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Correlation Between Macronutrient Intake and Physical Exercise with Muscle Mass and Fat Mass in Male Gym Members

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ABSTRACT

Background: Body composition, particularly the muscle-to-fat ratio, is an essential indicator of metabolic health and fitness. This study aimed to analyze the relationship between macronutrient intake (energy, protein, fat, carbohydrates) and physical exercise parameters (type, frequency, and duration) with the muscle mass and fat mass percentage in active males at a fitness center. Methods: A cross-sectional design involved 42 male participants (aged 20–40 years) selected through purposive sampling at Master Fitness Club. Macronutrient intake was assessed using a 2×24-hour food recall, exercise data were collected via questionnaires, and body composition was measured using Bioelectrical Impedance Analysis (BIA). Data were analyzed using Pearson and Spearman correlation tests, as well as the Mann-Whitney U test. Results: Fat intake was significantly negatively associated with muscle mass ($p=0.003$; $r=-0.443$) and significantly positively related to fat mass ($p=0.002$; $r=0.466$). Energy, protein, carbohydrate intake, exercise frequency, and duration were not significantly associated with either variable ($p>0.05$). Conclusion: Fat intake plays a significant role in influencing body composition among active males. Higher fat intake is associated with decreased muscle mass and increased fat mass, highlighting the importance of managing fat intake to achieve optimal body composition.

Keywords: macronutrient intake, physical exercise, muscle mass, fat mass, body composition, active men

INTRODUCTION

Weight loss (fat mass reduction) and muscle hypertrophy are two primary goals for many individuals training in fitness centers. Beyond physical appearance, these goals are crucial for maintaining metabolic health, enhancing physical performance, and preventing chronic diseases. However, despite regular exercise, some gym members still struggle with a high percentage of body fat (overfat), which can impair performance and increase metabolic disease risk. (Kochman et al., 2022). This phenomenon suggests that being physically active alone may not guarantee an optimal body composition. Instead, a combination of macronutrient intake (protein, fat, and carbohydrates) and proper exercise plays a crucial role. (Iraki et al., 2019).

Scientifically, exercise and diet are recognized as the two primary pillars of modulating body composition. Resistance exercise is a primary stimulus for muscle hypertrophy. In fact, a systematic review and meta-analysis found that structured resistance training programs significantly increased lean body mass by approximately 1.5 kg in healthy adult men (Benito et al., 2020). Macronutrient intake is another key factor. High-protein diets support increases in lean mass, especially when combined with resistance training, and improve strength (e.g., lower-body strength and bench press) (Nunes et al., 2022). Conversely, excessive intake of carbohydrates or fats tends to be stored as body fat if not offset by increased physical activity or increased energy expenditure. For example, diets high in protein and fiber, but low in simple carbohydrates, are associated with a lower fat-to-muscle ratio, suggesting that a balanced macronutrient intake (high protein, low simple carbs, and quality fats) is essential for increasing muscle mass and reducing body fat (Nishikori & Fujita, 2024). The primary role of resistance training and protein intake is well recognized. However, various lifestyle factors within specific populations, such as those of gym members, present a greater complexity. Individuals in this group often engage in intensive dietary and training practices, potentially introducing additional limiting factors beyond the commonly studied variables. For instance, when protein intake reaches the saturation point for an anabolic response, the overall macronutrient balance, including the proportions of carbohydrates and fats, may become a more dominant determinant of the muscle-to-fat ratio. An unbalanced diet, such as excessive intake of fats or simple carbohydrates, tends to promote energy storage as adipose tissue if not accompanied by adequate physical activity or energy expenditure. (Khodadadi et al., 2023).

METHODS

This study used a quantitative cross-sectional design at the Master Fitness Club in Bekasi, Indonesia, from March to July 2025. The target population was active male members of the fitness center. A purposive sample of 42 men (aged 20–40 years) was selected. The Inclusion criteria were male sex, age 20–40 years, active gym membership for at least two months, being in a healthy condition (with no serious injuries or acute illness), and willingness to participate, all with informed consent. Exclusion criteria included failure to complete data collection or participation in a medically prescribed or supervised diet program.

The dependent variables were the percentages of muscle mass and fat mass. Each was measured once per subject using a bioelectrical impedance analysis (BIA) and a stature meter for height. Results were expressed as a percentage of total body weight. The independent variables were daily macronutrient intake (in grams, including protein, fat, and carbohydrates) and physical exercise parameters (dominant exercise type: strength or cardio, frequency: times per week, and duration: minutes per session). Dietary intake was assessed using a 2×24-hour food recall and analyzed with nutrition software to quantify macronutrients. Exercise parameters were collected through a structured questionnaire completed by participants.

Data collection was conducted with ethical approval (0925-08.032/DPKE-KEP/FINAL-EA/UEU/VIII/2025). Eligible participants were approached, informed about the study, and asked to sign an informed consent form. Participants then underwent: (1) an interview for demographic data and completion of the exercise questionnaire, (2) anthropometric measurements and BIA body composition analysis, and (3) a 2×24-hour dietary recall interview on the same day.

Data was analyzed using IBM SPSS Statistics v25. Descriptive analysis summarized sample characteristics, and numerical variables (age, nutrient intake, frequency, and duration of exercise, body composition) were presented as mean ± standard deviation (SD). Categorical variables (exercise type, supplement use) were presented as frequency and percentage. Normality was assessed using the Shapiro–Wilk test (n = 42). Bivariate analysis tested hypotheses on relationships between independent and dependent variables. Pearson correlation was used when both variables were normally distributed; otherwise, Spearman correlation was used. Statistical significance was set at $p < 0.05$. The Mann–Whitney U test was used to compare exercise type with muscle mass and fat mass percentages.

RESULTS AND DISCUSSION

Table 1. Characteristics of Participants, Exercise Parameters, Nutrient Intake, Body Composition (n=42)

Variable	Mean ± SD	Minimum	Maximum
Demographic Characteristics			
Age (Years)	26.93±5.07	20	40
Exercise Parameters			
Frequency (times/week)	4.07±1.11	2	6
Duration (minutes/session)	90.36±28.01	45	180
Nutrient Intake			
Energy Intake (kcal/day)	2543±459	1695	3450
Protein Intake (g/day)	149.61±52.98	84.6	290.5
Fat Intake (g/day)	104.54±25.82	65.6	160.7
Carbohydrates (g/day)	233.46±40.27	170.3	360.2
Body Composition			
Weight (kg)	71.29	52.6	128.5
Height (cm)	170.5	161	181
BMI (kg/m^2)	24.46	18.04	40.1
Muscle Mass (%)	40.58±3.35	28.9	46.6
Fat Mass (%)	22.34±6.50	9.9	45.6

Based on Table 1, a total of 42 male fitness club members participated (mean age 26.93±5.07 years, range 20–40). Mean body weight was 71.29±11.85 kg (range 52.6–128.5 kg) and mean height was 170.5±5.64 cm (range 161–181 cm), yielding an average Body Mass Index (BMI) of 24.46 (range 18.04–40.1). Mean daily energy intake was 2543±459 kcal (range 1695–3450 kcal), 149.6±52.98 g protein (84.6–290.5 g), 104.5±25.82 g fat (65.6–160.7 g), and 233.5±40.27 g carbohydrates (170.3–360.2 g). Average training frequency was 4.07±1.11 sessions/week (range 2–6), and average duration was 90.36±28.01 minutes/session (range 45–180). Body composition results showed a mean **muscle mass** of 40.58±3.35% (range 28.9–46.6%) and a mean **fat mass** of 22.34±6.50% (range 9.9–45.6%). The wide variability in body composition indicates substantial diversity among the participants.

Table 2. Characteristics of Participants, Exercise Type, Supplement

Variable	Frequency (n)	Percentage(%)
Exercise Type		
Strength	31	73.8
Cardio	11	26.2
Total	42	100
Supplement		
Consumed	17	40.5
Not Consumed	25	59.5
Total	42	100

Table 2 showed participant characteristics, exercise type, and supplement use. All participants had trained regularly for at least two months (42/42, 100%). The majority (31 subjects, 73.8%) reported predominantly strength training, while 11 (26.2%) reported predominantly cardio training. In terms of supplements, 17 participants (40.5%) consumed whey protein and/or creatine, and 25 participants (59.5%) did not.

Table 3. Correlation analysis results between Nutrition Intake and Exercise Parameters with Body Composition

Independent Variable	Muscle Mass		Fat Mass	
	P-value	r	P-value	r
Energy Intake[a]	0.225	-0.191	0.228	0.190
Protein Intake[b]	0.742	-0.052	0.588	0.086
Fat Intake[a]	0.003*	-0.443	0.002*	0.466
Carbohydrates[b]	0.61	0.081	0.638	-0.075
Exercise Frequency[b]	0.069	0.283	0.085	-0.269
Exercise Duration[b]	0.776	-0.045	0.965	0.007

Information: *Significant Correlation ($p<0.05$). [a]Pearson Correlation Analysis. [b]Spearman Correlation Analysis

Correlation analysis results are summarized in Table 3. Daily fat intake showed a significant negative correlation with muscle mass percentage ($r = -0.443$, $p = 0.003$) and a significant positive correlation with fat mass percentage ($r = 0.466$, $p = 0.002$). In contrast, total energy intake, protein intake, and carbohydrate intake showed no significant correlations with either muscle or fat mass (all $p > 0.05$). Likewise, exercise frequency and duration were not significantly correlated with muscle or fat mass (all $p > 0.05$).

The most notable finding is the significant role of dietary fat intake. Fat intake was the only variable significantly associated with both outcomes: it correlated positively with fat mass percentage and negatively with muscle mass percentage. This aligns with basic energy metabolism: fat provides 9 kcal per gram, making it the densest macronutrient. In conditions of energy surplus, excess dietary fat is efficiently stored in adipose tissue. The mean fat intake (104.5 g/day) was relatively high, which corresponded to an average fat mass percentage at the upper end of the fitness range (22.34% fat) (Roberts et al., 2020).

The negative correlation between fat intake and relative muscle mass has both mathematical and physiological explanations. Mathematically, as total body weight increases due to added fat, the proportion of muscle naturally decreases even if absolute muscle does not change. Physiologically, diets high in fat—especially saturated fat—can induce chronic low-grade inflammation and insulin resistance in skeletal muscle.(Sheptulina et al., 2023). Insulin is a key anabolic hormone for muscle, and insulin resistance impairs amino acid and glucose uptake in muscle cells, reducing protein synthesis and growth. Insulin resistance can also promote the deposition of ectopic fat in muscle, further compromising muscle quality. In rodents, a high-fat, high-sugar diet has been shown to cause obesity and muscle degeneration, illustrating that excessive fat intake can actively hinder muscle health. Thus, our finding of higher fat intake linked to lower muscle percentage likely reflects these harmful mechanisms(Rasool et al., 2018).

Similarly, carbohydrate intake was not significantly related to body composition ($p>0.05$). Carbohydrates serve primarily as the primary fuel for high-intensity exercise and help spare protein from being used as an energy source. Only when carbohydrate intake is excessive, and glycogen stores are full, is it converted to fat, which is relatively inefficient unless in a large chronic surplus. In active individuals, if carbohydrate intake meets training needs, variations above that may not directly influence body composition(Yang et al., 2022). Consistent with this, (Nishikori & Fujita, 2024) Found that diets higher in protein and fiber and lower in simple carbs were associated with a lower fat-to-muscle ratio, underscoring the role of diet quality rather than just carbohydrate quantity. In the high-activity group, carbohydrate intake likely played a supportive role and thus showed no direct correlation with muscle or fat percentages.

Table 4. Correlation analysis results between Exercise Type and Body Composition

Variable		n	p-value Muscle Mass (%)	p- value Fat Mass (%)
Exercise Type	Strength	31	0.710	0.920
	Cardio	11		

Note: p-values were obtained using the Mann–Whitney U test

As shown in Table 4, no significant differences in body composition were found between exercise types. The p-values comparing strength vs. cardio groups were 0.710 for muscle mass and 0.920 for fat mass, indicating no significant differences and nearly equal mean ranks. In summary, the only significant finding was that higher fat intake was associated with higher fat mass percentage and lower muscle mass percentage. All other variables showed no significant associations with body composition.

The absence of a correlation between basic exercise parameters (frequency and duration) and body composition highlights a methodological issue. Muscle hypertrophy is driven by progressive overload, best quantified by training volume (load × sets × repetitions) rather than just frequency or time. For example, one person could train for two hours at low intensity, while another could achieve higher volume in one hour (Schoenfeld et al., 2016). The frequency (sessions per week) and duration (minutes per session) we measured are crude proxies and did not capture the actual intensity or volume of training. Differences in training volume have a significant impact on muscle adaptations in trained individuals. Thus, the lack of correlation in the data does not mean exercise is unimportant; it suggests that future research should include more precise measures of training load and intensity (e.g., total volume, weight lifted) to detect actual exercise–body composition correlation (Barsuhn et al., 2025).

A limitation in this study was that it did not consider other factors, such as sleep quality and stress levels, which can also affect body composition. The use of a 2x24-hour food recall was less accurate, which could lead to a risk of bias, as it relies on the subjects' memory and reporting accuracy regarding food consumption. It would be more effective to use a single 24-hour food recall twice, on non-consecutive days, covering both weekdays and weekends. The variables related to physical exercise were still incomplete, making it difficult to specifically distinguish the relationship between the type of exercise, its duration, and frequency. This limitation also resulted from the exercise type variable offering only two exercise options.

CONCLUSION

In this sample of active young men consuming a high daily protein intake, dietary fat emerged as the most significant factor associated with body composition. Higher fat intake was significantly associated with higher fat mass percentage and lower muscle mass percentage. In contrast, total energy intake, protein intake, carbohydrate intake, and basic measures of exercise (frequency and duration) were not significantly related to muscle or fat percentages in this population. These results likely reflect a saturated protein effect and limitations of exercise measures. The findings suggest that managing dietary fat intake may be crucial for achieving optimal body composition in individuals who are fitness-oriented. Future research should expand to include both genders and a broader population and should measure additional variables and more precise exercise loads. Improving the accuracy of diet and exercise assessments will clarify the complex interactions influencing muscle and fat mass more precisely.

AUTHOR CONTRIBUTION

AO: Conceptualization, Methodology, Data collection, Formal analysis, and Writing – original draft preparation.

MK: Corresponding author, Conceptualization, Methodology, Supervision, and Review.

DA: Conceptualization, Methodology, Supervision, and Review.

EY, NG: Supervision and Review.

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