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Original Article

Working memory and selective attention in adolescents with trauma experience and those recovered from acute COVID-19

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Abstract

Adolescence is a sensitive period characterized by rapid cognitive and emotional development, during which exposure to trauma or severe stressors can have lasting effects on cognitive functions. This study aimed to compare working memory and selective attention in adolescents who experienced parental-loss trauma and those who had recovered from acute COVID-19. A total of 120 adolescents (aged 12–20 years) participated, including 61 in the trauma group and 59 in the COVID-19 recovery group. The participants were assessed using the Wechsler Memory Scale, the Computerized Stroop Color–Word Test, the GHQ-28, and the WAIS. Descriptive statistics, independent t-tests, and multivariate analysis of variance (MANOVA) were employed to analyze group differences. Results indicated no significant differences between the two groups in working memory ($t = 1.902$, $p = 0.062$) or selective attention (Pillai's Trace = 0.0169, $p = 0.462$). These findings suggest that both trauma and recovery from acute COVID-19 may similarly affect adolescents' cognitive functions, though no group exhibited superior performance in either domain. The study highlights the importance of monitoring and supporting cognitive functions in adolescents exposed to significant stressors, emphasizing early intervention and preventive strategies. Future longitudinal studies are recommended to explore the long-term impact of trauma and COVID-19 on various cognitive domains.

Keywords

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Cognitive function
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Introduction

Adolescence represents a pivotal transitional period between childhood and adulthood, characterized by rapid biological, psychological, and social changes that shape emotional and cognitive development (Brown, 2021; Ipmawati & Pratisti, 2020). During this sensitive phase, adolescents are especially vulnerable to internal and external stressors, including traumatic experiences, which may have lasting effects on mental and cognitive health (Nelson et al., 2019). Psychological trauma refers to deep emotional wounds resulting from exposure to distressing or threatening events, potentially leaving long-term psychological and physiological consequences (Winfrey & Perry, 2021). According to the Diagnostic and Statistical Manual of Mental Disorders (APA, 2013), a traumatic event involves actual or threatened death, serious injury, or a threat to physical integrity and evokes intense fear or helplessness. Children and adolescents may encounter trauma due to parental loss, domestic violence, accidents, or natural disasters (Roehr, 2013; Shah et al., 2014). Empirical evidence shows that early trauma can result in enduring cognitive impairments, including deficits in working memory and attention (Basharpoor, 2012; Basharpoor et al., 2019; Barlow et al., 2017).

In recent years, the COVID-19 pandemic has emerged as another significant source of stress and trauma, declared a global health emergency by the World Health Organization in March 2020 (Daniel, 2020). Beyond its physical implications, the pandemic caused unprecedented psychological stress due to isolation, fear of infection, and disruption of daily routines (Iodice et al., 2021). Increasing evidence suggests that even after recovery from acute COVID-19, individuals may experience lingering cognitive difficulties, often

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described as "cognitive fog," including deficits in attention, working memory, and executive functioning (Becker et al., 2021; Takács et al., 2025). Studies in children and adolescents further confirm that post-COVID symptoms can involve long-term cognitive and emotional effects, highlighting the vulnerability of the developing brain (Hauke-Gleißner et al., 2025).

The adolescent brain undergoes extensive remodeling, particularly in the prefrontal cortex, which governs higher-order cognitive functions such as working memory and selective attention (Azul et al., 2022). Working memory (WM) refers to the ability to temporarily store and manipulate information for complex cognitive tasks (Baddeley, 1974, 2003). Dysfunction in this system can impair comprehension, decision-making, and emotional regulation (Rapin & Tuchman, 2008). Selective attention allows individuals to focus on relevant stimuli while filtering distractions, and disruptions in this process are associated with cognitive inefficiency and academic difficulties (Hafeze et al., 2019; Naglieri, 2003).

Previous research has shown that trauma and post-COVID conditions can similarly affect cognitive functions. Trauma survivors often display attentional biases toward threat-related cues, and dysregulation between the amygdala, anterior cingulate cortex, and prefrontal regions can disrupt executive control (Cohen et al., 2011; Lazarov et al., 2022). Likewise, adolescents recovering from COVID-19 may experience subtle but persistent cognitive deficits, including reductions in working memory and attention (Delgado-Alonso et al., 2022; Hauke-Gleißner et al., 2025; Takács et al., 2025). While most studies focus on adults, research in adolescents remains limited, particularly in non-Western contexts. Understanding how distinct yet stressful experiences—such as parental-loss trauma and post-COVID recovery—impact cognitive functioning during adolescence is essential, given the neuroplasticity and ongoing brain maturation during this period.

To address this gap, the present study aims to compare working memory and selective attention in two adolescent groups: those who experienced parental-loss trauma and those who recovered from acute COVID-19. By examining these populations, we seek to clarify whether trauma-related and post-infectious stress result in comparable patterns of cognitive alteration in youth. Accordingly, our research question is: Do adolescents who experienced parental-loss trauma and those who recovered from acute COVID-19 differ significantly in working memory and selective attention performance?

Method

Participants

This causal-comparative study was conducted over four months, from March to June 2021, in Karaj, Iran. Ethical approval was obtained from the Research Ethics Committee of Islamic Azad University, Karaj Branch (IR.KIAU.REC.1400.876). The purpose of the study was to compare working memory and selective attention among adolescents who had experienced parental-loss trauma and those who had recovered from acute COVID-19.

A total of 120 adolescents (aged 12–20 years) participated, including 61 adolescents who had lost one or both parents within the past two years (trauma group) and 59 adolescents who had recovered from acute COVID-19 (COVID group). Participants were selected using an availability (convenience) sampling method. The trauma group was recruited from four primary and secondary schools and local counseling centers, while the COVID-19 group was selected from medical laboratories that confirmed previous PCR-positive results and full recovery.

Inclusion Criteria

Participants met the following criteria:

- Willingness to participate in the study.
- Age range of 12–20 years.
- For the trauma group: loss of one or both parents within the past two years.
- For the COVID group: recovery from PCR-confirmed acute COVID-19 at least three months before participation.
- Being single and without major health problems.

Exclusion Criteria

Participants were excluded if they:

- Had a history of chronic diseases (e.g., diabetes, cardiovascular, thyroid, respiratory, or neurological disorders).
- Reported substance use or dependence.
- taking psychoactive or sedative medications.
- Had diagnosed psychiatric or neurodevelopmental disorders (e.g., intellectual disability, autism spectrum disorder).
- Participants with IQ scores below 90.

Instrument

To assess the study variables, standardized and validated psychological instruments were used to measure working memory, selective attention, general mental health, and intelligence quotient (IQ). All instruments had confirmed reliability and validity both internationally and within Iranian populations.

Wechsler Memory Scale (WMS):

Working memory was assessed using the Wechsler Memory Scale (Wechsler, 1945), which measures short-term and working memory across seven subtests, including orientation, mental control, logical memory, digit span (forward and backward), visual reproduction, and associative learning. The WMS provides a comprehensive evaluation of immediate recall, learning capacity, and retention. The WMS provides a comprehensive evaluation of immediate recall, learning capacity, and retention. Internationally, it demonstrates high internal consistency (α = 0.74–0.93) and test–retest reliability ranging from 0.83 to 0.90 (Wechsler & Scale, 2008). In Iran, psychometric studies have confirmed strong reliability (Cronbach’s α = 0.85; test–retest r = 0.82) and validity among adolescent samples (Saed et al., 2008).

Stroop Color–Word Test (Computerized Version):

Selective attention and cognitive inhibition were measured using the Computerized Stroop Color–Word Test (Golden et al., 1978). The task assesses interference control and executive attention by asking participants to identify the color of printed words while ignoring incongruent semantic meaning. Reaction times and error rates were recorded automatically by the software. International findings indicate strong reliability (reaction time ICCs = 0.83–0.97; error ICCs = 0.55–0.79) (Ataman & Özsoy, 2009; Golden et al., 1978) . In Iranian validation research, internal consistency (Cronbach's α = 0.79) and test–retest reliability (ICC = 0.72) confirmed adequate psychometric quality (Behroz-Sarcheshmeh et al., 2017).

Goldberg General Health Questionnaire (GHQ-28):

The GHQ-28 (Goldberg, 1972) was used to assess participants' general mental health to control for emotional or psychiatric factors that might influence cognitive performance. The questionnaire includes 28 items rated on a four-point Likert scale across four domains: somatic symptoms, anxiety/insomnia, social dysfunction, and depression. The reliability of this questionnaire has been examined across different cultures, for example the study by shagami et al (2000) reported a Cronbach's alpha of 0.90 (Sadock, 2015). The Persian version also showed high internal consistency (α = 0.85) and test–retest reliability (r = 0.84), confirming its suitability for use among Iranian adolescents (Ebrahimi, 2006).

Wechsler Adult Intelligence Scale (WAIS):

To assess general intellectual ability, the Wechsler Adult Intelligence Scale (WAIS) (Wechsler, 1995) was used. The WAIS includes 11 subtests—six verbal (e.g., information, vocabulary, comprehension) and five performance-based (e.g., block design, picture arrangement, symbol coding)—providing separate verbal, performance, and full-scale IQ scores. Internationally, test–retest reliability coefficients are excellent (total IQ = 0.97, verbal = 0.97, performance = 0.93) (Groth-Marnat, 2008).

Procedure

After receiving approval from the Ethics Committee, the researchers coordinated with school principals and laboratory managers to identify eligible participants. All participants and their parents or guardians were fully informed about the study's aims, confidentiality, and voluntary nature. Written informed consent was obtained from each participant prior to testing.

Assessments were conducted individually in quiet and well-lit rooms at participating schools and laboratories. To ensure participant comfort and cultural appropriateness, testing was carried out by same-gender examiners (male assessors for boys, female assessors for girls).

Each session lasted approximately 60–75 minutes and followed a standardized sequence:

1. Administration of the GHQ-28 and demographic questionnaire.
2. Assessment of IQ using the WAIS.
3. Measurement of working memory via the Wechsler Memory Scale.
4. Evaluation of selective attention using the Computerized Stroop Test.

Participants were allowed short breaks between tasks to minimize fatigue. Upon completion, all participants were thanked for their cooperation.

Data were analyzed using SPSS version 26. Descriptive statistics (mean, standard deviation, skewness, and kurtosis) were computed for all study variables. Assumptions of normality, linearity, and homogeneity of variance were examined prior to inferential testing.

To compare the two groups (trauma vs. COVID-19 recovery) on cognitive variables, Multivariate Analysis of Variance (MANOVA) was employed, as it allows simultaneous testing of group differences across multiple dependent variables (working memory and selective attention). Additionally, independent t-tests were used for supplementary comparisons. The level of statistical significance was set at $p < 0.05$, and partial eta squared (η^2) values were reported to indicate effect sizes.

Results

A total of 120 adolescents participated in the study, including 61 adolescents who experienced parental-loss trauma (31 boys [51.7%] and 29 girls [48.3%]) and 59 adolescents who had recovered from acute COVID-19 (31 boys [51.6%] and 29 girls [48.4%]). The age distribution in the trauma group was: 15 years = 0%, 16 years = 13.8%, 17 years = 20.7%, 18 years = 55.2%, and 19 years = 10.3%. In the COVID-19 recovery group, ages were: 15 years = 3.2%, 16 years = 19.4%, 17 years = 9.7%, 18 years = 64.5%, and 19 years = 3.2%.

Working Memory

Descriptive statistics for working memory scores are presented in Table 1. Adolescents in the COVID-19 recovery group had slightly higher mean working memory scores than those in the trauma group.

Table 1. Descriptive Statistics for Working Memory by Group

Group	N	Mean (M)	SD
Trauma	61	75.55	2.85
COVID-19 Recovery	59	77.14	3.60

An independent-samples t-test was conducted to compare working memory performance between the two groups. Levene's test indicated that the assumption of equal variances was not violated ($p = 0.062$). The results showed no significant difference in working memory performance between traumatized adolescents and those who had recovered from acute COVID-19, $t(118) = 1.90$, $p = 0.061$, Cohen's $d = 0.35$.

Selective Attention

Descriptive statistics for selective attention, as measured by the Computerized Stroop Test, are summarized in Table 2. The results show comparable performance between the trauma and COVID-19 recovery groups across all components, including reaction times, error rates, and correct responses.

Table 2. Descriptive Statistics for Selective Attention Scores by Group

Variable	Trauma (M ± SD)	COVID-19 Recovery (M ± SD)
Time Response 1	199.29 ± 41.73	209.93 ± 46.32
Errors 1	13.42 ± 17.92	12.38 ± 7.40
No Response 1	35.81 ± 32.44	38.34 ± 41.00
Correct 1	199.42 ± 52.59	190.31 ± 55.64
Reaction Time 1	869.06 ± 125.17	887.48 ± 206.05
Time Response 2	217.39 ± 22.36	220.10 ± 47.04
Errors 2	44.45 ± 48.52	43.69 ± 43.80
No Response 2	43.68 ± 25.43	44.14 ± 46.22
Correct 2	152.68 ± 59.96	146.55 ± 60.71
Reaction Time 2	886.61 ± 185.79	923.21 ± 209.10

A Multivariate Analysis of Variance (MANOVA) was conducted to examine differences in selective attention between the two groups. Box's M test confirmed the homogeneity of covariance matrices ($p = 0.329$), and Levene's tests were non-significant for all dependent variables ($p > 0.05$). Multivariate tests indicated no significant overall group effect on selective attention, Pillai's Trace = 0.0169, $F(10, 49) = 0.99$, $p = 0.462$, partial $\eta^2 = 0.017$; Wilks' Lambda = 0.983, $F(10, 49) = 0.99$, $p = 0.462$, partial $\eta^2 = 0.017$.

Tests of between-subject effects for individual components of selective attention confirmed that there were no significant differences between groups (all $p > 0.05$).

Table 3. Between-Subjects Effects for Selective Attention Components

Variable	F	p	Partial η^2
Time Response 1	0.88	0.353	0.015
Errors 1	0.08	0.773	0.001
No Response 1	0.07	0.791	0.001
Correct 1	0.43	0.517	0.007
Reaction Time 1	0.18	0.675	0.003
Time Response 2	0.08	0.774	0.001
Errors 2	0.004	0.949	0.001
No Response 2	0.002	0.962	0.001
Correct 2	0.16	0.696	0.003
Reaction Time 2	0.52	0.476	0.009

Overall, the results indicate that there were no statistically significant differences between adolescents who experienced parental-loss trauma and those who recovered from acute COVID-19 in terms of working memory or selective attention. Both groups exhibited comparable performance across all measures.

Discussion

Trauma represents a major global health challenge, with long-lasting cognitive, emotional, and behavioral consequences. One contemporary source of trauma is the COVID-19 pandemic, which, beyond its physical health impact, has produced psychological stress across populations. Individuals vary in their resilience, with some maintaining cognitive and emotional stability, while others experience pronounced deficits in memory, attention, and executive functioning. Research has demonstrated significant associations between COVID-19–related anxiety, obsessive-compulsive tendencies, and lower health literacy (Shokri et al., 2024), emphasizing the importance of evaluating cognitive functions to support healthier development.

The present study aimed to compare working memory and selective attention in adolescents who experienced parental-loss trauma with those who recovered from acute COVID-19. The findings indicate no significant differences between the groups in either cognitive domain. While direct comparisons between these two populations are rare, prior research has examined cognitive outcomes separately in trauma-exposed and post-COVID-19 individuals, producing broadly consistent results (Becker et al., 2021; Delgado-Alonso et al., 2022; Heidari et al., 2020; Kaseda & Levine, 2020; Yoo, 2022).

Previous studies on post-COVID-19 populations have reported cognitive complaints commonly described as "brain fog," including deficits in attention and memory several months after recovery (Becker et al., 2021). Yoo

(2022) observed that verbal working memory in young adults with a history of COVID-19 infection was significantly lower than in non-infected peers (Yoo, 2022). Similarly, Kaseda and Levine (2020) identified psychiatric, neurological, and cognitive deficits in hospitalized COVID-19 patients (Kaseda & Levine, 2020). Delgado-Alonso et al. (2022) reported that approximately 20% of COVID-19 survivors experienced memory difficulties over a one-year period, independent of disease severity(Delgado-Alonso et al., 2022). Kira et al. (2023) further confirmed deficits in working memory and cognitive inhibition in individuals' post-infection, highlighting the neurocognitive impact of COVID-19 (Kira et al., 2023).

Trauma exposure has likewise been linked to cognitive disruption. Blanchette and Caparos (2016) demonstrated reduced working memory performance in trauma-exposed individuals compared to controls (Blanchette & Caparos, 2016). Olver et al. (1996) found that traumatic experiences impair selective attention due to slower information processing, distractibility, and hypervigilance. These findings align with our study, suggesting that both trauma and COVID-19–related stress may affect adolescents' cognitive performance, particularly working memory and attention (Olver et al., 1996).

However, some studies report divergent findings. Baseler et al. (2022) noted significant memory declines in COVID-19 patients aged 25 and older but found no such effect in younger adults under 25, indicating that cognitive vulnerability may be age-dependent (Baseler et al., 2022). Kimble et al. (2010) suggested that trauma may not uniformly impair attention, highlighting the need for further investigation into individual and contextual moderators (Kimble et al., 2010).

The present study has several limitations. The sample was relatively small and restricted to adolescents from Alborz Province, limiting generalizability. Cultural factors and reluctance to discuss traumatic experiences restricted access to the trauma group. The cross-sectional, causal-comparative design precludes causal inferences and control over confounding variables. Future research should employ longitudinal designs to better capture the chronic effects of trauma and post-COVID-19 recovery on cognitive functioning. Additionally, studies should investigate other executive functions, such as reasoning, cognitive flexibility, and planning, across diverse age groups and cultural contexts.

Despite these limitations, this study provides preliminary evidence that both trauma and post-COVID-19 recovery may be associated with subtle declines in working memory and selective attention in adolescents. Early identification of cognitive deficits and timely psychological intervention could mitigate long-term consequences and support healthier cognitive development.

Conclusion

Both traumatic experiences, such as parental loss and acute COVID-19 infection can impact adolescents' cognitive functioning, particularly working memory and selective attention. Adolescents are not immune to these effects, highlighting the need for targeted preventive strategies and interventions to strengthen cognitive capacities. Parents, educators, and healthcare providers should monitor for signs of cognitive decline and seek timely support from mental health professionals. Future research should aim to replicate this study, explore additional cognitive domains, and examine interventions to promote resilience and cognitive recovery in trauma-affected and post-COVID-19 adolescents.

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Disclosure Statement

No potential conflicts of interest are reported by the authors.

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