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The Effect of Fish Oil Supplementation on Body Composition and Strength in a Young, Athletic Population

Case Study

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Abstract

Introduction: To investigate the effects of fish oil (FO) supplementation on body composition and strength in young, athletic individuals.

Methods: Six, division I athletes/competitive cheerleaders (age 20.2 [1.8], height 169.4 [9.8] cm, weight 71.0 [13.7] kg) were enrolled and completed the study. The participants were divided into two groups: 1) 3.2g/d FO or 2) 3g/d safflower oil (placebo [PL]). Body composition (body mass, lean body mass [LBM], and fat mass [FM]) via dual energy x-ray absorptiometry and upper-body strength via hand grip dynamometer was assessed at baseline and after 4-weeks. Participants provided three-day food records before and after the supplementation period. Dependent sample *t*-tests were used to determine within group differences. Repeated measures ANOVA was used to determine group by time interactions. Statistical significance was set at $p < 0.05$.

Results: FO supplementation increased LBM by 1.36kg (Pre: 52.49kg, Post: 53.85kg) whereas the PL group lost 0.9kg LBM (Pre: 53.42kg, Post: 52.50kg) (p=0.035). Upper-body strength increased in the FO group by 0.98kg (Pre: 39.43kg, Post: 40.41kg) and decreased in the PL group by 2.02kg (Pre: 35.03kg, Post: 33.01kg) (p =0.131).

Conclusions: Four-weeks of FO supplementation (3.2g/d) improved body composition but did not significantly improve strength in a young athletic population. Future trials need to be conducted to replicate our findings before definitive conclusions can be reached.

Key Words: omega-3 polyunsaturated fatty acids, lean body mass, athletes

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Introduction

It has been suggested that omega-3 polyunsaturated fatty acid (PUFA) supplementation may promote hypertrophy and strength. Human studies have shown that fish oil-derived PUFA supplementation, consisting of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), augments muscle protein synthesis (MPS) in response to amino acid and insulin infusions independent of anti-inflammatory activity.[1,2] Subsequent trials supported this concept and highlighted the ability of fish oils (FO) to enhance lean body mass (LBM)[3] and strength[4] in older adults. To date, most studies examining the effects of FO supplementation on LBM and strength have used samples of elderly participants, those with comorbidities, or non-athletes.[3,5] A recent systematic review determined that the relationship between FO supplementation and the promotion of LBM or strength is unclear and warrants further study.[6] Additionally, since 2019, the NCAA has allowed schools to provide omega-3 PUFAs to student-athletes; however, an appropriate dose has not been established for skeletal muscle outcomes. The purpose of this study was to determine if FO supplementation improves body composition and strength in a young, athletic sample.

Methods

Participants

Six healthy young male (n=3) and female (n=3) division 1 athletes and competitive cheerleaders volunteered to participate in this study (FO group, n=3; Placebo [PL] group, n=3). Participants were screened and excluded if they had taken an ergogenic aid within the past month or had any medical conditions that limited training. The study was approved by the University's Institutional Review Board. Written informed consent was obtained from each participant.

Protocol

Participants were randomly assigned by a computer-generated sequence to either 3.2g/d FO (1.625g EPA, 1.125g DHA) (Nordic Naturals; Watsonville, CA) or 3.0g/d safflower oil (Dymatize Enterprises, Dallas, TX) for 4 weeks (range 20-40 days) in a double-blinded manner and gender matched. Participants were instructed to maintain consistent dietary and exercise habits throughout the study. Baseline assessments were collected on week 1 and at the end of the study at the same time of day.

Height was assessed using a stadiometer in stocking feet and weight was obtained using a calibrated scale in light clothing and stocking feet. Body composition was estimated using the Hologic Discovery Series W Dual Energy X-ray Absorptiometry (DEXA) (Waltham, MA). Upper body strength was assessed by handgrip strength (HGS) using a dynamometer (Hydraulic Hand Dynamometer, Baseline® Evaluation Instruments). Participants provided three-day food records before and after supplementation. ESHA Food Processor Software (Version 11.1) was used to report total values of calories, protein, carbohydrates, and fats for further analysis.

Statistical Analysis

An ANOVA was used to determine any group by time interactions and dependent samples *t*-tests was used to assess within group differences. Shapiro-Wilk tests and boxplots indicated that the variables were normally distributed. SAS software (v. 9.4) was used for statistical analysis. The significance level was set *a priori* at $p < 0.05$.

Results

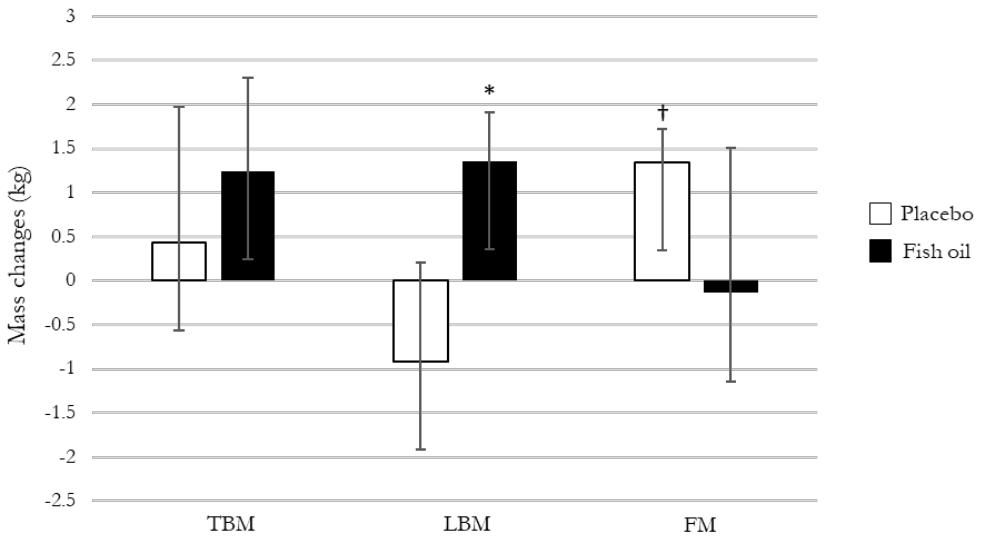
The participants' physical characteristics are presented in Table 1. (FO group, 2 females and 1 male; PL group, 2 females, 1 male). Pre-intervention characteristics were similar between groups ($p>0.05$).

Table 1. Baseline characteristics of participants

	Fish Oil (n=3)	Placebo (n=3)
Age, years	19.3±1.5	21.0±2.0
Sex, n		
Male	1	1
Female	2	2
Height (cm)	172.3±14.5	167.0±1.7
Body mass (kg)	72.0±16.1	70.0±14.4
BMI (kg/m²)	25.8±5.3	23.4±1.0
Body fat (%)	23.0±7.5	22.6±8.2

Values expressed as mean±SD. Abbreviations: BMI, body mass index

Both the FO and PL groups gained mass during the study (Figure 1). The FO group primarily gained lean mass, while the PL group primarily gained fat mass. There was a significant group by time interaction effect on lean mass $F(1,4)=9.93$, $p=0.035$.



Values are reported as means ± SD.
*, Significant difference between groups (p = 0.035).
†, Significant difference compared to baseline (p = 0.026).

Figure 1. Total body mass (TBM), lean body mass (LBM) and fat mass (FM) changes after four weeks of safflower oil (placebo) or fish oil supplementation.

The mean HGS non-significantly increased in the FO group and decreased in the PL group (Table 2). Dietary records were available for 5 of the 6 participants (PL, n=2; FO, n=3). The PL and FO groups both increased caloric intake during the study and all macronutrient variables were similar between groups (p>0.05) (Table 2).

Table 2. Strength and dietary changes

	Placebo		Fish oil		
	PRE	POST	PRE	POST	*G x T p*-value
HGS (kg)	35.0 ± 8.1	33.0 ± 7.1	39.4 ± 15.58	40.4 ± 15.26	0.131
Calories (kcals)	1863.1 ± 150.7	2258.1 ± 408.0	1870.2 ± 347.2	2070.6 ± 624.1	0.818
CHO intake (g)	220.9 ± 2.3	283.3 ± 90.6	240.1 ± 55.1	252.5 ± 78.7	0.537
PRO intake (g)	78.6 ± 28.3	100.2 ± 58.9	63.2 ± 11.8	87.7 ± 10.4	0.908
FAT intake (g)	73.9 ± 30.3	80.4 ± 21.1	66.0 ± 13.2	78.9 ± 31.2	0.759

Abbreviations: G x T, group x time; HGS, hand grip strength; CHO, carbohydrate; PRO, protein
Values are reported as mean ± standard deviation, rounded to the nearest tenth

Discussion

The main finding of this preliminary investigation was that 4-weeks of 3.2g/d FO supplementation was associated with a 1.36 kg (2.6%) increase in LBM and a 0.14 kg (0.9%) decrease in FM. Conversely, the PL group experienced a 0.92 kg (1.7%) decrease in LBM and a 1.34 kg (8.3%) increase in FM. Although both groups gained mass, the FO group uniquely gained LBM, which validates mechanistic data suggesting that EPA+DHA can increase MPS, especially since both groups increased calorie and protein intake.[1,2] Our results align with previous findings in young adult populations. Noreen et al[7] observed a significant 0.50 kg increase in LBM and a 0.50 kg reduction in FM after 6 weeks of FO (4g/d) supplementation. Couet et al[8] reported a significant 0.88 kg reduction in FM after only three weeks of supplementation, while LBM increased non-significantly by 0.20 kg. Smith[9] suggested a minimum effective FO dose of 2.4g/d was needed to elicit an anabolic response to increase LBM. Although the

suggested dose was based on research in older adults, results of this study and previous research,[7] suggest that this FO supplementation dose may also apply to younger athletes.

In addition to body composition measurements, we also examined changes in upper-body strength. Strength increased by 2.48% in the FO group compared to a 5.78% decline in the PL group (p=0.131). Our inability to detect a significant effect may be related to our participant cohort (young, resistance-trained) or, most likely, the small sample size and short duration. Previous research has reported strength gains, but FO supplementation lasted 12-24 weeks.[3–5] Since short duration studies (≤4 weeks) with an analogous population have reported similar results to those reported here,[10] we speculate that an extended intervention period may have detected an effect of FO supplementation on strength, especially since the direction of effect tracked with LBM changes in both groups. The nature of this field-based study precluded the collection of blood samples or any invasive procedure to lend additional insight.

Potential limitations of this study were the small sample size and short duration. The duration of FO supplementation was most likely not adequate to reach skeletal muscle phospholipid EPA+DHA saturation.[11] Subsequent trials should last at least 8 weeks with a daily FO dose ≥2.4g. Our results are preliminary in nature and should be interpreted with caution until this study can be replicated with a larger population of elite athletes.

In conclusion, our results indicate that 4-weeks of FO supplementation (3.2g/d) significantly increased LBM compared to PL. As expected, changes in strength trended with LBM, which non-significantly favored the FO group. This investigation highlights the positive impact that FO supplementation can have on body composition and extends the evidence to a young, athletic population. Future trials need to be conducted to replicate our findings before definitive conclusions can be reached.

Media-Friendly Summary
Fish oil supplementation (3.2g/d) may improve body composition in young, athletic individuals.

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Conflicts of Interest: The authors declare no conflicts of interest.

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