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A randomized, double-blind, controlled trial (RCT) aimed to evaluate the effectiveness of high-content DHA fish oil on enhancing attention

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Abstract: This study employed a randomized, double-blind, controlled trial to evaluate the effects of high-DHA fish oil on attention in healthy adults. Forty-four participants aged 24-55 years were recruited (43 completed the study: 22 in the intervention group and 21 in the control group). The intervention group received 1200mg of fish oil, while the control group received 1200mg of algal oil. Participants consumed the test products for 90 consecutive days, and their levels of attention were assessed at baseline (D0), day 30 (D30), and day 90 (D90) using the Stroop test and the MemTrax (MTX) task. Repeated measures analysis of variance revealed that the intervention group exhibited a significant reduction in Stroop mean response delay (Day 30: -16.05%, $p<0.05$; Day 90: -23.46%, $p<0.05$) and a significant improvement in Stroop accuracy (Day 30: +15.74%, $p<0.05$; Day 90: +18.42%, $p<0.05$). Furthermore, the intervention group showed a significant decrease in MTX multi-tasking reaction time (Day 30: -9.65%, $p<0.05$; Day 90: -19.30%, $p<0.05$) and an increase in accuracy (Day 30: +19.82%, $p<0.05$; Day 90: +25.61%, $p<0.05$). No significant improvements in attention were observed in the control group. The findings indicate that the high-DHA fish oil formulation used in the intervention group is more effective than the algal oil formulation used in the control group in improving attention. This evidence supports the application of high-concentration DHA fish oil in cognitive health management, demonstrating that a high-concentration DHA formulation improves attention, with its effects increasing over the 90-day intervention period.

1. Introduction

Efficient cognitive function is increasingly crucial in modern society, with attention and concentration as key components. Attention, regulating higher cognition, involves selective orientation, monitoring, and alertness [1]. However, 20-30% of adults experience intermittent attention deficits [2], impacting cognitive function and correlating with disorders [3]. Traditional interventions have limitations. Nutritional interventions, especially Omega-3s (DHA/EPA), are promising for cognitive enhancement due to safety. DHA, a key neuronal component [4] in learning/memory areas [5], boosts neuronal function via PI3K/Akt [6] and regulates inflammation [7]. Clinical trials show Omega-3 benefits [8]. However, attention-focused studies often lack fish oil

vs. algal oil comparisons. This study used Stroop and MTX tests to compare fish and algal oil's differential effects on attention, specifically conflict monitoring and working memory load allocation.

2. Methods

2.1. Experimental Design

This triple-blind, randomized, parallel-arm controlled trial will investigate the effects of fish oil and algal oil with varying DHA concentrations on attention and focus. ≥40 participants will be randomized into two groups: the intervention group receiving Biowell CONCENTRATED FISH OIL (1164mg DHA + 30mg EPA daily) and the control group receiving algal oil (600mg DHA + 600mg EPA daily) for 90 days.

Cognitive assessments (Stroop accuracy & latency, MTX accuracy & reaction time) were conducted online under standardized conditions at baseline (D0), mid-intervention (D30), and post-intervention (D90). Repeated-measures comparisons will analyze intra-group changes and inter-group differences to assess the intervention's temporal effects.

2.2. Subjects

2.2.1. Selection criteria

Study inclusion criteria: (1) Healthy Chinese adults aged 18-60 at study start; (2) Good compliance, able to perform standardized experimental procedures and complete questionnaires accurately; (3) Commitment to a stable daily routine and adherence to the experimental plan; (4) Full understanding and voluntary signed consent; (5) Agreement to discontinue potentially interfering cosmetics, medications, or supplements during the study.

2.2.2. Exclusion criteria

Exclusion criteria: (1) Known allergies or clinical contraindications; (2) Self-reported significant attention or memory deficits; (3) Pregnant, breastfeeding, or perimenopausal women; (4) Other physiological/psychological states affecting evaluation; (5) Participation in other clinical interventions within 2 months; (6) Presence of other interfering factors.

2.2.3. Subject characteristics

Forty-four qualified subjects enrolled, with 1 withdrawal, leaving 43 completing the study (22 intervention, 21 control). Ages ranged 24-55 (mean 40.00±1.87 years). All participants provided written informed consent after detailed explanation of the study (purpose, benefits, risks, rights, obligations), consistent with the Helsinki Declaration's right to unconditional withdrawal.

2.3. Test Methods

2.3.1. Test content

Based on studies [9-11], the Stroop and MemTrax (MTX) tests were used. The Stroop test [12] assesses processing speed, response inhibition, and executive function, reflecting visual search and working memory [13], and is used to evaluate cognitive interference [14], attention, executive function, and deficits in conditions like ADHD [15].

The MemTrax (MTX) online test [16] is a rapid (2-minute) continuous recognition task assessing

information processing, attention, and episodic memory, useful for clinical follow-up [17]. Participants identify 25 target images among 50 (≤3 seconds each) by pressing space bar; accuracy (MTXcorrect) and average response delay (MTXspeed) are recorded. Validity criteria include ≤5 false positives, ≥10 correct identifications, and MTXspeed of 0.4-2 seconds [18].

MemTrax objectively measures episodic memory, reliably identifying memory disorders like amnestic cognitive decline and enabling dynamic monitoring of interventions and disease progression.

2.3.2. Test process

The selected subjects completed the Stroop test and MTX online test under the guidance of the researchers at baseline (day 0). The following data were recorded: Stroop Test accuracy (%), average response delay(s); MTX memory recognition accuracy (%), average response delay(s). Subsequently, the researchers distributed test samples to the subjects and explained in detail the methods and precautions for taking. Subjects adhered strictly to the instructions for product consumption and returned for follow-up assessments on days 30 and 90, where the Stroop test and MTX online test were repeated to record relevant data. All experimental data were used for subsequent analysis to evaluate the effect of supplemental Biowell CONCENTRATED FISH OIL and algal oil on attention and cognitive function.

2.4. Data statistics analysis method

Statistical software was used to perform descriptive statistics for each measurement variable, including calculating the mean, standard error, and other relevant metrics. Subsequently, the percentage change was calculated using the formula:

Percentage Change (%) = [(Mean value after product use - Mean value before product use) / Mean value before product use] * 100%

This calculated percentage change was then used for subsequent data analysis and comparison.

3. Conclusions

3.1. Stroop Test Results

The intervention group (n=22) showed significant Stroop test improvements with Biowell high-concentration fish oil (Table 1). Accuracy increased from 83.73% to 96.91% (+15.74%, p=0.003) at D30 and to 99.15% (+18.42%, p=0.001) at D90. Response delay decreased from 1.62ms to 1.36ms (-16.05%, p=0.020) at D30 and to 1.24ms (-23.46%, p=0.003) at D90.

Table 1. Stroop test results of the test group (22 people).

Test items Statistics	Time point	Statistical description		Change rate	Significance test 1 (vs base value)	
		Mean	Standard Error		P value	Significance
Correct rate (%)	D0	83.73	4.32	/	/	/
	D30	96.91	0.97	15.74%	0.003	**
	D90	99.15	0.28	18.42%	0.001	**
Average response delay (ms)	D0	1.62	0.12	/	/	/
	D30	1.36	0.08	16.05%	0.020	*
	D90	1.24	0.04	23.46%	0.003	**

Note: 1. Interpretation of significance markers: p≥0.05, “n.s.” means no statistical difference; p<0.05, indicating significant difference; where “*” means 0.01≤p<0.05; “**” means 0.001≤p<0.01; “***” means p<0.001. "*" means the differences before and after use are the same.

The control group (n=21) showed minimal Stroop changes (Table 2). At D90, accuracy increased by 0.92% (83.71% to 84.63%), and response delay decreased by 0.11ms (1.61ms to 1.50ms), with only D90 response delay showing borderline significance (p=0.046). Intergroup comparisons (Figures 1) indicated significantly greater improvement in accuracy and reduced response delay in the experimental group compared to the control group.

Table 2. Stroop test results of the control group (21 people).

Test items Statistics	Time point	Statistical description		Change rate	Significance test 1 (vs base value)	
		Mean	Standard Error		P value	Significance
Correct rate (%)	D0	83.71	4.33	/	/	/
	D30	83.73	0.99	0.02%	>0.05	n.s
	D90	84.63	0.27	1.00%	>0.05	n.s
Average response delay (ms)	D0	1.61	0.10	/	/	/
	D30	1.60	0.07	-0.62%	>0.05	n.s
	D90	1.50	0.04	-6.83%	>0.05	n.s

Note: 2. Interpretation of significance markers: p≥0.05, “n.s.” means no statistical difference; p<0.05, indicating significant difference; where “*” means 0.01≤p<0.05; “**” means 0.001≤p<0.01; “***” means p<0.001. "*" means the differences before and after use are the same.

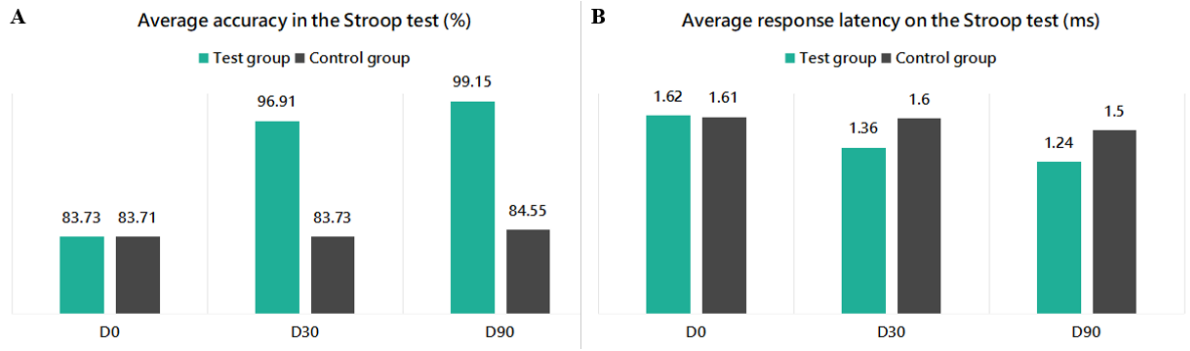

Figure 1. Analysis of the accuracy of the Strup test before and after use

3.2. MTX Multi-task Test Results

The experimental group demonstrated more significant cognitive improvements in the MTX test (Table 3). After 30 days of intervention, the accuracy rate increased from baseline (70.64%) to 84.64% (+19.82%, $p < 0.001$), while the average response delay decreased from 1.14 s to 1.03 s (-9.65%, $p = 0.013$). After 90 days of intervention, the accuracy rate further improved to 88.73% (+25.61%, $p < 0.001$), and the response delay reduced to 0.92 s (-19.30%, $p < 0.001$). All changes in the experimental group were highly significant.

Table 3. MTX online test results of the test group (22 people).

Test items Statistics	Time point	Statistical description		Change rate	Significance test 1 (vs base value)	
		Mean	Standard Error		P value	Significance
Correct rate (%)	D0	70.64	2.31	/	/	/
	D30	84.64	1.46	19.82%	＜0.001	***
	D90	88.73	1.07	25.61%	＜0.001	***
Average response delay(s)	D0	1.14	0.04	/	/	/
	D30	1.03	0.04	-9.65%	0.013	*
	D90	0.92	0.03	-19.30%	＜0.001	***

Note: 3. Interpretation of significance markers: p≥0.05, “n.s.” means no statistical difference; p<0.05, indicating significant difference; where “*” means 0.01≤p<0.05; “**” means 0.001≤p<0.01; “***” means p<0.001. "*" means the differences before and after use are the same.

The control group showed limited improvements in the MTX test (Table 4). At D90, the accuracy rate increased by only 3.73% (D0: 70.59%; D90: 73.22%), and the response delay decreased by 7.96% (D0: 1.13 s; D90: 1.04 s). Only the response delay change at D90 approached borderline significance (p=0.046). Intergroup comparisons (Figures 2) further confirmed that the experimental group exhibited significantly better improvements in cognitive processing speed and memory recognition accuracy compared to the control group.

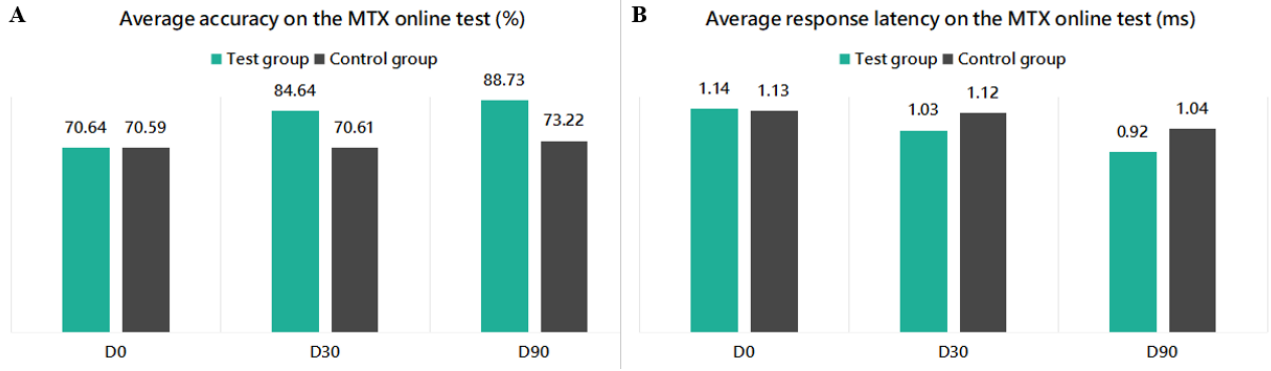

Figure 2. MTX online test accuracy analysis diagram before and after use.

Table 4. MTX online test results of the control group (21 people).

Test items Statistics	Time point	Statistical description		Change rate	Significance test 1 (vs base value)	
		Mean	Standard Error		P value	Significance
Correct rate (%)	D0	70.59	2.33	/	/	/
	D30	70.61	1.42	0.03%	>0.05	n.s
	D90	73.22	1.09	3.73%	>0.05	n.s
Average response delay(s)	D0	1.13	0.03	/	/	/
	D30	1.12	0.04	-0.88%	>0.05	n.s
	D90	1.04	0.03	-7.96%	≥0.046	*

Note: 4. Interpretation of significance markers: p≥0.05, “n.s.” means no statistical difference; p<0.05, indicating significant difference; where “*” means 0.01≤p<0.05; “**” means 0.001≤p<0.01; “***” means p<0.001. "*" means the differences before and after use are the same.

3.3. Baseline Consistency Analysis

At baseline (D0), there were no significant differences between the experimental group and the control group in terms of Stroop test accuracy (experimental group: 83.73%; control group: 83.71%) and MTX test accuracy (experimental group: 70.64%; control group: 70.59%) (p > 0.05). The average response delay metrics also showed baseline consistency (Stroop test: 1.62 ms vs. 1.61 ms; MTX test: 1.14 s vs. 1.13 s), ensuring the reliability of subsequent intervention effect analyses.

3.4. Temporal Effect Analysis

Both groups displayed significant differences over the course of the intervention (Figures 1-2). In the experimental group, Stroop test accuracy and MTX accuracy showed a stepwise increase over the intervention period (improvements of 1.51% from D30 to D90 and 4.09% overall, respectively), while response delay continuously decreased. In contrast, the control group's cognitive metrics showed minimal changes, with Stroop accuracy increasing by only 0.90% from D30 to D90, and the MTX response delay at D90 decreasing by 7.96%, significantly smaller than the improvements observed in the experimental group for both Stroop response delay (23.46%) and MTX response delay (19.30%).

These results suggest that sustained intervention with Biowell high-concentration fish oil (DHA 1164 mg/serving, EPA 30 mg/serving) can significantly enhance attention regulation efficiency and working memory load distribution, with effects strengthening as the intervention period extends.

4. Discussion

This study assessed the short-term (30-day) and long-term (90-day) effects of an intervention on attention (Stroop response delay) and memory (Stroop & MTX accuracy). The experimental group showed significant and sustained improvements in both, suggesting enhanced executive function, attention, and cognitive flexibility, unlike the control group. Stroop test results for the experimental group showed response delay decreases of 16.05% (D30) and 23.46% (D90), and accuracy increases of 15.74% (D30) and 18.42% (D90). MTX test results showed a 9.65% reduction in response delay and a 19.82% increase in accuracy at D30, improving to 19.30% and 25.61% at D90. These benefits likely arise from Biowell CONCENTRATED FISH OIL optimizing PFC function, possibly through a dose-dependent mechanism of Omega-3s (DHA/EPA) increasing synaptic protein and glutamate receptor expression, enhancing neuronal sensitivity and synaptic plasticity. DHA also supports hippocampal NMDA receptor function vital for learning and memory. The superior 90-day results indicate a cumulative effect or neural remodeling. Overall, high-DHA Biowell CONCENTRATED FISH OIL shows potential as a safe and effective supplement for improving reaction speed, memory, and attention in healthy individuals, with no severe side effects reported.

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