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The Role of Locus of Control and Mindfulness in Predicting Working Memory in Hospitalized Adolescents

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Abstract

Purpose: This study aimed to investigate locus of control and mindfulness in predicting working memory in hospitalized adolescents.
Method: This was a descriptive and correlational study. The statistical population included all adolescents hospitalized in Arak City Hospital. 200 people were selected using a purposive and *convenient* sampling method. Research data were collected using the Working Memory Test of Dunneman and Carpenter (1980), the Locus of Control Questionnaire (Rutter, 1996), and the Mindfulness Questionnaire (Bayer et al., 2004). Statistical data were analyzed using descriptive statistics (mean and standard deviation), correlation coefficient, and multivariate regression with SPSS-26.
Findings: The results showed that there is a significant relationship between internal and external locus of control, locus of control, and spiritual influences with working memory in adolescents (P<0.05). There is a significant relationship between mindfulness and each of its subscales including observation, description, action with mindfulness, and unconditional acceptance with working memory in hospitalized adolescents (P<0.05). The results of the regression analysis showed that the predictor variables together were able to explain 36% of the changes in working memory.
Conclusion: Locus of control and mindfulness affect people's beliefs and motivation and cause these people to have high working memory. Therefore, working memory can be predicted through these two variables.

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Introduction

Today, working memory has attracted the attention of many researchers as one of the important and fundamental topics. Working memory is one of the important cognitive processes that forms the basis of thinking and learning and, as one of the memory systems, allows the individual to retain information for a short period of time (1). Working memory is described as a short-term cognitive system that allows information to be temporarily stored for simultaneous processing or close to reference. In other words, working memory is responsible for the temporary storage, activation, and retention of information that is essential for a range of cognitive functions, including comprehension, reasoning, and learning (2). Working memory is the system or systems that are required to hold information in mind and perform complex tasks such as reasoning and learning (3). Memory is one of the foundations of our learning, thinking, creativity, planning, and everyday behavior, and it influences all of our social behavior. It serves the purposeful execution of a wide range of cognitive activities. Effective working memory function is essential for guiding behavior, making decisions, learning language, reasoning, problem solving, and planning (4). Working memory can be improved and strengthened by adaptive components

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that lead to improvements in working memory capacity, such as mindfulness and locus of control regulation.

Mindfulness means that people have the skills to become more aware of their thoughts without any judgment and are also able to view negative thoughts (positive or neutral) as mere passing mental events rather than as a reflection of reality (5). Mindfulness is a unique state of consciousness that allows us to engage with the present moment and be in the moment without being caught up in the past or future. This variable suggests that much of human suffering stems from the thoughts and feelings that individuals in society have about themselves (6). Mindfulness helps people understand that negative emotions may occur, but they are not a fixed and permanent part of their personality. It also allows the individual to respond to events thoughtfully and reflectively, rather than involuntarily and without reflection (7). In other words, mindfulness allows a person to respond wisely to events rather than involuntarily, thoughtlessly, and unthinkingly. For this reason, mindful people are considered more capable in managing and solving everyday problems (8).

The concept of locus of control refers to our perception or belief about the amount of control we have over the events in our lives and our ability to cope with them. Another definition of locus of control is the individual's belief that he or she is in control of events within or outside of his or her life (9). Locus of control has a significant impact on people's behavior. People with an external locus of control believe that they have no influence over their environment and do not value trying to improve their circumstances. In contrast, people with an internal locus of control believe that they are in control of their circumstances and behave accordingly. They perform at a higher level on laboratory tasks than people with an external locus of control. In addition, these people value their skills highly and are more aware of the environmental cues they use to guide their behavior. They have higher self-esteem and accept greater responsibility for their actions (10).

Soleimani-Dawdeli et al. (2023) compared the effectiveness of mindfulness training and working memory on test anxiety in female junior high school students. The findings of the study showed that there is no difference between the effectiveness of mindfulness training and working memory on test anxiety in female junior high school students. Mindfulness and working memory training are effective separately on test anxiety in female high school students in Bojnourd. The results showed that there is no difference between the effectiveness of mindfulness and working memory training on test anxiety. Therefore, it can be said that using these two training methods to reduce test anxiety can help counselors, psychologists, and other specialists (11).

Gilani and Mirzazadeh (2021) conducted a study titled "Holding mindfulness sessions and measuring working memory capacity of students admitted to graduate schools." The results suggest that enhanced attentional focus may be the key to unlocking skills that were until recently considered unchangeable. Finally, this study suggests that extensive practice on working memory capacity tests can be generalized to improve students' scores, IQ, and working memory capacity. These results could be used to screen students for admission to graduate programs, with a portion of the acceptance rate allocated to separate assessments of their cognitive ability throughout their education (12).

Shakib et al. (2020) conducted a study to investigate the effect of mindfulness-based intervention on executive functions (sustained attention, processing speed, response inhibition, and working memory) in children with attention deficit/hyperactivity disorder. In this study, the components of executive functions in the experimental and control groups were examined, and a hypothesis was designed in accordance with the research topic. After confirming the assumptions, the analysis of covariance statistical test was used to measure them. The Shapiro-Wilk test was used to examine the normality of the data distribution. According to the obtained significance levels, each of the research variables is greater than 0.05. The results showed that the mindfulness-based intervention improved sustained attention, processing speed, response inhibition, and working memory in the experimental group of children. Therefore, mindfulness-based exercises seem essential as an appropriate treatment strategy, free from side effects, to improve executive functions in children with attention deficit/hyperactivity disorder (ADHD) (13).

Jha et al. (2022) presented a study titled "Effects of Mindfulness Training on Working Memory Performance in High-Demand Groups: A Multi-Study Investigation." Working memory (WM) is critical for successful task performance and higher-order cognitive functions, such as planning and decision-making. Mindfulness training (MT) is also a potential method for enhancing cognitive resilience—the ability to maintain or recover cognitive capacities at risk of decline. US military groups were recruited from several military installations, and participants were assigned to receive MT or as active comparison participants or no training.

Soldiers' performance on a delayed recognition working memory task was assessed with emotionally or neutral military-related distractors embedded before (T1) and after (T2) the MT interval. The findings support the hypothesis that MT protects soldiers' working memory performance relative to controls (14).

The Method of Research: The present study is a descriptive and correlational study. The research is of

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field and descriptive type. The statistical population of the present study included all adolescents hospitalized in Arak city hospital, 317 people. In this study, 200 adolescents were selected from among the adolescents using a convenient and purposeful sampling method based on inclusion and exclusion criteria. - The inclusion criteria for the study included adolescents aged 12 to 16 years hospitalized in Arak hospitals, not participating in similar research programs at the time of the study, and willingness and informed consent to participate in the research. Exclusion criteria included failure to respond to one or more of the questionnaires, failure to complete the questionnaires, retardation, or diagnosis of psychological disorders. The research instruments included:

- Working Memory Test of Dunneman and Carpenter (1980): This test is a cognitive function measurement task related to executive functions and was first introduced by Kirchner in (1958). In this test, the individual responds to a stimulus, such as a number, if it is similar to the stimulus before it, and the presentation of the stimuli and the individual's response are continuous. Until the number of stimuli, which is 100 in this case, is exhausted. Since this task involves both the storage and manipulation of cognitive information, it is known to be very suitable for measuring working memory performance. Reliability coefficients in the range of 0.54 to 0.84 showed high reliability of this test. The validity of this test is also very acceptable as an indicator of working memory performance (15).
- Rotter's Perception of Control Questionnaire: This scale was developed by Rutter (1966) based on social learning theory to assess an individual's generalized expectations regarding internal or external control. This scale is a 29-question questionnaire, each question has two statements in the form of A and B, one of which is the internal control scale, and the other is the external control scale. Six of the 29 questions are neutral, which is used to hide the purpose of the questionnaire from the subject. The scoring of this scale is based on counting the internal control responses from the 23 questions, with a score of 9 or higher indicating an external locus of control, and a score of less than 9 indicating an internal locus of control. Reliability coefficients were calculated using Cronbach's alpha method, with coefficients for internal control being 0.81 and external control being 0.91 (16).
- Kentucky Mindfulness Skills Questionnaire: This questionnaire was developed by Bear, Smith & Allen (2004) and has 39 questions and includes four mindfulness components: observation, description without labels, action with awareness, and acceptance without judgment. Its internal consistency (alpha coefficient) was reported to be between 0.76 and 0.91 for four components by Bear et al. (2004). In Iranian norming, Dehghani et al. (2014) showed that this questionnaire has a good internal consistency (0.81 to 0.93) and the convergent validity of its components is between 0.67 and 0.78. The results of Bear's (2003) psychometric analysis on participants showed that this questionnaire has high internal consistency (0.73) and that the Cronbach's alpha coefficients for the observational, descriptive, focused, and accepting subscales are 0.91, 0.84, 0.83, and 0.87, respectively. Dehghan Manshadi et al. (2012) reported the Cronbach's alpha characteristics of this questionnaire as 0.82 (17).

Descriptive statistics (mean and standard deviation), correlation coefficient, and multivariate regression with simultaneous entry method were used to analyze the data, while observing the statistical assumptions in regression theories. All analyses were performed with the help of SPSS statistical software, version 26.

Findings

Table 1: Mean and standard deviation of working memory scores in adolescents

Research variables		Mean	Standard deviation
working memory	Cognitive Information Retention	23.08	3.17
	Executive Actions	19.44	2.84
	Total Score	42.59	7.96
Locus of Control	Internal Locus of Control	22.39	2.23
	External Locus of Control	31.86	3.17
	Total Score	54.22	8.11
Mindfulness	Observationalism	18.63	3.77
	Descriptiveism	20.79	5.64
	Mindful Action	17.55	2.96
	Unconditional Acceptance	19.27	4.18
	Total Score	76.24	10.48

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Table 2 : Results of Pearson's correlation coefficient between locus of control and working memory in adolescents

Predictor variables	Criterion variable: active memory	P-value
Internal locus of control	0.417**	0.011
External locus of control	0.322**	0.002
Total locus of control	0.519**	0.007
Observationalism	0.119**	0.006
Descriptiveism	0.99**	0.001
Mindful action	0.103**	0.004
Unconditional acceptance	0.117**	0.001
Mindfulness	0.477**	0.001

The findings in the table show that there is a significant relationship between the total locus of control and each of its two dimensions, i.e., internal and external locus of control, with working memory, and between mindfulness and its subscales with working memory among adolescents (P<0.05).

Table 3: Summary results of the regression analysis model of locus of control and mindfulness with working memory

Model	Correlation coefficient	Coefficient of determination	Modified R	Standard deviation of estimated error
locus of Control	0.296	0.292	0.330	5.411
mindfulness	0.230	0.216	0.192	2.725

Table 4: Results of multivariate regression analysis of working memory based on locus of control in adolescents

Model		Non-standard coefficients		Standard coefficients	T	F	P-value
		B	error criterion N	B			
1	Constant	230.62	0.910	-	44.614	204.258	0.004
	locus of Control	0.888	0.024	0.255	7.231		
2	Constant	165.23	0.438	-	28.978	90.531	0.004
	mindfulness	0.584	0.021	0.291	3.266		

Table 5: Table of coefficients (indices) of multivariate regression analysis of working memory prediction based on locus of control and mindfulness

Criterion variable	Predictor Variable	Standardized beta value	constant value	Square R^2	t-value	P
Working memory	mindfulness	41.0			4.22	0.001
	Locus of Control	28.0			1.18	0.000

As can be seen in Table 1, the values of the coefficient of determination, the adjusted coefficient of determination, and the estimated standard error in the source of control are 0.292, 0.330, and 5.411, respectively, and in mindfulness are 0.216, 0.152, and 2.725, respectively.

Data analysis shows that the predictor variables (mindfulness and locus of control) were able to predict and explain working memory among adolescents. The beta value for mindfulness was 0.41 and for locus of control was 0.28, and it was significant at the (P=0.001) level. Also, the predictor variables (mindfulness and locus of control) were able to explain 0.36 percent of the variance related to working memory together (P<0.001).

Discussion

The first finding of the study indicated that there is a statistically significant relationship between overall locus of control and its two dimensions, namely internal and external locus of control, and working memory among adolescents (P < 0.05). This finding suggests that the way individuals perceive the source of control over life events is closely associated with their cognitive functioning, particularly their ability to store, process, and manipulate information in working memory.

In explaining this result, it can be argued that individuals with an external locus of control tend to attribute their achievements and successes to external factors such as luck, chance, fate, or the influence of other people. As a result, they may experience a lower sense of personal responsibility and reduced motivation to actively engage in cognitive and problem-solving tasks. This reduced cognitive engagement can negatively influence the development and performance of working memory [18,19].In contrast, individuals with an internal locus of control generally believe that their successes and failures are largely determined by their own abilities, efforts, and decisions. This belief fosters a stronger sense of personal agency and responsibility,

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which can enhance motivation, persistence, and goal-directed behavior. Adolescents who recognize that their thoughts and efforts directly influence their outcomes are more likely to actively regulate their learning processes and employ effective cognitive strategies. Such self-regulation and sustained mental effort contribute to improved working memory performance. The second finding of the study showed that there is a significant relationship between mindfulness and its subscales and working memory among adolescents ($P<0.05$). In the explanation of the present study, it can be said that mindfulness helps people respond to events with reflection and thought instead of involuntary responses. People who have mindfulness skills perceive events in the present moment as less distressing than they are.

Conclusion

According to the results of the present study, it can be stated that people with an external locus of control, because they have external evidence, have less working memory compared to people with an internal locus of control. People with an internal locus of control have higher self-confidence, self-efficacy, and problem-solving ability. This causes these people to have a more positive self-image, which ultimately leads to them having a higher working memory.

In addition, mindfulness encourages people to focus their attention on neutral stimuli and to be purposeful in their body and mind, freeing them from preoccupation with threatening thoughts and worries about performance, and taking their minds out of automatic mode. Mindfulness also helps regulate emotions without judgment and increases awareness of mental and physical feelings. It helps to clearly see and accept emotions as they occur, and ultimately improves people's working memory. This study also had some limitations: Because the population of the present study was limited to adolescents hospitalized in Arak city hospitals, and because the study is a correlational study, caution should be exercised in generalizing the results of the study to other populations and inferring causality from those results. This study used self-report instruments (questionnaires), which could have caused fatigue in the subjects, reduced their accuracy, and to some extent distorted their responses to the questions. It is suggested that future studies examine a broader population. awareness of personal control over behavior can strengthen metacognitive skills, allowing individuals to monitor and adjust their cognitive processes more efficiently. This heightened cognitive awareness encourages better attention control, information organization, and problem-solving abilities, all of which are essential components of working memory. Therefore, adolescents with a stronger internal locus of control tend to demonstrate higher levels of working memory capacity compared to those who predominantly rely on external explanations for their achievements and failures [20].

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Author contribution

The author conceptualized the study objectives and design.

Ethics

None

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