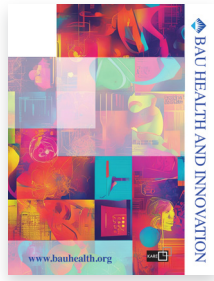
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Original Article

Examination of the Relationship Between Archers' Attention Levels and Nutritional Intakes: A Pilot Study

Ferhan Sude İnce, İrem Nur Şahin Anılgan, Muttalip Ayar

Department of Nutrition and Dietetics, İstanbul Beykent University Faculty of Health Sciences, İstanbul, Türkiye

Abstract

Objectives: Archery performance relies heavily on sustained attention and concentration. This pilot study examined the relationships between attention level, concentration performance (CP), and dietary intakes in adolescent and young adult archers.

Methods: The sample comprised 27 active archers from Istanbul Anka Sports Club (mean age 17.3±3.2 years). Nutritional intake was assessed using a 3-day food consumption record. Attention was evaluated with the d2 Test of Attention, and concentration-related indices were derived. Body composition was estimated by measuring skinfold thickness at three sites (triceps, subscapular, and abdominal), and body fat percentage was calculated accordingly. Data were analyzed using the Statistical Package for the Social Sciences 20.0.

Results: Regarding the general nutritional status of the archers, it was observed that total energy and fluid intakes were generally below the recommended levels for their age groups. A significant negative association was found between attention consistency (FR) and body fat percentage (r=-0.507, p=0.043). Processing speed (TN-E) scores were negatively correlated with protein intake (g/kg) (p=0.035). CP showed significant positive relationships with carbohydrate intake (g/kg) and fiber intake (g) (p<0.05). Vitamin C intake was negatively associated with attention consistency (FR) and specific learning difficulty (E2) (p<0.05).

Conclusion: The findings indicate that nutritional factors and body composition are meaningfully related to attention and concentration metrics in archers. Appropriate, balanced nutrition strategies, particularly regarding macronutrient distribution and fiber intake, may support concentration continuity, whereas higher body fat percentage may be linked to reduced sustained attention. These results offer practical insights for sports nutrition and cognitive performance interventions in archery.

Keywords: Archery, athlete health, attention, cognitive performance, nutrition.

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Archery is a sport that requires a high level of attention, concentration, and fine motor skills. One of the most critical factors determining an athlete's performance is the ability to focus on the target and sustain concentration.[1,2] During shooting, the athlete's capacity to manage psychological pressure, maintain visual-motor coordination, and resist environmental distractions directly influences performance.[3,4] Therefore, attention and concentration are regarded not only as cognitive functions but also as integral components of athletic success.[5]

Sports nutrition plays a crucial role in both the physical and cognitive dimensions of performance. Carbohydrates,

Address for correspondence: İrem Nur Şahin Anılgan, PhD. İstanbul Beykent Üniversitesi Sağlık Bilimleri Fakültesi, Beslenme ve Diyetetik Anabilim Dalı, İstanbul, Türkiye

Phone: +90 536 830 82 85 **E-mail:** nursahin@beykent.edu.tr

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as the primary energy source for the brain, are key determinants in sustaining attention and concentration. Proteins and fats are essential for muscle health, energy metabolism, and neurological function.[6,7] Moreover, vitamins and minerals, particularly antioxidant nutrients such as Vitamins C and E, have been reported to influence mental fatigue and the continuity of attention.[8,9] However, excessive antioxidant supplementation may suppress exercise-induced adaptive processes.[10]

Hydration is another critical factor for cognitive performance. Even mild dehydration has been shown to impair attention, decision-making, and reaction time.[11,12] Savvides et al.[13] emphasized that dehydration negatively affects both performance and subjective perceptions in archery, whereas Esen et al.[14] demonstrated that fluid balance and sleep quality play a decisive role in the performance of elite archers. Such physiological demands and recovery needs may differ between genders; for instance, Esen et al.[14] reported significant sex differences in energy intake, sweating rates, and electrolyte losses among archers. These findings suggest that a sex-specific approach is necessary when evaluating the interplay between nutrition and cognitive performance.

Recent studies have highlighted the close relationship between dietary habits, performance, and attentional processes among archers. For instance, Günay et al.[15] observed improvements in hematological parameters and performance indicators among archers who received nutrition education. Shaari et al.[16] found that competitive anxiety negatively affected attention processes, indicating that psychological variables, along with nutrition, play a substantial role in performance. Despite these insights, the specific relationship between daily dietary intakes, anthropometric characteristics, and attentional processes among young athletes remains insufficiently explored in the literature. Most existing research focuses on elite adult populations, leaving a gap in understanding how spontaneous nutritional choices and body composition relate to cognitive metrics in developing athletes.

In this context, the present study aims to investigate the relationship between attention levels, CP, dietary intake, and anthropometric profiles in young archers. Furthermore, aligned with the need for individualized sports nutrition, this study explicitly aims to evaluate whether these parameters and their relationships exhibit significant sex-based differences. The findings are expected to contribute to the existing literature on sports nutrition and cognitive performance and to provide guidance for developing effective sex-based nutritional strategies for archers in practice.

Materials and Methods

Sample

The study employed a pilot study design using a convenience sampling approach, targeting all active athletes training at the Istanbul Anka Sports Club during the data collection phase. Inclusion criteria required participants to be active licensed archers with a minimum of 1 year of regular training experience and a willingness to participate voluntarily. Conversely, exclusion criteria were defined as having any diagnosed neurological or psychiatric disorders, utilizing medications that might influence cognitive functions or attention levels, or providing incomplete dietary records. Based on these criteria, the final study sample comprised 27 athletes (20 females and 7 males) aged between 13 and 21 years.

Ethical approval was obtained from the Non-interventional Clinical Research Ethics Committee of İstanbul Beykent University (Approval No: E-45778635–050.99–180002; Date: February 27, 2025). Written informed consent was obtained from all participants and, for those under 18 years of age, from their legal guardians. The study was carried out in accordance with the principles of the Declaration of Helsinki.

Data Collection Process

The research was conducted between February and April 2025, corresponding to the active competition season for the athletes. At the beginning of the study, participants' age was recorded, and height and body weight were measured. Each athlete completed a personal information form and a voluntary participation consent form. To assess dietary habits, a 3-day food consumption record (2 weekdays and 1 weekend day) was collected from each participant. Attention levels were measured using the d2 Test of Attention. All measurements and assessments were conducted at the facilities of the Istanbul Anka Archery Club.

Data Collection Instruments

Anthropometric Measurements

Participants' height (cm) was measured using a stadiometer (SECA, Germany), and body weight (kg) was measured with a digital scale (Tanita BC730, Japan). Body mass index was calculated using the formula (kg/m^2). Skinfold thickness was measured at the triceps, subscapular, and abdominal sites using a Holtain skinfold caliper to estimate body composition. Body fat percentage was estimated using the Lohman (1981) equation, which is appropriate for this age group.[17] Waist and hip circumferences were measured with a non-elastic measuring tape. All anthropometric measurements

were conducted by the primary researcher before the start of daily training sessions to ensure standardized conditions.

Assessment of Attention Level (d2 Test)

To measure participants' selective attention and concentration levels, the d2 Test of Attention,[18] originally developed by Brickenkamp and Zillmer and whose Turkish validity and reliability study was previously conducted,[19] was administered to the athletes. The test was conducted in a quiet environment under standardized instructions, and a stopwatch was used to ensure timing accuracy. The test consists of 14 lines, each containing the letters "p" and "d." Participants were given 20 s to complete each line.

The scores obtained from the test reflect both quantitative and qualitative aspects of attention performance. The total number of processed items (TN) represents the total number of items marked and indicates psychomotor speed. Total errors (E) include both incorrectly marked items (E2) and omitted correct items (E1). The error percentage (%E) expresses the ratio of errors within the total number of processed items; a lower error rate reflects higher accuracy and quality of attention. The total performance score (TN-E) is calculated by subtracting the total number of errors from the total number of processed items, representing both speed and accuracy components of attention performance. This score highlights the quantitative aspect of performance and typically follows a normal distribution. Concentration performance (CP) is calculated by subtracting E2 from the correctly marked target items and is largely independent of random marking or skipped lines. The attention consistency (FR) indicates the difference between the line with the highest and lowest number of processed items; higher FR values are associated with inconsistency in processing speed or reduced motivation. The TN-E scores were used to determine the overall level of attention performance, classified as follows: 50–60% (low), 60–70% (moderate), 70–85% (normal), and above 85% (very good).[20]

Assessment of Nutritional Habits

To evaluate the nutritional status of the athletes, 3-day dietary intake records (2 weekdays and 1 weekend day) coinciding with the athletes' active training days were collected. Total daily fluid intake was calculated based on these records; however, physiological fluid losses during training or competition (e.g., sweat rate) were not objectively measured. Before the recording period, participants and their guardians were provided with detailed oral and written instructions by the researchers on accurate food recording. Portion sizes were estimated using a standardized photographic food atlas to minimize reporting errors. Participants recorded all foods and beverages consumed, categorized by meal, and the records were reviewed together with the researchers to ensure accuracy. The data were analyzed using the Nutrition Information System (BeBiS) software to determine daily energy intake as well as macro- and micronutrient consumption.[21] In addition, total fluid intake and meal frequency patterns were evaluated. It is important to note that these dietary records are intended to reflect intake patterns and are not, by themselves, sufficient to define the participants' overall nutritional status. The analysis specifically focused on omega-3 fatty acids, tryptophan, and caffeine due to their established roles in neurological function, neurotransmitter synthesis, and the regulation of alertness and attention, which are critical for archery performance. Meal frequency was not included in the final analysis to maintain focus on nutrient density and its relationship with cognitive metrics.

Statistical Analysis

Data obtained from the study were analyzed using the Statistical Package for the Social Sciences version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as mean±standard deviation and minimum-maximum values. The normality of data distribution was assessed using the Shapiro–Wilk test. For group comparisons based on sex, the independent sample t-test was used for normally distributed data, whereas the Mann–Whitney U test was applied for variables showing non-normal distribution. Relationships between variables were analyzed using Spearman's correlation test. A significance level of $p<0.05$ was adopted for all statistical analyses.

Results

The mean age of the participants was 16.3±2.0 years. The mean age of female athletes was 16.1±1.7 years, whereas that of male athletes was 17.3±3.2 years; the difference was not statistically significant ($p=0.345$). The participants had a mean sports experience of 3.2±1.1 years. The athletes followed a structured training program consisting of an average of 12±2.5 h of practice per week.

The anthropometric characteristics and demographic data of the archers are presented in Table 1. While most parameters showed no significant differences between sexes, males exhibited significantly higher values in height ($p<0.001$), waist circumference ($p=0.001$), and biceps circumference ($p=0.043$) compared to females. Despite these physical differences, body fat percentage was found to be similar across both groups ($p=0.676$).

Table 1. Anthropometric and demographic characteristics of archers according to sex

Variables	Total (n=27) Mean±SD (Min-Max)	Female (n=20) Mean±SD (Min-Max)	Male (n=7) Mean±SD (Min-Max)	p
Age (years)	16.3±2.0 (13.0-21.0)	16.1±1.7 (13.0–20.0)	17.3±3.2 (14.0–21.0)	0.345
Experience (years)	3.2±1.1 (1.0–5.0)	3.1±1.0 (1.0–5.0)	3.5±1.4 (2.0–5.0)	0.420
Body weight (kg)	56.3±9.6 (42.3–82.4)	53.7±6.7 (42.3–68.8)	70.4±11.4 (59.8–82.4)	0.258
Height (cm)	164.9±9.2 (154.0–187.0)	161.7±4.7 (154.0–170.0)	182.3±8.1 (173.0–187.0)	0.000**
Waist circumference (cm)	70.4±7.9 (60.0–91.0)	68.2±5.6 (60.0–80.0)	82.7±8.0 (75.0–91.0)	0.001**
Hip circumference (cm)	94.6±5.3 (82.8–106.0)	93.8±4.9 (82.8–102.0)	99.2±6.0 (95.0–106.0)	0.108
Biceps circumference (cm)	26.1±2.1 (23.0–30.5)	25.7±1.9 (23.0–29.0)	28.3±2.0 (26.5–30.5)	0.043*
Calf circumference (cm)	32.0±2.7 (28.0–40.0)	31.9±2.9 (28.0–40.0)	32.3±1.5 (31.0–34.0)	0.826
Subscapular skinfold (mm)	13.0±3.4 (7.8–21.8)	12.7±2.8 (7.8–18.2)	14.7±6.3 (10.0–21.8)	0.380
Triceps skinfold (mm)	14.0±3.6 (8.8–17.6)	16.8±3.2 (12.0–23.6)	14.1±4.7 (8.8–17.6)	0.232
Abdominal skinfold (mm)	13.8±4.1 (7.8–21.8)	13.3±4.1 (7.8–21.8)	16.3±4.2 (11.6–19.8)	0.258
Body fat percentage (%)	15.4±2.4 (11.6–19.0)	15.3±2.2 (12.6–18.9)	16.0±3.9 (11.6–19.0)	0.676

Independent Samples t–test was used. *: p<0.05, **: p<0.01. SD: Standard deviation, Min: Minimum, Max: Maximum.

Analysis of energy and nutrient intakes revealed that male athletes had significantly higher intakes of Vitamin A, carotene, Vitamin K, calcium, and iron compared with females (p<0.05). Although water intake was higher among males, the difference was not statistically significant (p=0.056). When assessed against age- and sex-specific recommended daily allowances (RDA) for the 13–21 age range, it was determined that the majority of both male and female athletes had suboptimal total energy and fluid intakes. This observation suggests a general trend of inadequate dietary consumption regardless of the specific developmental stage within the sample (Table 2).

Attention levels were evaluated using the d2 Test of Attention. The results indicated no statistically significant sex differences in TN, E1, E2, TN-E, CP, or FR (p>0.05). Although the CP scores of male athletes were notably higher than those of female athletes, the difference did not reach statistical significance (Table 3).

A significant negative correlation was found between FR and body fat percentage (r=-0.507; p=0.043). No significant correlations were observed between other attention parameters and anthropometric measurements (Table 4).

A significant negative correlation was found between TN-E and protein intake (g/kg) (p=0.035). CP showed a positive relationship with carbohydrate intake (g/kg) (p=0.023) and fiber intake (g) (p=0.009). No other significant relationships were found between energy or macronutrient intake and attention parameters (Table 5).

Regarding micronutrient intake, a significant negative correlation was found between Vitamin C intake and both FR and E2 (p=0.034). This finding suggests that higher Vitamin C intake may be associated with fluctuations in attention performance within this specific sample (Table 6).

Discussion

This pilot study utilized an in-person, cross-sectional design to investigate the potential relationships between dietary intakes, anthropometric characteristics, and attention levels in young archers. The findings revealed that athletic performance in archery is closely associated not only with physical but also with cognitive factors. The results of this study indicate that a significant proportion of the archers in our sample do not meet their required energy and nutrient targets. A critical finding is the widespread suboptimal dietary intake observed across the participants when compared to the age- and sex-specific RDA. Specifically, the mean energy intake (1593.3±359.2 kcal) was notably lower than the metabolic requirements for active adolescents and young adults, who face high demands to support both physical growth and intensive training loads. This persistent energy deficit, particularly during training seasons, was not limited to macronutrients; micronutrient intakes, most notably calcium and iron in female archers, were also found to be below the recommended thresholds. Such nutritional deficiencies are particularly concerning, as they may potentially impact not only physical development and physiological recovery but also cognitive functions and overall athletic performance. Consequently, these data suggest that the archers' current dietary patterns may not fully support the high cognitive demands of their sport, providing a solid, evidence-based foundation for the observed associations between nutritional factors and attention metrics.

Table 2. Energy, nutrient, and caffeine intakes of archers according to sex

Variables	Total (n=27) Mean±SD (Min–Max)	Female (n=20) Mean±SD (Min–Max)	Male (n=7) Mean±SD (Min–Max)	p
Energy (kcal)	1593.3±359.2 (1093.1–2545.1)	1545.6±372.8 (1093.1–2545.1)	1847.9±56.2 (1815.5–1912.9)	0.188
Water (mL)	891.3±319.5 (458.2–1505.7)	831.4±294.2 (458.2–1505.7)	1210.9±296.1 (869.0–1381.8)	0.056
Protein (g)	64.1±13.5 (46.1–83.9)	62.8±14.2 (46.1–83.9)	70.9±7.5 (62.3–75.2)	0.308
Protein (% energy)	17.0±3.9 (12.0–28.0)	17.2±4.3 (12.0–28.0)	16.0±1.7 (14.0–17.0)	0.647
Protein (g/kg)	1.2±0.3 (0.7–1.8)	1.2±0.3 (0.7–1.8)	1.0±0.1 (0.9–1.1)	0.372
Carbohydrate (g)	180.4±65.5 (110.1–408.2)	176.6±71.0 (110.1–408.2)	201.2±4.7 (195.8–203.9)	0.565
Carbohydrate (% energy)	46.1±9.1 (30.0–66.0)	46.3±10.0 (30.0–66.0)	45.0±1.7 (43.0–46.0)	0.827
Carbohydrate (g/kg)	3.2±1.3 (1.6–7.6)	3.4±1.4 (1.6–7.6)	2.9±0.4 (2.5–3.3)	0.599
Fat (g)	66.5±21.9 (34.9–104.8)	63.8±22.7 (34.9–104.8)	80.8±8.8 (75.7–90.9)	0.228
Fat (% energy)	37.0±8.8 (21.0–52.0)	36.6±9.5 (21.0–52.0)	39.0±3.5 (37.0–43.0)	0.681
Fiber (g)	16.5±6.5 (9.7–36.5)	15.8±6.7 (9.7–36.5)	19.8±5.4 (13.8–22.9)	0.352
Vitamin A (µg RE)	881.7±453.9 (111.8–1781.2)	774.7±412.1 (111.8–1781.2)	1452.6±9.3 (1447.2–1463.4)	0.013*
Carotene (mg)	2.0±1.3 (0.2–4.6)	1.7±1.0 (0.2–4.1)	3.7±1.6 (1.8–4.6)	0.013*
Vitamin D (µg)	3.3±3.7 (0.2–12.0)	2.6±3.5 (0.2–12.0)	6.7±3.6 (2.6–8.8)	0.081
Vitamin E (mg)	13.1±6.7 (3.2–28.5)	12.6±7.1 (3.2–28.5)	16.1±2.8 (14.4–19.4)	0.426
Vitamin K (µg)	302.4±126.0 (123.0–584.1)	266.4±84.1 (123.0–455.7)	494.5±155.3 (315.2–584.1)	0.001**
Vitamin B1 (mg)	0.7±0.2 (0.4–1.2)	0.6±0.2 (0.4–1.2)	0.7±0.1 (0.5–0.8)	0.866
Vitamin B2 (mg)	0.9±0.3 (0.6–1.5)	0.9±0.3 (0.6–1.5)	1.1±0.2 (0.9–1.2)	0.448
Vitamin B3 (mg)	11.0±3.5 (5.6–17.9)	10.8±3.7 (5.6–17.9)	12.5±1.4 (10.9–13.3)	0.450
Vitamin B6 (mg)	1.1±0.2 (0.6–1.5)	1.1±0.2 (0.6–1.5)	1.2±0.0 (1.2–1.3)	0.240
Folate (µg)	86.9±28.8 (25.4–157.5)	84.6±30.4 (25.4–157.5)	99.2±16.0 (80.7–108.4)	0.436
Vitamin B12 (µg)	3.2±1.6 (0.6–6.5)	3.3±1.7 (0.6–6.5)	2.4±0.1 (2.4–2.6)	0.416
Vitamin C (mg)	71.5±35.4 (4.2–125.6)	66.5±34.1 (4.2–125.6)	98.0±36.3 (56.1–118.9)	0.163
Sodium (mg)	3344.7±1125.8 (1534.3–5585.8)	3098.4±875.7 (1534.3–5419.5)	4658.1±1606.8 (2802.8–5585.8)	0.023*
Potassium (mg)	1837.5±439.4 (1059.9–2901.2)	1785.7±445.8 (1059.9–2901.2)	2113.7±332.2 (1728.9–2306.1)	0.246
Calcium (mg)	609.6±365.7 (151.2–1326.6)	516.1±287.0 (151.2–1292.5)	1108.4±377.9 (619.7–1326.6)	0.006**
Magnesium (mg)	220.9±56.2 (124.9–327.4)	215.6±55.4 (124.9–327.4)	249.2±63.0 (176.4–285.6)	0.356
Iron (mg)	10.5±3.6 (6.5–17.5)	9.7±2.7 (6.5–16.7)	14.4±5.4 (8.2–17.5)	0.030*
Zinc (mg)	7.7±2.0 (4.7–12.3)	7.7±2.1 (4.7–12.3)	8.1±1.4 (6.5–8.9)	0.724
Omega-3 (g)	2.0±1.3 (0.5–5.7)	1.9±1.4 (0.5–5.7)	2.1±0.8 (1.7–3.0)	0.828
Tryptophan (mg)	709.0±145.4 (468.0–947.1)	694.8±153.4 (468.0–947.1)	784.9±59.7 (716.0–819.3)	0.339
Caffeine (mg)	14.6±26.2 (0–93.3)	16.9±28.0 (0–93.3)	2.2±3.9 (0–6.7)	0.388

An independent samples t-test was used. *: p<0.05, **: p<0.01. SD: Standard deviation, Min: Minimum, Max: Maximum.

Table 3. Evaluation of D2 attention test results of archers according to sex

Variables	Total (n=27) Mean±SD (Min-Max)	Female (n=20) Mean±SD (Min-Max)	Male (n=7) Mean±SD (Min-Max)	p
TN	456.7±86.8 (309.0–596.0)	462.4±90.5 (309.0–596.0)	426.3±68.7 (364.0–500.0)	0.524
E1	58.6±36.7 (5.0–126.0)	62.3±37.4 (5.0–126.0)	39.3±30.9 (6.0–67.0)	0.335
E2	12.2±12.4 (0.0–52.0)	13.1±13.3 (0.0–52.0)	7.0±2.6 (5.0–10.0)	0.447
E (%)	15.1±9.2 (3.0–37.4)	14.2±9.0 (3.0–37.4)	19.6±10.6 (12.6–31.8)	0.370
TN-E	385.9±76.9 (248.0–569.0)	387.1±81.6 (248.0–569.0)	380.0±56.6 (342.0–445.0)	0.889
CP	119.8±43.7 (21.0–237.0)	116.1±46.1 (21.0–237.0)	139.3±23.6 (121.0–166.0)	0.414
FR	17.7±12.6 (3.0–55.0)	19.0±13.1 (4.4–55.0)	10.5±7.3 (3.0–17.6)	0.299

SD: Standard deviation, Min: Minimum, Max: Maximum, TN: Psychomotor speed, E1: Selective attention, E2: Specific learning difficulty, E (%): Error percentage, TN-E: Processing speed, CP: Concentration performance, FR: Attention consistency.

Table 4. Relationship between D2 test subdimensions and anthropometric characteristics

Variables	Body weight	Waist circumference	Body fat percentage
TN	r=0.165 p=0.499	r=0.125 p=0.609	r=-0.009 p=0.972
E1	r=-0.201 p=0.388	r=-0.104 p=0.673	r=-0.271 p=0.263
E2	r=-0.182 p=0.456	r=-0.367 p=0.122	r=-0.005 p=0.982
TN-E	r=0.316 p=0.188	r=0.250 p=0.302	r=0.124 p=0.614
CP	r=0.136 p=0.578	r=0.217 p=0.372	r=-0.076 p=0.759
FR	r=-0.409 p=0.082	r=-0.403 p=0.087	r=-0.507 p=0.043*

Spearman correlation coefficient (r). *: p<0.05 indicates statistical significance. TN: Psychomotor speed, E1: Selective attention, E2: Specific learning difficulty, E (%): Error percentage, TN-E: Processing speed, CP: Concentration performance, FR: Attention consistency.

The negative correlation observed between FR and body fat percentage (r=-0.507, p=0.043) represents a moderate-to-strong effect size. This finding suggests that body composition may be a factor in explaining a portion of the variance in attentional consistency among archers. Similarly, the positive correlations found between CP and carbohydrate intake (r=0.519) and fiber intake (r=0.581) also reflect moderate effect sizes. These values indicate that dietary intake appeared to have a meaningful association with cognitive stability during performance. By focusing on these effect sizes rather than just statistical significance, it becomes clearer that dietary interventions targeting macronutrient balance could offer tangible benefits for an archer's mental focus. Similarly, Ates et al.[22] reported that a lower fat percentage was associated with better attention performance in physically active children. Considering that performance accuracy in archery can depend on millimeters, it may be inferred that

Table 5. Relationship between D2 attention test subdimensions and nutritional intakes

Variables	Energy (kcal)	Protein (g/kg)	Carbohydrate (g/kg)	Fiber (g)	Omega-3 (g)	Water (mL)	Caffeine (mg)	Tryptophan (mg)
TN	r=0.266 p=0.271	r=-0.205 p=0.399	r=0.217 p=0.371	r=0.064 p=0.795	r=0.199 p=0.413	r=-0.283 p=0.240	r=-0.283 p=0.241	r=-0.124 p=0.613
E1	r=0.311 p=0.195	r=0.422 p=0.072	r=0.397 p=0.092	r=0.12 p=0.616	r=0.236 p=0.330	r=-0.121 p=0.623	r=0.063 p=0.797	r=0.281 p=0.243
E2	r=0.015 p=0.951	r=0.327 p=0.172	r=0.010 p=0.968	r=-0.212 p=0.384	r=0.367 p=0.123	r=-0.399 p=0.091	r=-0.004 p=0.986	r=0.269 p=0.265
TN-E	r=0.149 p=0.542	r=-0.485 p=0.035*	r=0.054 p=0.826	r=0.047 p=0.847	r=0.053 p=0.829	r=-0.198 p=0.417	r=-0.348 p=0.144	r=-0.317 p=0.186
CP	r=0.149 p=0.542	r=-0.046 p=0.852	r=0.519 p=0.023*	r=0.581 p=0.009*	r=0.045 p=0.855	r=0.174 p=0.475	r=-0.015 p=0.951	r=0.020 p=0.935
FR	r=-0.164 p=0.502	r=0.372 p=0.117	r=0.126 p=0.607	r=-0.065 p=0.790	r=-0.019 p=0.938	r=-0.213 p=0.381	r=0.108 p=0.661	r=0.124 p=0.612

Spearman correlation coefficient (r). *: p<0.05 indicates statistical significance.

Table 6. Relationship between D2 test subdimensions and selected micronutrient intakes

Variables	Magnesium	Iron	Vitamin C	Vitamin A	Vitamin E	Vitamin B6	Folate	Vitamin B12
TN	r=0.067 p=0.784	r=0.032 p=0.895	r=-0.082 p=0.738	r=-0.231 p=0.340	r=0.025 p=0.918	r=0.019 p=0.938	r=-0.083 p=0.735	r=-0.015 p=0.952
E1	r=0.297 p=0.217	r=0.243 p=0.316	r=-0.443 p=0.058	r=-0.138 p=0.573	r=-0.122 p=0.619	r=0.074 p=0.762	r=0.023 p=0.925	r=0.161 p=0.509
E2	r=0.097 p=0.694	r=-0.104 p=0.673	r=-0.488 p=0.034*	r=-0.181 p=0.458	r=0.421 p=0.073	r=0.002 p=0.994	r=-0.235 p=0.333	r=0.133 p=0.587
TN-E	r=-0.081 p=0.740	r=-0.063 p=0.799	r=0.197 p=0.419	r=-0.166 p=0.497	r=0.019 p=0.939	r=-0.014 p=0.955	r=-0.067 p=0.955	r=-0.115 p=0.639
CP	r=0.306 p=0.202	r=0.299 p=0.213	r=0.027 p=0.913	r=-0.119 p=0.628	r=0.385 p=0.103	r=0.401 p=0.089	r=-0.031 p=0.899	r=-0.442 p=0.058
FR	r=-0.033 p=0.893	r=-0.117 p=0.633	r=-0.488 p=0.034*	r=-0.162 p=0.507	r=-0.224 p=0.356	r=-0.141 p=0.565	r=-0.235 p=0.334	r=0.184 p=0.452

Spearman correlation coefficient (r). *: p<0.05 indicates statistical significance.

body fat percentage is critical not only for physical agility but also for mental stability.

Regarding the sex-based differences found in our results, males exhibited significantly higher intakes of certain micronutrients and different anthropometric profiles compared to females. To our knowledge, these findings represent a novel contribution, as sex-specific dietary patterns in young archers are rarely addressed in the literature. These differences highlight the need for sex-based nutritional strategies even when cognitive outputs remain similar between sexes.

The negative correlation found between TN-E and protein intake represents a rare and noteworthy finding in the existing literature. While protein intake is well known to play an essential role in maintaining muscle function, supporting recovery processes, and preserving immune function,[6,23] this inverse association appeared to be linked to an imbalance in overall energy consumption within our sample. Specifically, reduced carbohydrate intake may be associated with fluctuations in the brain's primary energy source, which could indirectly relate to cognitive functioning. Thus, the observed relationship is more likely a reflection of an imbalance between macronutrients rather than a direct negative effect of protein. Esen et al.[14] similarly emphasized that disproportionate macronutrient consumption may be associated with fluctuations in cognitive performance. Nevertheless, some studies have proposed that high-quality protein intake can enhance attention and cognitive performance.[8] Therefore, the timing and quality of protein intake may also play a crucial role in sustaining optimal attention levels.

The positive correlations observed between CP and both carbohydrate and fiber intake further support this interpretation. Carbohydrates are the brain's principal energy substrate, and insufficient intake has been linked to reduced concentration and mental fatigue.[7,24] Fiber intake, on the other hand, is potentially related to cognitive stability by improving glycemic control and may support brain function via the gut–brain axis.[9]

The negative associations between Vitamin C intake and both FR and specific learning difficulty indicate that antioxidant intake does not necessarily enhance performance. High levels of antioxidant supplementation may suppress exercise-induced oxidative stress and consequently hinder adaptive physiological processes.[10,25] Therefore, in young athletes, the indiscriminate use of vitamin and mineral supplements should be approached cautiously, as excessive intake may be counterproductive. This outcome underscores the importance of "balance" and "individualized supplementation" principles in sports nutrition. Although no significant associations were found between omega-3 fatty acid or water intake and attention parameters, certain trends were observed. Previous studies have consistently demonstrated that hydration plays a crucial role in cognitive performance.[11,12] Savvides et al.[13] reported that dehydration negatively affects archery performance, whereas Esen et al.[14] identified fluid intake during competition as a key determinant of elite archers' performance. Moreover, Esen and Goodall[14] documented sex-based differences in sweating rate and electrolyte loss, highlighting the need for individualized hydration strategies among athletes. Omega-3 fatty acids have also been associated with cognitive function and attention in previous research.[9,26] However, the absence of significant findings in the present study may be attributable to both the small sample size and the generally low omega-3 intake among young athletes.

The psychological dimension of these findings requires cautious interpretation. While our results appear to align with studies by Shaari et al.[16] and Wang et al.,[4] who linked attention to anxiety and resilience, it must be clarified that our study did not directly measure psychological processes. Therefore, the suggestion that nutrition-supported attention serves as a mechanism for psychological regulation remains a tentative interpretation and should be viewed as a hypothesis for future research.

Overall, this research indicates that cognitive performance in archers is closely linked to the triad of balanced nutrition, adequate hydration, and optimal body composition. The findings are consistent with the recommendations of Thomas et al.[6] and the most recent position stand of the International Society of Sports Nutrition regarding exercise and sports nutrition.[7]

Study Limitations

This study possesses a novel focus as a pilot investigation into the diet-cognition relationship specifically within the under-researched population of young archers, providing practical insights for individualized coaching. However, several limitations must be acknowledged. First, the relatively small sample size of 27 athletes restricts the generalizability of the findings. Since the research was conducted exclusively with archers from the Istanbul Anka Sports Club, the results may not be directly applicable to different age groups, sports disciplines, or larger athletic populations. Furthermore, there is a notable sex imbalance in the sample (n=20 females vs. n=7 males), which makes the sex-based comparisons less robust.

Second, the assessment of dietary intake was based on a 3-day food record. While this method is valuable for reflecting short-term energy and nutrient intake, it may not fully represent participants' long-term dietary habits. The short recording period also introduces potential variability due to day-to-day differences in food consumption. Furthermore, while fluid intake was recorded, the absence of objective measurements for fluid losses (e.g., sweat rate) limits the assessment of the participants' overall hydration dynamics during high-intensity archery training.

Finally, the study employed a cross-sectional design. Although it identified associations between nutritional status and attention performance, causal inferences cannot be drawn. Future studies using longitudinal or experimental designs are needed to establish the direction and mechanisms of these relationships.

Conclusion

This pilot study highlights that nutritional intake and body composition are meaningfully associated with cognitive performance metrics in young archers. The findings suggest that higher carbohydrate and fiber intakes are linked to better concentration performance, while a lower body fat percentage appears to be related to greater attention consistency. However, it is essential to interpret these findings with caution, as a cross-sectional study, these results indicate correlations rather than definitive causal or adverse effects. For instance, the observed negative associations involving protein and Vitamin C intake should be viewed as indicators of potential macronutrient imbalances within this specific sample rather than direct negative impacts on focus. Given the prevalent dietary inadequacies identified relative to RDA standards, developing individualized nutrition strategies that ensure energy balance and nutrient density may serve as a supportive tool for optimizing the cognitive demands of archery. Future longitudinal research is needed to clarify further the physiological mechanisms underlying these associations.

Disclosures

Ethics Committee Approval: The study was approved by the İstanbul Beykent University Non-interventional Clinical Research Ethics Committee (no: E-45778635–050.99–180002, date: 27/02/2025).

Informed Consent: Written informed consents were obtained from patients who participated in this study.

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