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Impact of eight weeks of Spirulina supplementation on body fat reduction in overweight young males: A randomized controlled trial

Research Article

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Abstract

Spirulina, a blue-green microalga, is high in protein, vitamins, minerals and antioxidants, making it a popular supplement for improving general health. Due to its potentiality for fat metabolism, the study aims to explore the effect of eight weeks of Spirulina supplementation in reducing body fat in overweight young males. Following CONSORT 2010 checklist, eight-week placebo-controlled trial has been implemented involving twenty participants. The experimental group received 5 grams of Spirulina supplementation for eight weeks. The intake frequency increased from 3 days per week in the first week to daily by the sixth week, ensuring controlled adaptation. No significant differences were found in demographic and anthropometric characteristics between the controlled and experimental groups. Spirulina supplementation led to a slight reduction in body fat percentage in experimental group, though the changes were not statistically significant (p=0.75). The reduction of body fat in the supraspinal and subscapular regions was relatively higher in the experimental group volunteers. The findings of the study indicate that providing overweight young boys with Spirulina supplementation for eight weeks did not have a significant impact on reducing body fat or modifying other physical measurements. The absence of significant change in body composition can be attributed to the duration of intervention, dosage and individual variability in response. The synergy of Spirulina supplementation and physical activity could be pivotal in effective weight control. Further research is required to examine the possible benefits of using Spirulina supplementation with other lifestyle strategies to achieve an effective reduction of body fat.

Keywords: Spirulina, Body fat %, Anthropometry, Overweight, BMI, Somatochart.

Introduction

Overweight may be defined as abnormal or excessive accumulation of body fat that triggers health risk. According to report of World Health Organisation (WHO) body mass index (BMI) more >25.0 kg/m^2 to <30.0 kg/m^2 consider as overweight, while over 30.0 define as obesity. Overweight is a huge global problem that is affecting mankind. Physical activity and exercise, is widely accepted as a weight-loss strategy that increases energy, maintain nutritional balance, and body function. A substantial amount of research has been done to evaluate the influence of different types of exercise on cellular fat levels in order to contribute to the treatment of overweight or obesity-related disorders (1). Given the prevalence of obesity and its severe health consequences, healthy meals and physical activities have recently been advocated as effective weight-control treatments. A balanced diet should contain dietary antioxidants from various sources and regular exercise should be encouraged to lower cardiovascular disease risk factors (2). Herbal pills have lately been used as a weight-loss strategy. In accordance with pertinent literature, Spirulina (blue-green algae) is a kind of microalgae that is an excellent substitute for reducing fatty liver, risk of cardiovascular disease, and blood cholesterol levels in diabetics and obese individuals since it is a rich source of minerals and vitamins (3). In light of earlier results, the study was conducted to determine the impact of eight-week Spirulina supplementation treatment on the body fat percentage of young, overweight males.

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Methods

Study Design

A parallel-group, randomized controlled trial was executed with a 1:1 allocation ratio to ensure an equitable distribution of overweight young male volunteers into two groups: (a) controlled group and (b) experimental group. Random number generator v1.4 application has been used for fair and unbiased randomization.

The participants

After a short survey a total of 20 college going overweight male volunteers (age: 19.7±1.3 years, height: 170.7±6.0 cm and body mass: 79.4±7.8 kg) had been randomly selected from Purba Medinipur district of West Bengal. All the volunteers were aware of the study's purpose, procedures, and benefit of the study. A brief questionnaire, containing basic health and personal information along with written consent was filled out and duly signed by the volunteers. The contained study, dietary supplementary procedure was approved by apex body of Panskura Banamali College (Autonomous) according to their code of academic and research ethics. All the volunteers were selected according to specified Body Mass Index (25.0–29.9 kg/m^2) and life style (sedentary/ no active physical activity) for the study.

Interventions

The experimental group volunteers were instructed to intake Spirulina capsules for a period of eight weeks, according to a specified dose before 20 to 30 minutes of lunch. The dose of Spirulina capsules was fixed according to the advice of the nutritionist and medical practitioner. All the volunteers of the study were not restricted from their daily sedentary live living activities. Pre and Post-test data of both groups were collected under natural environmental conditions in the afternoon session (between 4:00 to 5:30 pm), before and after eight weeks of Spirulina supplementation treatment.

Table 1: Advised dose of Spirulina supplementation for experimental Group

Weeks	1st	2nd	3rd	4th	5th	6th	7th	8th
Intake intensity (days/week)	3	4	5	6	6	7	7	7
Dose (gm/day)	5	5	5	5	5	5	5	5

Measuring Variables

Demographic and anthropometric variables (4) were measured before and after eight weeks Spirulina supplementation treatment. Body density was measured using Durnin and Womersley four-site skinfold (1974) formula and percentage of body fat was measure utilising Siri equation (1956) (5–7).

Body Density = 1 .1620-0.0630 log (ΣSF) for 17-19yrs male = 1.1631-0.0632 log (Sum of SF) for 20-29yrs male

Where, ΣSF= (Biceps + Triceps + Subscapular +Supraspinal) skin fold

Siri Equation (1956)

Body Fat (%) = (495 / Body Density) – 450

Statistical Analysis

All the data was expressed using descriptive statistics. The Anderson-Darling test was performed to examine the distribution pattern of data. Since the majority of the data set followed a normal distribution, a parametric test was used to conduct further analysis. One-way analysis of variance (ANOVA) with a Tukey post hoc test was used to investigate specified differences within the group. The value of level of significance for the study was considered as $p \leq 0.05$. Gnumeric spreadsheet (Ver:1.12.48) and Jamovi 2.5.3.0 free statistical software was used for statistical analysis and Graphical representation.

Results

This study aimed to assess the impact of an eight-week Spirulina supplementation on body fat percentage in young, overweight males by comparing a controlled group (n=10) with an experimental group (n=9). One volunteer from the experimental group has been excluded from the study because of irregularity in Spirulina supplementation. Morphological characteristics (Somatotype: endomorphy, mesomorphy, ectomorphy) of overweight young males have been measured according to the somatotype instruction manual (8).

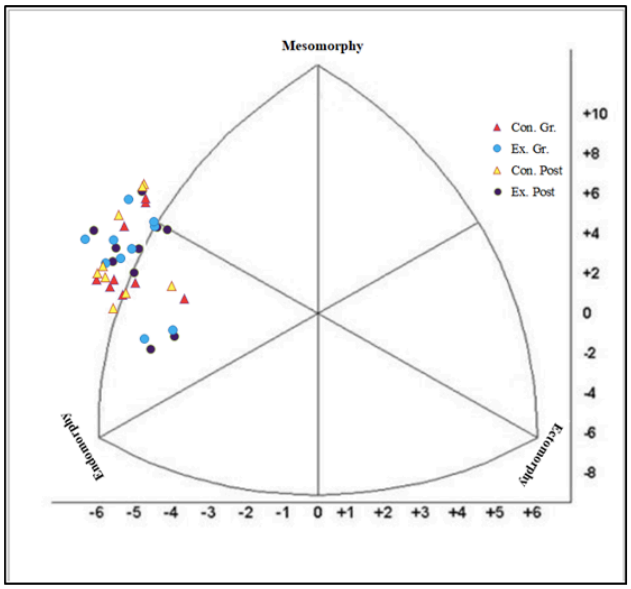
Table 2: Demographic and morphological characteristics of overweight young males

Parameters	Controlled Group (n==10)		Experimental Group (n=9)		P value
	Pre test	Post test	Pre test	Post test	
Age (years)	19.3±1.2	19.3±1.2	20.1±1.4	20.1±1.4	0.32
Height (cm)	170.9±6.3	170.4±6.1	171.0±6.3	170.5±6.1	0.99
Body Mass (kg)	79.5±7.3	80.7±8.0	79.4±8.3	78.1±8.5	0.92
BMI (kg/m^2)	27.2±1.0	27.5±1.2	27.3±1.3	26.8±1.3	0.60
Endomorphy (a.u)	6.4±0.6	6.5±0.6	6.4±0.6	6.3±0.6	0.80
Mesomorphy (a.u)	5.1±0.8	5.0±0.9	5.0±1.2	4.9±1.3	0.98
Ectomorphy (a.u)	0.7±0.1	0.8±0.3	0.8±0.2	0.9±1.3	0.65
Body fat (%)	24.7±1.3	25.1±1.2	24.7±1.3	24.4±1.2	0.75
Fat free mass (kg)	59.9±5.8	60.5±6.3	59.8±6.1	59.0±6.3	0.96
Level of significance p≤0.05					

Analysis of the data in Table 2 reveals no significant distinctions between the two groups in terms of demographic and anthropometric characteristics at the outset (4). Both groups demonstrated similar attributes in age, height, body mass, BMI, endomorphy, mesomorphy, ectomorphy, body fat percentage, and fat-free mass. The p-values associated with these parameters all exceed 0.05, indicating an absence of statistically significant differences. This lack of substantial variations suggests that, initially, the groups were adequately matched. While certain variables, such as body fat percentage, exhibited minor fluctuations, these changes were not significant enough to be attributed to the administration of Spirulina.

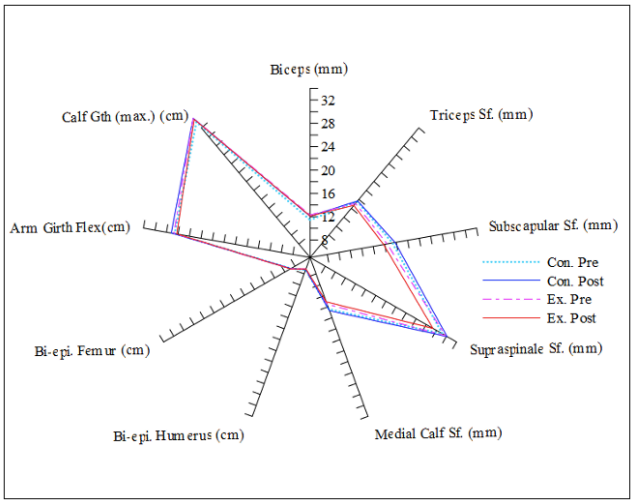
The Somatochart (Figure 1), employed to quantify the physical traits of the participants, measured the Endomorphy, Mesomorphy, and Ectomorphy components during both pre-test and post-test stages in this research study. Within the controlled group, there was a marginal increase in Endomorphy from 6.4±0.6 to 6.5±0.6, whereas the experimental group exhibited a slight decrease from 6.4±0.6 to 6.3±0.6. Notably, mesomorphy values decreased in both groups, with the controlled group experiencing a shift from 5.1±0.8 to 5.0±0.9, and the experimental group displaying a change from 5.0±1.2 to 4.9±1.3. Ectomorphy values increased in both groups, though the changes were not statistically significant. The P values for Endomorphy, Mesomorphy, and Ectomorphy were 0.80, 0.98, and 0.65, respectively, indicating no significant differences between pre-test and post-test values within or between the groups. These findings suggest that the addition of Spirulina supplements over an eight-week period did not elicit significant alterations in the evaluated morphological characteristics in this initial investigation.

Figure 1: Somatochart comparison of controlled and experimental group young overweight males



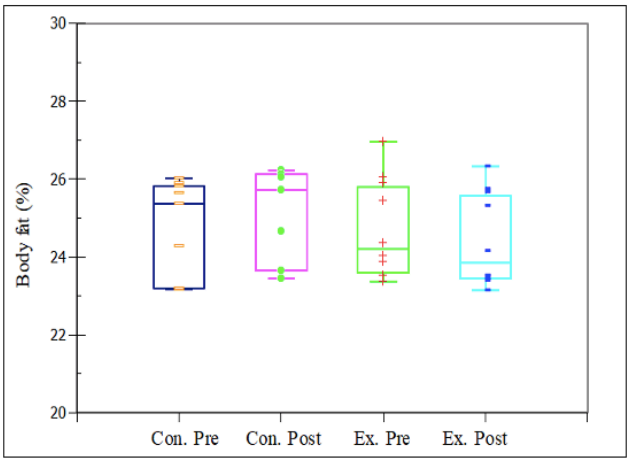
The radar plot (Figure 2) visually represents the effects of an eight-week Spirulina supplementation on various anthropometric components of young overweight males. The illustration depicts the rate of change in different skinfolds, girth and bi-epicondyle parameters. A slight increase has been noted in the Biceps and Supraspinale Skinfold measurements of the participants in the controlled group. In the case of biceps skinfolds, experimental group exhibited the same, whereas Triceps Skinfold thickness decreased from 17.1 to 16.7 mm. The radar plot indicates a decrease in Supraspinale and subscapular skinfolds of experimental group volunteers. However, it is important to mention that no statistically significant differences have been detected in the remaining measured variables, such as Triceps Skinfold, Medial Calf Skinfold, Bi-Epicondylar Humerus, Bi-Epicondylar Femur, Arm Girth Flexion, and Maximum Calf Girth. These findings indicate that although there may be specific effects on certain body measurements, the overall influence of the eight-week Spirulina supplementation did not lead to significant changes in all evaluated factors in this group of young overweight males.

Figure 2: Radar plot of various anthropometric parameters of young overweight males



The influence of an eight-week Spirulina supplementation on body fat percentage in young overweight males is visually represented in the Boxplot (Figure 3). The body fat percentage of controlled group volunteers showed a marginal increase from 24.7±1.3% in the pre-test to 25.1±1.2% in the post-test. Conversely, the experimental group exhibited a slight decrease in body fat percentage, from 24.7±1.3% to 24.4±1.2%. The controlled group experienced a slight increase in fat-free mass, going from 59.9±5.8 kg to 60.5±6.3 kg, while the experimental group saw a slight decrease, going from 59.8±6.1 kg to 59.0±6.3 kg. The P values for body fat percentage and fat-free mass were 0.75 and 0.96, respectively. This suggests that there were no significant differences in the values before and after the test, both within and between the groups. The results suggest that while an eight-week Spirulina supplementation leads to a reduction in body fat, it is not adequate to bring about significant changes in body composition parameters among young overweight males.

Figure 3: Comparison of body fat percentage of controlled and experimental group young overweight males using a boxplot



Discussion

The increasing prevalence of overweight and obesity has prompted an intensified exploration of various nutritional interventions aimed at managing body weight and composition. One such supplement that has garnered attention for its potential health benefits is Spirulina, blue - green algae renowned for its rich nutritional profile (3). Scientifically known as Arthrospira Platensis, Spirulina is a microorganism that thrives in alkaline lakes and is celebrated for its high protein content, essential amino acids, vitamins, minerals, and antioxidants(9). Additionally, Spirulina contains gamma-linolenic acid (GLA), a polyunsaturated fatty acid with anti-inflammatory properties (9,10). These nutritional components make Spirulina a compelling candidate for exploring its potential in weight management.

According to the design of the study, the advised dose of Spirulina supplementation for the experimental group in this eight-week placebo-controlled trial was 5 grams, administered incrementally from 3 times a week to 7 times a week before lunch. The experimental group displayed a slight reduction in body fat percentage, which was not enough to conclude statistical significance. However, according to the findings of a systematic review and meta-analysis conducted by Moradi et al. (2019), Spirulina supplementation is the cause of a significant reduction in weight as well as body fat percentage in obese individuals (1). Although this study was specifically designed for overweight young males, not obese individuals, the findings of Moradi et al. (2019) regarding body mass index align with the findings of this study, showing no significant changes (1). The investigation explores the impact of eight weeks of Spirulina supplementation on body fat percentage in young overweight males as well as potential benefits of dietary intervention. In assessing the baseline characteristics of the controlled and experimental groups, substantial similarities were exhibited in terms of age, height, body mass, BMI, and various morphological traits, including endomorphy, mesomorphy, ectomorphy, body fat percentage, and fat-free mass. The associated p-values for these parameters were consistently above 0.05, indicating a lack of statistically significant differences between the groups at the outset of the study. However, the study reveals that eight weeks of dose-dependent Spirulina supplements reduce body fat, especially from the supraspinatus and subscapular regions, but the rate of reduction was not significant enough to make any conclusive statements. The homogeneity of the groups suggests that any observed changes in body fat percentage throughout the study are less likely to be influenced by pre-existing disparities between the groups, which could have resulted from the intake of Spirulina supplements. In the path of our findings, a study conducted by Hernández-Lepe et al. (2019) investigates the combined effects of systematic physical exercise and Spirulina maxima supplementation on body composition, cardiorespiratory fitness, and blood lipid profile in young sedentary men with excess body weight (11). The study concludes that Spirulina maxima supplementation may act synergistically with exercise, enhancing the effects on body composition, cardiorespiratory fitness, and blood lipid profile. Another review article by DiNicolantonio et al. (2020) discussed the positive impacts of Spirulina, including reducing body fat, waist circumference, body mass index, and improving blood lipids, as well as weight management (12). The findings from the pilot study that used the Somatochart and Spirulina supplements for eight weeks shows that there were no appreciable changes to the morphological traits that were evaluated. While there were discernible trends in endomorphy, mesomorphy, and ectomorphy, the lack of statistical significance emphasizes the need for more research to make firm conclusions about how Spirulina affects body composition. The findings indicate that supplementing with Spirulina for a short period of time is not enough to significantly reduce body fat; rather, the effects seem to be gradual. Incorporating physical activity with Spirulina supplementation can improve results for reducing body fat. In alignment with the statement, a study conducted by Gholamimoghadam et al. (2021) aimed to investigate the combined effects of Spirulina supplementation and Circuit Resistance Training (CRT) on plasma resistance levels and various indicators of body composition in overweight and obese police officers (13). The findings of the study revealed a significant reduction in body weight, body mass index, fat percentage, and waist-to-hip ratio. Similar to our findings, Zarezadeh et al. (2021) concludes that Spirulina supplementation demonstrates beneficial effects on body weight and various anthropometric parameters (14). However, no significant effect was observed on body mass index, whereas a positive impact on body mass index was noted in studies lasting for at least 12 weeks. Nobari et al. (2022) investigated the impact of 8 weeks of high-intensity interval training (HIIT) and Spirulina supplementation on humoral immunity, cardiorespiratory fitness, and body composition in overweight and obese women and observed a significant reduction in fat-free mass (2).

Our study also finds a reduction in fat-free mass. The multidimensional effects of Spirulina supplementation were discovered by Kalafati et al. (2010), who explored the ergogenic and antioxidant effects of Spirulina supplementation in humans (10). The study revealed that Spirulina supplementation encouraged improvements in exercise performance, fat metabolism, and antioxidant defence, while also mitigating exercise-induced lipid peroxidation. The potential mechanisms underlying Spirulina's impact on body fat are multifaceted. The high protein content in Spirulina may contribute to increased satiety and reduced overall caloric intake, potentially influencing weight loss (12). Furthermore, the presence of bioactive compounds, such as phycocyanin and chlorophyll, may modulate lipid metabolism and adipogenesis, affecting the storage and utilization of body fat (11). The Somatochart, a tool utilized to quantify physical traits, revealed subtle changes in endomorphy, mesomorphy, and ectomorphy within the Spirulina supplemented groups, indicating potential alterations in body composition. However, the lack of statistical significance suggests that these changes may not be substantial or consistent across the population. While preliminary studies suggest a potential role for Spirulina supplementation in reducing body fat in overweight males, future research endeavours incorporating refined methodologies and larger sample sizes are warranted to comprehensively elucidate the potential effects of Spirulina on body composition.

Conclusion

Spirulina, with its rich nutritional profile, has garnered attention amid the escalating overweight and obesity rates. Despite a modest reduction in body fat observed in an eight-week trial, statistical significance was elusive. Baseline homogeneity in controlled and experimental groups mitigated pre-existing disparities. Eight weeks of dose-dependent Spirulina supplementation showed a relatively higher reduction in the supraspinal and sub-scapular region. Insights from related studies supported potential synergies with exercise. Spirulina's multidimensional effects, including improved exercise performance and antioxidant defense, reveal promising aspects. Comprehensive research with refined methodologies and larger samples is crucial for a nuanced understanding of Spirulina's role in weight management.

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Conflict of interest: The authors declare no conflicts of interest for this study.

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