterior attentional system, which regulates voluntary focus and the posterior attentional system, which reflexively responds to environmental stimuli.[7] Attentional control plays a significant role in enhancing physical performance, as heightened attention improves reaction time and task precision. Insufficient attention may lead to errors, disorganized execution and reduced efficiency in motor tasks.[8] Various factors influence attention, including exogenous elements such as sensory stimuli and competition and endogenous factors like personality traits and arousal levels.[9] Attention also interacts with working memory, which allows individuals to retain and manipulate information to guide ongoing tasks.[10]

The attentional control scale (ACS) is a widely used instrument for assessing individual differences in attention regulation. Developed by Derryberry and Reed, the ACS evaluates the ability to focus and shift attention, offering valuable insights into cognitive flexibility and executive function.[8] This scale measures attentional focusing (the ability to maintain concentration despite distractions) and attentional shifting (the ability to transition between tasks efficiently). Previous studies have demonstrated that attentional control influences manual dexterity, with higher attentional capacity linked to enhanced performance in motor tasks such as pegboard tests and finger tapping activities.[11] Neurological changes associated with aging often lead to declines in attentional efficiency, affecting cognitive and motor coordination. Executive functions such as planning, inhibition and task switching play an essential role in maintaining dexterity. Research by Corti et al found that executive planning ability correlates strongly with performance on manual dexterity assessments.[12] Similarly, Fraser et al identified cognitive load as a determining factor in dexterity performance, highlighting the need for optimal attentional control in precision-based tasks.[13] Given the interdependence of finger dexterity and attention, this study aims to explore their correlation in the dominant hand among young adults. Understanding how attentional mechanisms modulate dexterity can provide insights into cognitive-motor interactions, facilitating advancements in rehabilitation, skill training and performance optimization. The findings of this research may have practical applications in domains such as sports, occupational therapy and neuromuscular rehabilitation, ultimately contributing to the enhancement of fine motor skills and functional efficiency in everyday tasks.

METHODS

Study design and setting

This observational study was conducted at Tejasvini Hospital Group of Institutions, Mangalore (July 2024 to March 2025), with the primary aim of examining the association between finger dexterity and attention in the dominant hand among young adults. The research follows a structured approach to ensure robust data collection and meaningful analysis.

Sample size and selection

The sample size was estimated using the formula based on the study of Rinne et al, $n = (Z_\alpha+Z_\beta / C)^2 + 3$, where $C=0.5 \log (1+r/1-r)$. Based on this calculation, the required sample size is 100 participants.[13] A total of 100 healthy young adults aged 18-25 years were voluntarily recruited based on strict inclusion and exclusion criteria to ensure consistency and minimize confounding factors. Participants provided informed consent prior to participation, acknowledging their understanding of the study procedures, potential risks and their right to withdraw at any time. Individuals aged 18-25 years and attention score of at least 20 on the ACS were included and self-reported neuromuscular disorders, functional deficiencies affecting hand dexterity, pain or discomfort in the upper extremities that limits movement, history of medical conditions or medication use affecting neuromuscular function were excluded from the study.

Data collection procedure

Upon recruitment, participants underwent a hand dominance assessment followed by tests measuring their attention levels and manual dexterity. Socio-demographic information, including age, gender, height (cm) and weight (kg), was recorded to contextualize findings and assess possible relationships between physical attributes and study outcomes.

Step 1: Identifying hand dominance

The hit-the-dot test was used to determine each participant's dominant hand. Participants were provided with a worksheet featuring blank circles arranged in a grid. Within 30 seconds, they were required to place a dot at the

centre of each circle, using both hands separately. The hand with the higher accuracy and speed was identified as the dominant hand.[14,15]

Step 2: Assessing attention control

The ACS, a self-administered 20-item questionnaire, was utilized to evaluate attentional focus, distraction resistance and cognitive flexibility. Responses were recorded on a 4-point Likert scale (1=almost never to 4=always). Higher scores indicate stronger attentional control, which is crucial for cognitive and motor performance.[16,17]

Step 3: Measuring finger dexterity

The nine-hole peg board test (NHPT) was conducted to assess manual dexterity and fine motor skills. Participants were instructed to place and remove pegs from a 3×3 pegboard as quickly as possible. The time taken to complete each trial was recorded using a stopwatch and performances were compared across dominant and non-dominant hands. This test provides a standardized measure of hand-eye coordination, speed and precision.[18,19]

Outcome measures

Hit-the-dot test determines hand dominance based on speed and accuracy. ACS measures attention regulation and cognitive flexibility. Nine-hole peg board test evaluates fine motor dexterity and coordination.

Statistical analysis

Kolmogorov-Smirnov test was used to assess data normality. Since the data followed a normal distribution, demographic variables were expressed as mean, standard deviation (SD) and percentages. Pearson's correlation was applied to determine the strength and direction of the relationship between finger dexterity and attention. Statistical significance was set at 95% confidence interval (CI) with $p<0.05$.

RESULTS

Among the 100 participants, 38% were males and 62% were females, indicating a higher representation of female participants in the study (Figure 1). The mean age of participants was 19.04±1.46 years, with an average height of 164.59±9.93 cm and a mean weight of 55.31±12.08 kg.

Attention and dexterity performance

The total attention score, measured using the Attention Control Scale (ACS), averaged 50.23±6.15. The two sub-components-Attention Focus and Attention Shift- had mean scores of 21.58±3.61 and 28.56±3.70, respectively. The manual dexterity, assessed through the Nine-Hole Peg Board Test, had an average completion time of 17.63±2.06 seconds, demonstrating moderate dexterity among participants (Table 1).

Correlation analysis

A Pearson correlation analysis was conducted to examine the association between attention levels and dexterity performance (Table 2). Strong positive correlation, indicating that higher overall attention scores were associated with better dexterity ($r=0.878$, $p<0.001$). Significant positive correlation, suggesting that greater attentional focus contributed to improved dexterity ($r=0.820$, $p<0.001$). Strong positive correlation, emphasizing the role of flexible attentional control in manual dexterity ($r=0.825$, $p<0.001$).

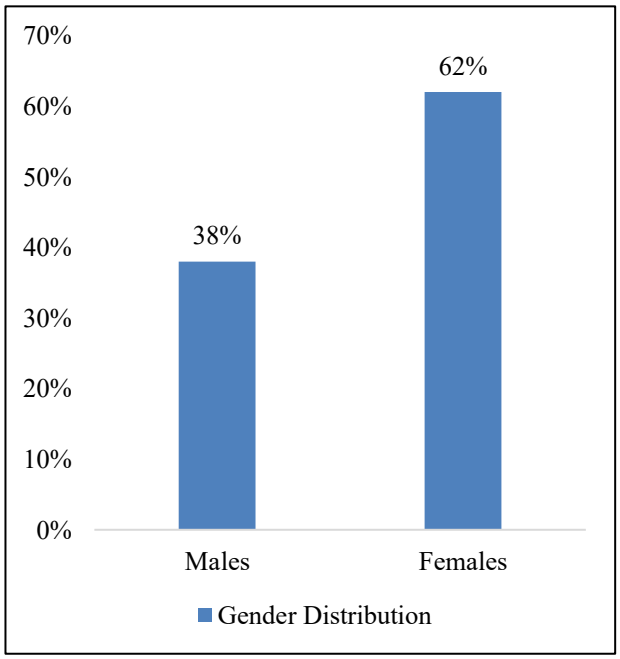

Figure 1: Gender Distribution of the sample.

The results demonstrate a significant positive correlation between attention levels and finger dexterity, highlighting the crucial role of cognitive engagement in motor performance. Higher attention scores, particularly in focus and shifting capabilities, were linked to faster completion times in the dexterity test. These findings suggest that strong attentional control enhances manual precision and efficiency, reinforcing the interdependence between cognitive and motor functions in young adults.

Table 1: Baseline characteristics of the study.

Demographic variables (n=100)	Mean±SD
Age (in years)	19.04±1.46
Height (cm)	164.59±9.93

Continued.

Demographic variables (n=100)	Mean±SD
Weight (kg)	55.31±12.08
Attention total	50.23±6.15
Attention focus	21.58±3.61
Attention shift	28.56±3.70
Dexterity (sec)	17.63±2.06

Table 2: Correlation analysis between dexterity and level of attention.

Correlation		Level of attention (attention control scale)		
		Attention total	**Attention focus**	**Attention shift**
Dexterity (9-hole peg board test)	Pearson Correlation	0.878	0.820	0.825
	Sig. (2-tailed)	0.001*	0.000*	0.000*

*Statistically Significant at 95% CI.

DISCUSSION

This study highlights the significant correlation between finger dexterity and attention in the dominant hand among young adults, reinforcing the interplay between cognitive and motor functions. The findings suggest that individuals with higher attentional control tend to perform dexterity tasks with greater speed and precision, supporting previous research on cognitive-motor integration Bieliauskas et al, Zanto et al and Gazzaley et al.[20,21] The ability to focus and shift attention effectively appears to be crucial in executing fine motor movements, contributing to increased efficiency in various manual tasks.

Attention plays a vital role in facilitating controlled hand movements, particularly in tasks requiring precision, coordination and adaptability. Baldauf et al and Deubel et al emphasize that attention and working memory significantly impact reaching and grasping movements, reinforcing the current study's findings.[22] Similarly, Reuter-Lorenz et al, highlight that working memory enables individuals to retain and manipulate information, guiding both present and future motor actions, making it an essential component of manual dexterity.[11] Given that executive functions such as planning, inhibition and flexibility contribute to motor control (Jurado et al and Rosselli et al the strong association between attention and dexterity further supports the neurological basis of cognitive-motor coordination.[23]

The correlation observed in this study aligns with findings from Fraser et al, who demonstrated that executive functions significantly impact fine motor performance.[24] Similarly, Corti et al identified planning ability as a critical determinant of dexterity, emphasizing its relevance in both unimanual and bimanual tasks.[12] The strong connection between attention and dexterity underscores the necessity of dual-task training in cognitive and physical rehabilitation, as improving attention control may enhance dexterity and vice versa. Studies by Cuya et al further validate this approach, showing that executive function and attention contribute to better motor coordination.[25] Furthermore, research on aging suggests that cognitive decline leads to diminished attentional control and manual dexterity Carment et al, Xia et al.[26,27] Understanding this relationship in younger adults provides valuable insights into skill development and early interventions aimed at preserving fine motor abilities over time. Wang et al findings on finger exercises improving dexterity, attention and memory further support the idea that targeted cognitive and motor training can enhance performance across different age groups.[19]

Additionally, gender differences in dexterity and grip strength, as reported by Metehan Yana et al, align with the current study's results, demonstrating the dominant hand's superiority in manual coordination.[28] The 8.4% advantage in grip strength and 7.7% improvement in dexterity further reinforce the role of hand dominance in motor efficiency. Despite the growing interest in cognitive-motor interactions, research specifically examining the relationship between attention and dexterity in young adults remains scarce. The findings of this study fill this gap, providing foundational knowledge for training programs, occupational applications and rehabilitation strategies. Future research should explore larger and more diverse populations, incorporating factors such as gender-based variations, external influences on attention and the impact of specialized skill development on dexterity and cognitive function.

Despite its valuable contributions to understanding the correlation between finger dexterity and attention in the dominant hand among young adults, this study has certain limitations that should be considered when interpreting the findings. The ACS is a self-administered questionnaire, meaning participants' responses may have been influenced by subjective interpretations or inattentiveness, potentially affecting the accuracy of the attention scores. While the Nine-Hole Pegboard Test (NHPT) is a widely accepted tool for assessing fine motor dexterity, individual variations in execution such as using two fingers instead of one to grasp the pegs could have led to inconsistent measurements. This may impact the comparability of dexterity performance across participants. The Hit-the-Dot Test was used to determine hand dominance; however, it

may not fully account for mixed or ambidextrous individuals, potentially influencing the categorization of dominant-hand dexterity. The study was conducted with 100 participants, which may not fully capture variations in handedness and cognitive-motor abilities in a broader population. A larger sample size could improve generalizability and statistical power. Various external factors, including fatigue, prior experience, motivation and environmental distractions, may have affected individual performance on both the attention and dexterity assessments, introducing variability that is difficult to control. This study used a cross-sectional design, assessing participants at a single point in time. As a result, long-term trends, training effects and potential improvements in attention or dexterity could not be evaluated. Future longitudinal studies may be necessary to observe dynamic changes over time.

To address these limitations, future research could consider using objective attention measures, such as eye-tracking or neurophysiological assessments, to reduce self-reported biases. Standardizing execution techniques for the pegboard test to ensure uniform measurement. Incorporating a larger and more diverse sample, accounting for individual variability in hand dominance and cognitive-motor abilities. Employing longitudinal designs to assess changes in attention and dexterity over extended periods.

CONCLUSION

This study highlights a significant positive correlation between finger dexterity and attention in the dominant hand among young adults, emphasizing the cognitive-motor connection. Individuals with stronger attention control demonstrated superior manual dexterity, reinforcing the role of cognitive engagement in executing precise hand movements. While previous research focused on older adults, this study underscores the relevance of attention in fine motor skills for younger populations, with implications for fields requiring precision, such as surgery, music and sports. The findings suggest that enhancing attention may improve dexterity, making it essential to explore interventions that optimize both cognitive and motor functions.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Review Board (TPC/IRB/BPT/2024/06)

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Cite this article as: Megha K, Riyas Basheer KB, Rai S, Pinto RF. An observational study examining the correlation between finger dexterity and attention in the dominant hand among young adults. Int J Res Med Sci 2025;13:3741-6.