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Effects of Ramadan Fasting on Cognitive Performance and Mood in Young Adults

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Abstract

Ramadan fasting is a culturally embedded lifestyle practice characterized by marked changes in sleep–wake patterns, hydration, caloric intake, and daily routines. These shifts may influence cognitive performance efficiency and emotional regulation, particularly in adolescents and young adults undergoing continued neurodevelopment. This study examined cognitive performance and mood among 56 healthy Muslim young adults (ages 18–20) using a within-subject design that compared fasting and non-fasting days under controlled conditions. Participants completed computerized attention and working-memory tasks, a psychotechnical test of processing speed, and the Profile of Mood States (POMS) questionnaire.

Fasting was associated with a substantial decline in concentration (–44.6%) and a significant reduction in psychotechnical performance, where memory showed a small, non-significant decrease. Mood outcomes revealed higher levels of tension, anger, and fatigue during fasting, alongside a significant reduction in vigor; depressive symptoms remained stable. These findings suggest that fasting disproportionately affects attentional control and executive efficiency, which appear more sensitive than memory to metabolic, circadian, and behavioral changes.

The relative stability of depressive symptoms may reflect belief-based and contextual emotional regulation mechanisms that support affective balance despite increased physiological and attentional load. By integrating cognitive and emotional outcomes, this study contributes to understanding how lifestyle-embedded fasting practices modulate cognitive performance under ecologically valid conditions, with implications for cognitive enhancement research, education, and applied health contexts.

1.0 Introduction

Introduction Recent advances in the field of econeurobiology provide an essential theoretical foundation for understanding how environmental, educational, physiological, and psychosocial factors collectively shape brain development and cognitive–emotional functioning. Author et al. (2024a) demonstrated that children's neurodevelopment is profoundly influenced by biological embedding processes, environmental exposures, and school-based interventions that integrate movement, nutrition, stress regulation, and enriched learning environments. Complementing this framework, Author et al. (2024b) emphasized that education and health operate as core social determinants that jointly influence neural plasticity, resilience, and long-term cognitive and emotional outcomes. These two foundational studies underscore the multifactorial nature of cognitive performance and mood regulation and highlight the importance of considering environmental and behavioral factors—such as fasting routines—within broader neurodevelopmental and socio-ecological contexts.

Ramadan, the ninth month of the Islamic calendar, represents one of the most spiritually meaningful practices in Islam, during which Muslims abstain from food, drink, and other physical needs from dawn to sunset. Beyond its profound religious significance, Ramadan fasting constitutes a unique natural

model of intermittent fasting accompanied by substantial lifestyle modifications—including altered sleep–wake cycles, reduced and delayed caloric intake, changes in hydration, circadian rhythm disruption, and shifts in communal and spiritual activity (Azizi, 2010; Roky et al., 2001; Trabelsi et al., 2022). For adolescents and young adults—whose brains continue to develop structurally and functionally, especially in domains related to executive functioning, attention, and emotional regulation—such lifestyle changes may have measurable effects on cognitive performance and mood (Gudden et al., 2021; Iqbal et al., 2019).

A substantial body of literature has examined the cognitive effects of Ramadan fasting, producing mixed findings. Some studies demonstrate impairments in attention, vigilance, working memory, and executive function during fasting, particularly in the later afternoon hours when circadian disruption, dehydration, caloric restriction, and accumulated fatigue interact (BaHammam et al., 2013; Hakkou et al., 1988; Ali & Amir, 1989; Ganio et al., 2011; Armstrong et al., 2012; Qasrawi et al., 2017). Meta-analytic evidence similarly indicates that short-term fasting can affect complex cognitive processes such as planning and inhibitory control (Benau et al., 2021**; Bastorek & Hromatko, 2024).** Disrupted sleep—characterized by delayed bedtime, reduced total sleep time, and daytime sleepiness—is one of the most consistent correlates of cognitive changes during Ramadan (BaHammam & Alaseem, 2019; Almeneessier et al., 2021; Nasreddine & Naja, 2021). This is important because sleep restriction alone is known to impair concentration and memory (Li et al., 2013).

However, other studies report preserved or even enhanced cognitive performance. For example, morning testing often shows stable attention and memory before fatigue accumulates (BaHammam, 2010). In adolescents, Miladi et al. (2024) found no decline in reaction time or neurophysiological indices (P300) during Ramadan. Among university students, Koul and Tariq (2024) and Attash et al. (2025) report that many maintain academic performance despite sleep and fatigue fluctuations. Research on physically active groups, such as athletes, similarly shows stable or improved cognitive control and reaction time (Rachid et al., 2021; Trabelsi, Stannard, & Maughan, 2020; Bougrine et al., 2024; Elghoul et al., 2024; Zerguini et al., 2007). Neuroimaging studies reveal no significant structural brain changes during Ramadan fasting (Bakan et al., 2015; Iqbal et al., 2019), supporting the view that fasting-related cognitive changes are functional and context-dependent rather than structural.

Parallel to cognitive findings, emotional responses to Ramadan fasting are heterogeneous. Although some individuals experience increases in tension, irritability, or fatigue—especially early in Ramadan or late in the day—others report greater calmness, spiritual fulfillment, improved emotional regulation, and enhanced self-discipline. These positive emotional outcomes have been associated with increased levels of serotonin, dopamine, BDNF, and NGF during fasting, which support neuroplasticity and mood regulation (Bastani et al., 2017; de Cabo & Mattson, 2019; Khoshandam Ghashang et al., 2024).
Psychological and socioreligious research highlights the role of communal practices, shared rituals, and spiritual meaning in buffering emotional distress. Adolescents and young adults, in particular, may derive emotional benefits from the structured, reflective, and communal aspects of Ramadan. A recent study found that emotional intelligence scores improved among fasting youth, suggesting that the self-

discipline and reflection inherent to Ramadan may strengthen socio-emotional skills (Sweileh et al., 2022; Fond et al., 2013).

Despite the expanding literature, notable gaps remain. Most research focuses on adults or clinical populations; fewer studies examine healthy adolescents and young adults—despite their heightened vulnerability to sleep disruption, emotional fluctuation, and cognitive load. Moreover, only a limited number of studies employ within-subject designs comparing fasting and non-fasting conditions under controlled environmental parameters, which is essential for isolating fasting-specific effects (Alhaj & Alhusaini, 2025; Rouane et al., 2024). Even fewer studies simultaneously assess cognitive performance and mood, although these domains are physiologically intertwined and influenced by overlapping neuroendocrine mechanisms. Recent interdisciplinary work underscores the importance of integrating religious, psychological, and biological perspectives in understanding health behaviors during Ramadan (Chekroud et al., 2016).

The present study aims to address these gaps by investigating the effects of Ramadan fasting on both cognitive performance and mood among healthy Muslim young adults aged 18–20. Using a within-subject design, participants were assessed twice—once during a Ramadan fasting day and once on a non-fasting day—under controlled environmental and temporal conditions. Cognitive performance was evaluated using standardized computerized tasks and a psychotechnical reaction-time test, while mood was assessed using the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971), validated in cross-cultural settings (Netz et al., 2005; Yeun & Shin-Park, 2006). By integrating neurocognitive, emotional, and contextual data, this study contributes to understanding how religious fasting shapes mental functioning in a developmentally sensitive population and informs educators, clinicians, and community leaders about potential support strategies aligned with cultural and spiritual practices.

2.0 Methods

Participants

The study included 56 healthy Muslim adolescents and young adults (52% female; ages 18–20) enrolled in 11th and 12th grades at a high school in northern Israel. All participants provided informed consent prior to participation, with parental consent obtained for minors. Inclusion criteria required that participants be physically healthy, regularly observe Ramadan fasting, and report no known neurological, psychiatric, or chronic sleep disorders.

Study Design

A within-subject repeated-measures design was used to compare each participant's cognitive performance and mood under two conditions: (1) a fasting day during Ramadan and (2) a comparable non-fasting day outside Ramadan. All assessments were conducted in the afternoon (14:00–17:00) to capture the period when fasting-related effects are typically most pronounced.

Procedure

Each participant completed two assessment sessions approximately one week apart. Testing occurred in a quiet, temperature-controlled room with consistent environmental conditions across sessions. Upon arrival, participants received standardized instructions and then completed the assessment battery in the following fixed order:

1. Computerized concentration and working-memory tasks
2. A standardized psychotechnical test of reaction time and processing speed
3. The Profile of Mood States (POMS) questionnaire

This fixed sequence ensured consistency across participants and minimized potential bias from mood assessments influencing cognitive performance.

Measures

Cognitive Tasks

Two categories of cognitive tasks were administered:

- **Computerized Attention and Working-Memory Tasks**: These tasks assessed selective attention, sustained attention, and short-term working memory using rapid visual stimuli requiring accurate responses.
- **Psychotechnical Test**: A clinically validated measure of psychomotor speed, processing efficiency, perceptual accuracy, and response consistency.

Mood Assessment

Mood was assessed using the **Profile of Mood States (POMS)** (McNair, Lorr, & Droppleman, 1971). Five dimensions were measured: tension, anger, depression, vigor, and fatigue. The validated Hebrew version (Netz et al., 2005) was used, supported by cross-cultural evidence confirming its reliability and construct validity (Yeun & Shin-Park, 2006). Items were rated on a 5-point Likert scale ranging from 0 (“Not at all”) to 4 (“To a very great extent”). Higher Vigor scores reflect better mood, while higher scores on the remaining subscales indicate more negative emotional states.

Statistical Analysis

Statistical analyses were conducted to evaluate differences in cognitive and emotional measures between fasting and non-fasting conditions.

- **Paired-samples t-tests** were used for variables with normally distributed difference scores (e.g., memory, concentration, vigor, fatigue).
- **Shapiro–Wilk tests** were conducted to evaluate the normality of distribution.

- **Wilcoxon Signed-Rank Tests** were used for variables that violated normality assumptions (e.g., tension, anger, depression).
- **Spearman's rank correlations** were computed to examine associations between cognitive outcomes (e.g., concentration, psychotechnical scores) and emotional states (POMS subscales).

All analyses used a significance threshold of $p < .05$. Unless otherwise justified by the literature, all tests were two-tailed. Analyses were performed using SPSS (Version XX). The use of both parametric and non-parametric methods ensured robust interpretation of the findings in accordance with best practices in behavioral and cognitive research.

Ethical Considerations

Ethical approval

for this study was granted by the Institutional Ethics Committee at Oranim Academic College (Approval No. 242; issued 2025). The study was reviewed under the project titled *"The Impact of Eco-Neurobiological Factors on the Cognitive, Emotional, and Social Performance of Students in the School Educational Environment."* The committee confirmed that the research meets institutional and national ethical standards, with approval valid until November 30, 2026, and subject to renewal thereafter.

All participants—and legal guardians for minors—provided written informed consent prior to participation, and all procedures adhered to the principles of the Declaration of Helsinki.

3.0 Results

3.1 Cognitive Performance

3.1.1 Concentration

A paired-samples analysis revealed a substantial decline in concentration performance during Ramadan fasting. Participants performed markedly better in the non-fasting condition (M = 138.4, SD = 159.1) compared with the fasting condition (M = 76.6, SD = 59.1), representing a **44.6% reduction** in concentration scores (Table 1).

A paired-samples *t*-test showed that this difference was statistically significant,

$t(55) = 2.84$, $p = .003$, corresponding to a small-to-moderate effect size ($d = 0.38$).

Although the Shapiro–Wilk test indicated a violation of the normality assumption ($W = 0.703$, $p < .001$), the *t*-test remained appropriate based on the Central Limit Theorem due to the relatively large sample size (N = 56). To confirm robustness, a **Wilcoxon signed-rank test** was also conducted, which similarly revealed a significant difference,

$W = 1047$, $p < .001$, indicating a moderate rank-biserial correlation ($r = 0.52$).

Together, these results provide strong and converging evidence that sustained attention and concentration are significantly impaired during Ramadan fasting, making concentration the most sensitive cognitive domain affected by fasting-related physiological and behavioral changes in this study.

Table 1. Comparison of Concentration Scores Between Fasting and Non-Fasting Conditions

This table presents mean, standard deviation, and statistical comparisons of sustained attention performance under fasting and non-fasting conditions. Higher scores reflect better concentration. Both parametric and non-parametric analyses indicated significantly reduced concentration during fasting.

Paired Samples t-Test

Comparison	Statistic	df	*p*	Mean Difference	SE Difference
Concentration – Normal vs. Concentration – Fasting	$t(55) =$ **2.84**	55	**.003**	61.8	21.7
Note. H□: $\mu_{(}$Normal$_{)} - \mu_{(}$Fasting$_{)} > 0$.					
Normality Test (Shapiro–Wilk)					

Comparison	W	*p*
Concentration – Normal minus Concentration – Fasting	**0.703**	**< .001**
Note. A low *p*-value indicates violation of the normality assumption.		
Descriptive Statistics		

Condition	N	Mean	Median	SD	SE
Concentration – Normal	56	138.4	100	159.1	21.26
Concentration – Fasting	56	76.6	65	59.1	7.90

3.1.2 Memory

Memory performance also declined during fasting; however, the effect was less pronounced and did not reach statistical significance. Under normal conditions, participants achieved an average memory score of 777.0 (SD = 987), compared with 608.0 (SD = 331) during fasting—representing a **21.8% reduction**. The effect size, measured by Cohen's *d*, was small ($d = 0.18$) (Table 2).

A paired-samples *t*-test indicated that the difference between conditions was **not** statistically significant,

$t(55) = 1.36$, $p = .090$, corresponding to a small effect size ($d = 0.18$).

Because the Shapiro–Wilk test revealed a significant deviation from normality (W = 0.657, $p < .001$), a **Wilcoxon signed-rank test** was conducted. The non-parametric test likewise showed no significant difference between conditions,

$W = 856$, $p = .321$, with a negligible effect size ($r = 0.07$).

Taken together, these results indicate that although memory performance showed a downward trend during fasting, the high variability in scores and small effect size suggest that short-term memory was **not robustly affected** under the fasting conditions assessed in this study.

Table 2

Memory Performance During Fasting and Non-Fasting Conditions This table summarizes memory task scores across both conditions. Although memory scores declined during fasting, the reduction did not reach statistical significance in either parametric or non-parametric tests.

Measure	Normal Condition (N = 56)	Fasting Condition (N = 56)	Statistic	df	p-value	Effect Size
Mean ± SD	777 ± 987	608 ± 331	$t = 1.36$	55	.090	Cohen's $d = 0.18$
Wilcoxon Signed-Rank Test	—	—	W = 856	—	.321	Rank-biserial $r = 0.072$
Shapiro–Wilk (difference scores)	—	—	W = 0.657	—	< .001	Normality violated
% Change	—	−21.75%	—	—	—	—

Note. Higher scores reflect better memory performance. The decline observed during fasting did not reach statistical significance in either parametric or non-parametric analyses.

Summary of Cognitive Findings

Cognitive performance was differentially affected by Ramadan fasting. Concentration showed a substantial and statistically significant decline, whereas memory performance displayed a non-significant downward trend. These findings align with existing literature indicating that attentional systems are more sensitive to metabolic, circadian, and physiological changes during fasting than memory systems.

3.2 Psychotechnical Test Performance

Psychotechnical performance showed a statistically significant decline during Ramadan fasting. Participants achieved higher scores under normal (non-fasting) conditions (M = 4.93, SD = 1.69)

compared with the fasting condition (M = 4.25, SD = 1.73), reflecting a **15.87% reduction** in overall processing speed and accuracy (Table 3).

A paired-samples *t*-test indicated that the difference between conditions was statistically significant,

$t(55) = 2.64$, $p = .005$ (one-tailed), consistent with the directional hypothesis predicting reduced performance during fasting. The corresponding two-tailed value ($p = .011$) further supports the robustness of this finding, demonstrating that participants performed significantly better when not fasting.

To verify statistical assumptions, a Shapiro–Wilk test was conducted on the difference scores. The results (W = 0.958, $p = .051$) indicated no violation of normality, confirming the appropriateness of the paired-samples *t*-test for this dataset.

Overall, these results demonstrate that Ramadan fasting significantly impairs psychotechnical performance, particularly on tasks requiring rapid information processing, accuracy, and sustained executive efficiency. These findings complement the marked reduction observed in concentration scores and suggest that executive cognitive functions are especially sensitive to the physiological and behavioral demands of prolonged fasting.

Table 3

Psychotechnical Test Scores Comparing Fasting and Non-Fasting Days This table displays mean scores and statistical outcomes for processing speed, accuracy, and psychomotor efficiency. Participants showed significantly lower performance during fasting.

Measure	Normal Condition (N = 56)	Fasting Condition (N = 56)	Statistic	df	p-value	Effect Size
Mean ± SD	4.93 ± 1.69	4.25 ± 1.73	$t = 2.64$	55	.005 (one-tailed) / .011 (two-tailed)	—
Shapiro–Wilk (difference scores)	—	—	W = 0.958	—	.051	Normality assumption met
% Change	—	−15.87%	—	—	—	—

Note. Higher scores indicate better performance. A one-tailed test was used based on the directional hypothesis predicting reduced performance during fasting. The normality assumption for the *t*-test was satisfied.

3.3 Emotional State (POMS)

The Profile of Mood States (POMS) questionnaire revealed pronounced changes in emotional functioning during Ramadan fasting across four of the five assessed mood dimensions. Significant

increases were observed in tension, anger, and fatigue, while vigor showed a significant decrease. Depression demonstrated a small, non-significant rise.

Tension

Tension levels showed a marked and statistically significant increase during Ramadan fasting. Under normal conditions, participants reported a mean tension score of 0.321 (SD = 0.504, SE = 0.0674), whereas during fasting the mean increased to 0.631 (SD = 0.967, SE = 0.1293). This reflects a substantial rise of approximately **96%** between conditions (Table 4).

A paired-samples *t*-test indicated that the increase in tension during fasting was statistically significant,

$t(55) = -2.99$, $p = .004$, confirming that participants experienced higher tension while fasting.

A Shapiro–Wilk test conducted on the difference scores revealed a significant deviation from normality,

$W = 0.735$, $p < .001$, suggesting violation of the normality assumption. However, given the sufficiently large sample size (N = 56), the *t*-test remains valid under the Central Limit Theorem.

To further validate these findings, a **Wilcoxon signed-rank test** was performed. Results also indicated a significant increase in tension during fasting,

$W = 102$, $p = .002$, supporting the robustness of the parametric analysis.

Taken together, both parametric and non-parametric analyses demonstrate that tension levels increased significantly during Ramadan fasting, reflecting heightened emotional strain during prolonged daily fasting.

Table 4
Tension Levels (POMS Subscale) During Fasting and Non-Fasting Conditions This table reports differences in tension scores between conditions. Both t-test and Wilcoxon analysis indicate significantly increased tension during fasting.

Analysis	Statistic	df	p-value	Notes
Paired Samples t-Test	$t = -2.99$	55	.004	Higher tension during fasting
Wilcoxon Signed-Rank Test	W = 102	—	.002	24 tied pairs
Shapiro–Wilk Normality Test	W = 0.735	—	< .001	Normality violated

Descriptive Statistics

Condition	N	Mean	Median	SD	SE
Tension – Normal	56	0.321	0.000	0.504	0.0674
Tension – Fasting	56	0.631	0.333	0.967	0.1293

Depression

Depression scores showed a small increase during fasting; however, this change did not reach statistical significance. Under normal conditions, participants reported an average depression score of 0.457 (SD = 0.432, SE = 0.0577), compared with 0.538 (SD = 0.448, SE = 0.0598) during fasting, representing a modest **17.8% increase** in depressive symptoms (Table 5).

Because the normality assumption was violated, a **Wilcoxon signed-rank test** was used. The results indicated that the difference between fasting and non-fasting conditions was *not* statistically significant,

$W = 386$, $p = .069$,

suggesting that depressive symptoms remained generally stable across fasting and non-fasting days.

A Shapiro–Wilk test confirmed a significant deviation from normality in the difference scores,

$W = 0.927$, $p = .002$,

supporting the use of non-parametric analysis. Although the direction of change indicated a slight elevation in depressive mood during fasting, the effect was too small to reach statistical significance.

Taken together, these findings indicate that Ramadan fasting did not significantly influence depressive symptoms. This relative stability may reflect the protective role of spiritual engagement, communal belonging, and the cultural meaning associated with Ramadan, which are known to buffer against increases in depressive mood.

Table 5

Depression Scores (POMS Subscale) During Fasting and Non-Fasting Conditions This table presents depression ratings across conditions. Although scores were slightly higher during fasting, differences were not statistically significant.

Analysis	Statistic	p-value	Mean Difference	SE Difference	Notes
Wilcoxon Signed-Rank Test	W = **386**	.069	−0.0715	0.0634	11 tied pairs
Shapiro–Wilk Test (normality)	W = **0.927**	.002	—	—	Normality violated
Descriptive Statistics					

Condition	N	Mean	Median	SD	SE
Depression – Normal	56	0.457	0.429	0.432	0.0577
Depression – Fasting	56	0.538	0.429	0.448	0.0598
Anger					

Anger levels increased significantly during fasting compared with the normal condition. Under normal (non-fasting) conditions, participants reported an average anger score of 0.503 (SD = 0.573, SE = 0.0766), while during fasting the mean score increased to 0.711 (SD = 0.649, SE = 0.0867), representing a **42% rise** in anger (Table 6).

A paired-samples *t*-test indicated that this increase was statistically significant,

$t(55) = -2.82$, $p = .007$,

demonstrating that participants experienced higher anger levels when fasting.

Because the Shapiro–Wilk test revealed a deviation from normality,

$W = 0.950$, $p = .020$,

a **Wilcoxon signed-rank test** was performed as a confirmatory analysis. The Wilcoxon test also indicated a significant increase in anger,

$W = 223$, $p = .003$,

reinforcing the robustness of the finding.

Table 6. Anger Levels (POMS Subscale) During Fasting and Non-Fasting Conditions

This table compares anger responses between fasting and non-fasting days. Statistical tests show a significant increase in anger during fasting.

Statistical Tests

Analysis	Statistic	df	p-value	Notes
Paired Samples t-Test	$t = -2.82$	55	.007	Anger significantly higher during fasting
Wilcoxon Signed-Rank Test	W = 223	—	.003	Confirms non-parametric significance
Shapiro–Wilk Test (normality)	W = 0.950	—	.020	Normality assumption violated

Descriptive Statistics

Condition	N	Mean	Median	SD	SE
Anger – Normal	56	0.503	0.333	0.573	0.0766
Anger – Fasting	56	0.711	0.667	0.649	0.0867

Fatigue

Fatigue exhibited the strongest and most statistically robust change among all POMS mood dimensions. Participants reported substantially higher fatigue levels during fasting (M = 1.479, SD = 0.953, SE = 0.127) compared with the normal condition (M = 0.750, SD = 0.899, SE = 0.120), representing a **96% increase** in subjective tiredness (Table 7).

A paired-samples *t*-test indicated that this increase in fatigue during fasting was highly significant,

$t(55) = -4.85$, $p < .001$,

demonstrating a strong effect of fasting on self-reported fatigue. The negative *t*-value reflects the direction of the difference, indicating higher fatigue scores during fasting.

The Shapiro–Wilk test conducted on the difference scores revealed no violation of the normality assumption,

$W = 0.967$, $p = .128$,

supporting the appropriateness of the parametric *t*-test for this analysis.

Overall, these findings indicate that Ramadan fasting leads to a significant and substantial increase in fatigue. This pronounced elevation likely reflects the combined effects of altered sleep schedules, hydration patterns, and reduced caloric intake that characterize fasting days.

Table 7

Fatigue Levels (POMS Subscale) During Fasting and Non-Fasting Conditions This table provides fatigue scores showing a pronounced and statistically significant increase during fasting.

Analysis	Statistic	df	p-value	Mean Difference	SE Difference	Notes
Paired Samples t-Test	$t = -4.85$	55	< .001	−0.729	0.150	Fatigue significantly higher during fasting
Shapiro–Wilk Normality Test	$W = 0.967$	—	.128	—	—	Normality assumption met

Descriptive Statistics

Condition	N	Mean	Median	SD	SE
Fatigue – Normal	56	0.750	0.400	0.899	0.120
Fatigue – Fasting	56	1.479	1.200	0.953	0.127

Vigor

Vigor—the only positively valenced POMS mood dimension—showed a significant decrease during fasting. Under normal conditions, participants reported a mean vigor score of 2.31 (SD = 0.762, SE = 0.102), whereas during fasting the mean score declined to 2.02 (SD = 0.879, SE = 0.118), representing a **12.9% reduction** in perceived energy and vitality (Table 8).

A paired-samples *t*-test indicated that this decrease was statistically significant,

$t(55) = 2.40$, $p = .020$,

showing that participants experienced lower vigor when fasting.

A Shapiro–Wilk test performed on the difference scores indicated a violation of the normality assumption,

$W = 0.933$, $p = .004$.

However, because the sample size was sufficient (N = 56), the paired-samples *t*-test remained appropriate under the Central Limit Theorem.

To confirm the robustness of the finding, a non-parametric **Wilcoxon signed-rank test** was conducted. This analysis also yielded a statistically significant difference,

$W = 856$, $p = .035$,

providing converging support for reduced vigor during fasting.

Taken together, these analyses indicate that vigor levels declined significantly during Ramadan fasting, reflecting reduced energy, vitality, and motivation. The agreement across both parametric and non-parametric results strengthens confidence in the reliability of this effect.

Table 8. Vigor Levels (POMS Subscale) During Fasting and Non-Fasting Conditions

This table displays vigor scores, revealing significantly lower energy and vitality during fasting according to both parametric and non-parametric analyses.

Statistical Tests

Analysis	Statistic	df	p-value	Notes
Paired Samples t-Test	$t = 2.40$	55	.020	Vigor significantly lower during fasting
Wilcoxon Signed-Rank Test	W = 856	—	.035	Confirms non-parametric significance
Shapiro–Wilk Normality Test	W = 0.933	—	.004	Normality violated

Descriptive Statistics

Condition	N	Mean	Median	SD	SE
Vigor – Normal	56	2.31	2.33	0.762	0.102
Vigor – Fasting	56	2.02	2.00	0.879	0.118

4.0 Discussion

The present study provides important insights into the cognitive and emotional effects of Ramadan fasting among healthy Muslim adolescents and young adults. Through a within-subject design comparing the same individuals on fasting and non-fasting days under controlled conditions, the study offers a nuanced understanding of how fasting influences mental functioning during a sensitive developmental stage. The findings are aligned with, yet extend, the existing interdisciplinary literature on fasting, cognition, mood, and religious practice.

Our cognitive results showed a marked decline in concentration during fasting days, with a reduction of 44.6% compared to non-fasting days. This pattern is consistent with studies showing that fasting influences attention and vigilance, particularly in the afternoon when circadian misalignment, reduced sleep quality, dehydration, and fluctuating glucose levels converge to increase cognitive load (BaHammam et al., 2013; Ganio et al., 2011; Armstrong et al., 2012; Qasrawi et al., 2017). Moreover, adolescent populations are particularly sensitive to sleep disturbances, and Ramadan is known to reduce total sleep time and alter sleep architecture (Almeneessier et al., 2021; BaHammam & Alaseem, 2019). The significant decline in concentration observed in the present study parallels findings from Attash et al. (2025), who reported that sleep loss and fatigue during Ramadan contributed to reduced academic performance in university students.

In contrast, memory performance in our study showed only a 21.8% decline and did not reach statistical significance. This finding aligns with research suggesting that memory may be less vulnerable to short-term fasting than attention. Experimental studies have demonstrated that memory recall remains relatively stable during brief fasting periods (Green et al., 1995), and neurophysiological studies such as those conducted by Miladi et al. (2024) support the notion that core cognitive processes can remain intact even during metabolic fluctuations. Additionally, some fasting individuals may activate compensatory strategies—such as increased effort or reliance on previously consolidated knowledge—to maintain adequate performance on memory tasks.

Mood outcomes in the present study revealed substantial increases in tension, anger, and fatigue during fasting days, alongside a decrease in vigor. These findings align with evidence that emotional responses to fasting are highly sensitive to energy depletion, hydration status, and circadian disruption (Bastani et al., 2017; Khoshandam Ghashang et al., 2024). Consistent with our results, Lone et al. (2025) observed heightened tension and irritability among medical students fasting during Ramadan. Similarly, Elsahoryi et al. (2025) found that fasting participants reported greater stress and mood disturbances, particularly

among those with poor sleep quality. The reduction in vigor aligns with studies demonstrating that prolonged fasting can affect physical energy, motivational drive, and emotional vitality.

Interestingly, depressive symptoms did not show a significant change in our sample. This aligns with research indicating that although fasting can elevate fatigue and tension, the belief-based, communal, and meaning-oriented aspects of Ramadan may buffer against increases in depressive mood (Fond et al., 2013; Sweileh et al., 2022). Belief-based engagement and structured meaning-making practices are strongly associated with resilience, emotional stability, and adaptive stress responses (Chekroud et al., 2016). The sense of purpose, self-discipline, collective rituals, and structured reflection and meaning-oriented practices inherent in Ramadan may serve as protective factors, mitigating the emotional toll of fasting despite physiological strain. This stability can be interpreted in cognitive terms as reflecting belief-mediated emotional regulation and contextual buffering, which may help preserve affective balance and support cognitive–emotional integration despite increased physiological and attentional load during fasting.

Building on this perspective, Ramadan fasting as a culturally embedded practice provides an essential framework for understanding these emotional outcomes. Beyond physiological influences such as altered sleep, hydration, and caloric intake, Ramadan fosters structured reflection, communal solidarity, and intentional self-regulation. These dimensions may help explain the stability of depressive symptoms despite increases in tension and fatigue. Shared rituals—such as prayer, family gatherings, and collective evening meals—may strengthen social support networks and enhance emotional resilience in adolescents and young adults.

Our findings contribute a more integrated understanding of the interplay between biological, cognitive, and emotional regulatory processes, demonstrating how culturally embedded fasting practices can modulate cognitive performance and affective states in developmentally sensitive populations. Moreover, adolescents' enhanced emotional plasticity and their engagement in structured, meaning-based practices during Ramadan may further support emotional intelligence, self-regulation, and adaptive coping (Bastani et al., 2017; de Cabo & Mattson, 2019).

Despite these strengths, the study has several limitations. The sample was drawn from a single geographic and cultural context—Muslim adolescents in northern Israel—which may limit generalizability to other populations. Additionally, sleep patterns and hydration levels were not objectively measured, even though they are known to influence fasting outcomes (Roky et al., 2001; Almeneessier et al., 2021). Incorporating objective sleep metrics (e.g., actigraphy), hydration markers, and dietary logs would enhance future analyses. The use of a single mood instrument (POMS) may also limit the emotional resolution of the findings; future studies could include broader psychological measures or biomarkers such as cortisol.

Future research should investigate longitudinal patterns across the entire month of Ramadan, as individuals often adapt to fasting over time. Recent studies by Jandali et al. (2024) and Batorek and Hromatko (2024) show that emotional and cognitive changes may stabilize or reverse as fasting

continues. Comparative studies between traditional Ramadan fasting and modified intermittent fasting models may also help disentangle the unique contributions of religious context versus metabolic changes. Furthermore, research should examine moderators such as physical activity levels (Ameur et al., 2025), socioeconomic background, gender differences, and personality traits, all of which may shape individuals' fasting experiences.

From a cognitive enhancement perspective, Ramadan fasting may be conceptualized as a naturalistic, non-pharmacological modulation paradigm that differentially affects attentional control, processing efficiency, and emotional regulation under ecologically valid conditions.

Overall, this study underscores that Ramadan fasting has multifaceted effects on cognition and mood in adolescents and young adults. While fasting poses cognitive and emotional challenges—particularly related to attention, tension, and fatigue—the spiritual, communal, and personal-growth aspects of Ramadan likely contribute to emotional resilience and stability. These findings have practical implications for educators, clinicians, families, and community leaders seeking to support fasting youth. Enhancing sleep hygiene, modifying academic or athletic demands during peak fasting hours, and fostering supportive spiritual environments may help young individuals navigate fasting more effectively while benefiting from the meaningful traditions of Ramadan.

Declarations

Competing Interests:

The authors declare that they have no known financial or non-financial conflicts of interest that could have influenced the work reported in this paper.

Ethical Approval:

All procedures involving human participants were conducted in accordance with the ethical standards approved by the Oranim Academic College Institutional Ethics Committee. Informed consent was obtained from all individual participants and their legal guardians prior to participation.

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Author Contribution

Conceptualization: Raed Mualem, Asel Aslie, Ahlam Abass, Coral Cohen, Rania H. Farraj, and Caesar Anton. Data Collection: Raed Mualem, Asel Aslie, Ahlam Abass.Writing (Original Draft): Raed Mualem wrote the first draft. Writing (Review & Editing): All authors (R.M., A.A. (Aslie), A.A. (Abass), C.C., R.H.F., and C.A commented on previous versions and approved the final manuscript.

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Data Availability

The datasets generated and analyzed during the current study are not publicly available due to the privacy of adolescent participants but are available from the corresponding author, Dr. Raed Mualem, on reasonable request.

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