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Effects of a low-glycemic diet combined with resistance training on body composition in recreational adults

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Abstract

The aim of this study was to examine the effect of combining a low-glycemic index carbohydrate diet with structured strength training on the morphological characteristics of recreational participants. The sample included 16 subjects (8 men and 8 women), aged 19 to 50. The program lasted an average of 87.56 days. Participants followed a low-glycemic dietary regimen six days per week, with a free-choice diet on the seventh day. Strength training was conducted five times per week in the afternoon and consisted of a warm-up, main workout, and cooldown. Morphological measurements were performed using bioelectrical impedance analysis (Tanita BC-587) and a standard tailor's measuring tape. The results showed statistically significant improvements (p < .05) in all monitored parameters, including reductions in body weight, body fat percentage, circumferences, and metabolic age, as well as an increase in total body water. Sex-based analysis revealed that, aside from differences in height and metabolic rate (favoring males), there were no statistically significant differences in progress, suggesting similar program effectiveness across genders. The combination of a low-glycemic index diet and structured strength training can produce significant improvements in body composition among recreational exercisers, regardless of sex.

Keywords: *low-glycemic diet; strength training; body composition; bioimpedance; recreational activity.*

INTRODUCTION

Regular physical activity and a balanced diet are essential factors in maintaining health and preventing chronic diseases [1]. The combination of targeted exercise and nutritionally controlled diets has been shown to be an effective strategy for improving body composition in adults [2,3].

In recent decades, particular attention has been given to the role of the glycemic index of ingested carbohydrates in influencing metabolism, body weight, and adipose tissue accumulation [4,5]. A low-glycemic index diet, which focuses on the intake of slowly digestible carbohydrates, may improve glycemic control, increase insulin sensitivity, and provide a more gradual release of energy [6].

When this dietary approach is combined with resistance training, a potentially synergistic effect may occur, enhancing fat reduction and preserving or increasing lean muscle mass [7]. Resistance training offers multiple metabolic benefits, including increased basal metabolic rate, improved hormonal status, and greater energy expenditure post-exercise [7].

For recreational exercisers, implementing a well-structured training program (warm-up, main session, cool-down), along with a combination of training methods (e.g., partial and circuit training), may further contribute to improvements in morphological parameters.

Considering the increasing use of low-glycemic index dietary regimens in both recreational and clinical settings, the aim of this study was to examine the effect of a combined intervention—low-glycemic index carbohydrate intake and structured resistance training—on changes in the morphological characteristics of physically active adults.

MATERIALS AND METHODS

The study was conducted on a sample of 16 participants (8 men and 8 women), aged 19 to 50 years (mean age: 35 years). All participants were physically active recreational adults without diagnosed chronic diseases, and they voluntarily agreed to participate in the study. Their height ranged from 163 cm to 189 cm (mean: 175.5 cm).

The average duration of the program was 87.56 days, with a range from 35 to 130 days. Participants trained five times per week, predominantly in the afternoon. Each training session had a standardized structure:

- Warm-up (5–10 minutes),
- Main session – resistance training (25–35 minutes),
- Cool-down (5–10 minutes).

For six days a week, participants followed a dietary regimen based on low-glycemic index carbohydrates, excluding fruits and high-calorie beverages. One day per week was designated as a free-choice day. Protein sources included eggs, chicken, beef, fish, and pork. Carbohydrate intake was primarily based on legumes (beans, lentils, peas) and low-glycemic vegetables. Although caloric intake was not strictly restricted, all participants received dietary education on appropriate food combinations, recommended quantities, and meal timing.

Morphological characteristics were measured at the beginning and end of the program. Body weight, body fat percentage, water percentage, basal metabolic rate, and metabolic age were assessed via bioelectrical impedance using the Tanita BC-587 analyzer. Circumferences were measured using a non-elastic tailor's tape according to standard anthropometric procedures. Height was measured using a SECA SE-206 stadiometer (range up to 220 cm, precision 1 mm).

Statistical analysis was performed using a paired samples t-test to assess differences between pre- and post-intervention values, and an independent samples t-test was used to examine gender differences. Statistical significance was set at $p < .05$. All analyses were conducted using IBM SPSS Statistics software, version 25.0.

RESULTS

A sample of 16 participants was analyzed to assess changes in morphological parameters before and after the training-nutrition program. The results of the paired samples t-test are presented in **Table 1**.

Table 1. Changes in morphological parameters before and after intervention.

Parameters	Initial state (N=16)	Final state (N=16)	Significance of T-test (p-value)
	Mean value	Mean value	
Body weight (kg)	92,20 ± 20,56	83,80 ± 18,84	p<0,0005*
Body fat (%)	27,81 ± 6,88	23,54 ± 6,58	p<0,0005*
Body water (%)	52,28 ± 4,04	55,36 ± 3,74	p<0,0005*
Lean body mass (kg)	62,75 ± 13,54	60,61 ± 13,00	p<0,0005*
Basal metabolic rate (BMR)	1878,31 ± 379,72	1778,25 ± 347,15	p<0,0005*
Visceral fat	7,87 ± 6,57	5,93 ± 5,65	p<0,0005*
Bone mass	3,27 ± 0,65	3,12 ± 0,62	p=0,007*
Metabolic age	36,00 ± 11,09	28,43 ± 13,04	p<0,0005*
Abdominal circumference (cm)	101,40 ± 15,79	91,93 ± 16,25	p<0,0005*
Waist circumference (cm)	94,37 ± 18,96	86,09 ± 18,03	p<0,0005*
Iliac crest circumference (cm)	104,68 ± 14,37	95,56 ± 14,76	p<0,0005*
Hip/gluteal circumference (cm)	111,12 ± 8,04	103,81 ± 8,31	p<0,0005*
Thigh circumference (cm)	63,56 ± 5,28	59,81 ± 4,61	p<0,0005*

**statistically significant at the 0.05 level (p < 0.05)*

At the end of the program, the average body weight decreased by 8.4 kg (from 92.20 ± 20.56 kg to 83.80 ± 18.84 kg; $p < .0005$). Body fat percentage dropped from 27.81 ± 6.88% to 23.54 ± 6.58% (difference: –4.27 pp; $p < .0005$). Lean body mass slightly decreased from 62.75 ± 13.54 kg to 60.61 ± 13.00 kg (difference: –2.14 kg; $p < .0005$).

Total body water percentage increased from 52.28 ± 4.04% to 55.36 ± 3.74% (difference: +3.08%; $p < .0005$), indicating improved hydration and reduced adiposity. Basal metabolic rate decreased by 100.06 kcal (from 1878.31 ± 379.72 kcal to 1778.25 ± 347.15 kcal; $p < .0005$), while metabolic age dropped by 7.57 years (from 36.00 ± 11.09 to 28.43 ± 13.04; $p < .0005$).

Significant reductions were also observed in body circumferences:

- Umbilical: –9.47 cm (101.40 ± 15.79 → 91.93 ± 16.25 cm; $p < .0005$)
- Waist: –8.28 cm (94.37 ± 18.96 → 86.09 ± 18.03 cm; $p < .0005$)
- Iliac crest: –8.50 cm (104.06 ± 14.37 → 95.56 ± 13.72 cm; $p < .0005$)
- Hip (gluteal): –7.31 cm (111.12 ± 8.94 → 103.81 ± 8.31 cm; $p < .0005$)
- Right thigh: –3.75 cm (63.56 ± 5.28 → 59.81 ± 4.61 cm; $p < .0005$)

Subsequently, gender-based differences in the magnitude of improvement were examined. The results of the independent samples t-test are presented in **Table 2.**

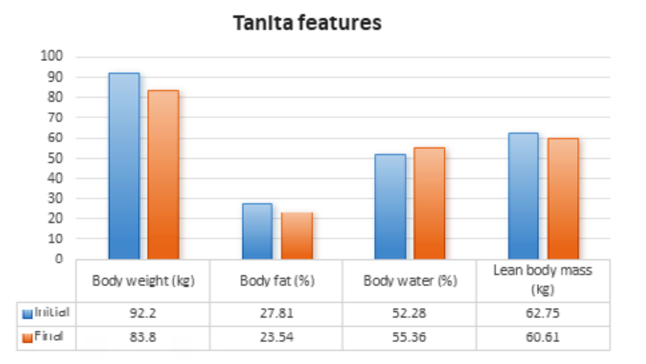

Figure 1. Changes in body composition parameters measured by Tanita analyzer (initial vs. final values).

Figure 1 presents the mean values of four key body composition parameters – body weight (kg), body fat percentage (%), body water percentage (%), and lean

Table 2. Gender differences in intervention outcomes.

Parameters	Man (N=8)	Woman (N=8)	Significance of T-test (p-value)
	Mean value	Mean value	
Height (cm)	181,87 ± 6,72	169,25 ± 6,40	p=0,002*
Training frequency	87,12 ± 33,09	88,00 ± 26,12	p=0,954
Age	33,50 ± 10,58	36,62 ± 9,88	p=0,551
Weight (kg)	9,36 ± 2,76	7,43 ± 2,08	p=0,138
Body fat (%)	3,67 ± 1,93	4,86 ± 2,50	p=0,306
Body water (%)	2,56 ± 2,26	3,60 ± 2,06	p=0,354
Lean body mass (kg)	2,58 ± 2,25	1,68 ± 1,23	p=0,338
Basal metabolic rate (BMR)	128,50 ± 37,97	71,62 ± 20,20	p=0,002*
Visceral fat	2,62 ± 1,68	1,25 ± 0,46	p=0,056
Bone mass	0,2 ± 0,26	0,1 ± 0,07	p=0,317
Metabolic age	5,50 ± 6,27	9,62 ± 6,09	p=0,204
Abdominal circumference (cm)	8,75 ± 3,28	10,18 ± 3,06	p=0,381
Waist circumference (cm)	8,56 ± 2,85	8,00 ± 2,69	p=0,692
Iliac crest circumference (cm)	8,31 ± 2,78	9,93 ± 3,11	p=0,290
Hip/gluteal circumference (cm)	5,62 ± 1,55	9,00 ± 4,35	p=0,058
Thigh circumference (cm)	4,31 ± 1,57	3,18 ± 2,03	p=0,237

**statistically significant at the 0.05 level ($p < 0.05$)*

body mass (kg) – measured by bioelectrical impedance analysis (Tanita BC-587) at the beginning and end of the intervention. A significant decrease in body weight and fat percentage is observed, along with an increase in body water. Lean body mass remained relatively stable, with a slight reduction.

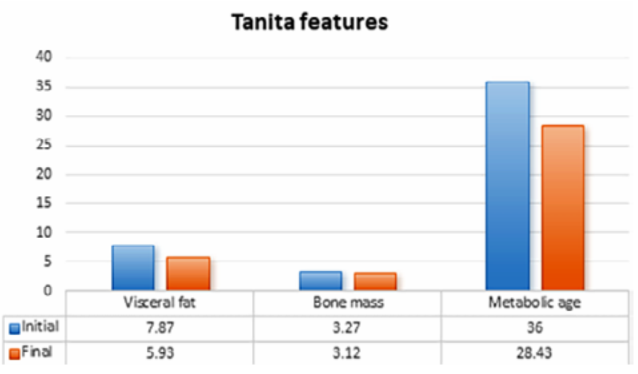

Figure 2. Changes in visceral fat, bone mass, and metabolic age before and after the intervention.

Figure 2 presents average values of visceral fat, bone mass, and metabolic age in participants before and after the intervention. A significant reduction in visceral fat (from 7.87 to 5.93) and metabolic age (from 36 to 28.43 years) is observed, while bone mass remained relatively stable.

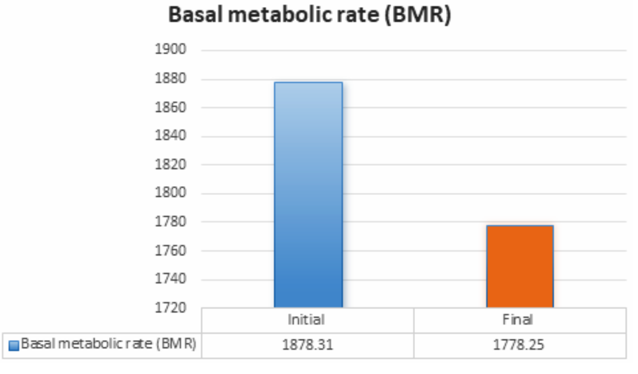

Figure 3. Changes in basal metabolic rate before and after the intervention.

Figure 3 illustrates the decrease in basal metabolic rate (BMR) following the intervention. The average BMR dropped from 1878.31 kcal to 1778.25 kcal. This reduction may be associated with weight loss and metabolic adaptations to reduced energy intake.

Figure 4 presents the changes in body circumferences at five anatomical sites—abdomen, waist, iliac crest, hip/gluteal region, and thigh—following the intervention program. Statistically significant reductions were observed in all measured regions, with the most notable decreases in abdominal and hip girths, indicating a reduction in both visceral and subcutaneous fat.

Statistically significant differences were observed in height and metabolic rate. Males were significantly taller (181.87 ± 6.72 cm) than females (169.25 ± 6.40 cm; *p* = .002). Additionally, males showed greater increases in metabolic rate (+128.50 ± 37.97 kcal) compared to females (+71.62 ± 20.20 kcal; *p* = .002).

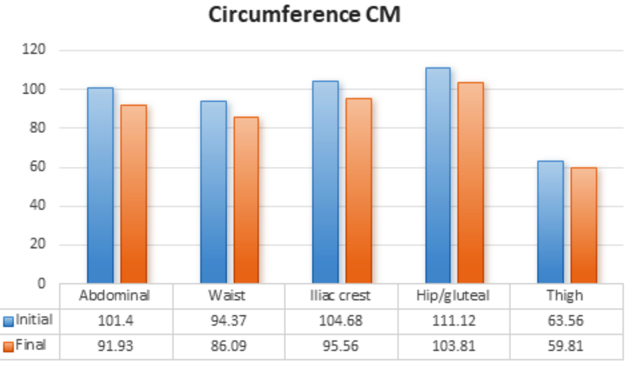

Figure 4. Changes in body circumference measurements (in cm) before and after the intervention.

For all other variables—including reductions in body weight, fat percentage, circumferences, and increases in body water—no statistically significant gender differences were detected (*p* > .05), indicating that the intervention was equally effective for both sexes.

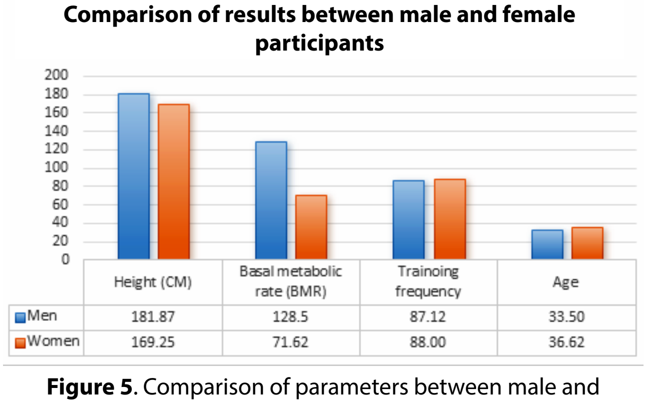

Figure 5. Comparison of parameters between male and female participants.

Figure 5 displays key demographic and metabolic differences between male and female subjects. Men showed significantly higher body height (p = 0.002) and basal metabolic rate (p = 0.002), while no statistically significant differences were observed in training frequency or age. These results align with physiological sex-based differences but suggest that the intervention effects were equally effective across genders.

Figure 6 illustrates gender-based differences in the reduction of body weight and circumferences at various body sites. Both groups demonstrated improvement, but women showed greater reductions in abdominal (10.18 cm), waist (8 cm), iliac crest (9.93 cm), and gluteal (9 cm) circumferences. In contrast, men exhibited a slightly greater reduction in total body weight (9.36 kg vs. 7.43 kg) and thigh circumference (4.31 cm vs. 3.18 cm). These results suggest gender-specific responses in fat distribution and adaptation to the intervention.

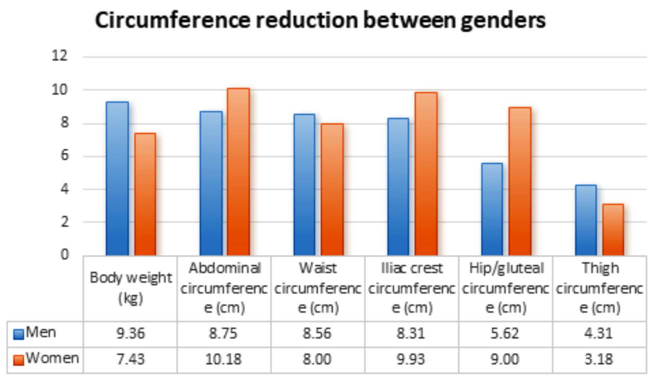

Figure 6. Reduction in body weight and circumferences among male and female participants.

Figure 7 illustrates gender-specific differences in changes in body fat percentage, visceral fat, lean body mass, water percentage, and metabolic age following the intervention. Women experienced a greater reduction in total body fat (–4.86% vs. –3.67%) and a more pronounced increase in total body water (+3.60% vs. +2.56%). Although men exhibited a slightly greater loss in lean body mass, women showed almost double the reduction in metabolic age (–9.62 years vs. –5.50 years), suggesting a potentially stronger metabolic response to the diet and training protocol in female participants.

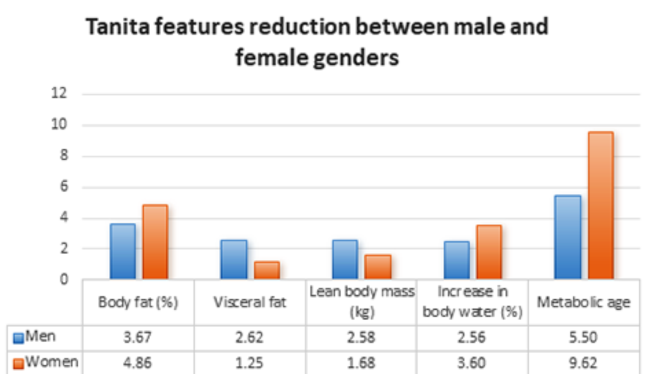

Figure 7. Differences in Tanita-based parameter reductions between male and female participants.

DISCUSSION

The results of this study demonstrate that a combined intervention of low-glycemic index carbohydrate intake and structured resistance training leads to significant improvements in body composition among recreationally active adults. The most notable changes were observed in body weight reduction (–8.4 kg), body fat percentage (–4.3 percentage points), and reductions in waist and hip circumferences (7–9.5 cm on average), which are consistent with prior findings emphasizing the effectiveness of integrative approaches in fat loss and weight regulation [8,9,10].

Low-glycemic index diets have been shown to improve glycemic control, reduce insulin resistance, and decrease appetite, facilitating dietary adherence without the need for strict caloric restriction [11,12,13]. In our study, an additional benefit of this dietary model was reflected in a 3% increase in total body water, suggesting improved cellular hydration and possibly reduced visceral fat [14].

Although a statistically significant reduction in lean body mass was observed (–2.1 kg), such a decrease is expected under negative energy balance conditions. Given the absence of dietary supplements or high-protein protocols, this level of muscle loss remains within physiologically acceptable limits [6].

Significant gender differences were found only in height and basal metabolic rate, consistent with known biological differences between males and females [15]. However, no gender-related differences were observed in fat loss, body weight changes, or circumference measurements, indicating that the program was equally effective across sexes [16].

The observed increase in body water percentage, alongside fat reduction, is supported by recent research as a marker of improved body composition and possibly functional muscle gain [14]. These findings reinforce contemporary guidelines emphasizing integrative approaches – including structured physical activity and nutritional control—as essential strategies for optimizing health and metabolic balance in adults.

CONCLUSION

The conducted study demonstrated that the combination of low-glycemic index carbohydrate intake and structured resistance training has a significant impact on the morphological characteristics of recreationally active adults. On average, participants experienced an 8.4 kg reduction in body weight, a 4.3 percentage point decrease in body fat percentage, and substantial reductions in waist and hip circumferences.

Despite a modest reduction in lean body mass, total body water percentage increased, while metabolic age and basal metabolic rate improved—indicating an overall enhancement in body composition and metabolic health. The intervention proved equally effective for both men and women, underscoring its broad applicability in recreational settings.

Based on these findings, it can be concluded that a structured approach to nutrition and physical activity represents an effective model for improving health and optimizing body composition in adults engaged in recreational exercise.

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Efekti ishrane sa niskim glikemijskim indeksom u kombinaciji sa treningom snage na telesni sastav kod rekreativaca

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Kratak sadržaj

Cilj ovog istraživanja bio je da se ispita efekat kombinovane primene ishrane sa ugljenim hidratima niskog glikemijskog indeksa i treninga snage na morfološke karakteristike rekreativaca. Uzorak je činilo 16 ispitanika (8 muškaraca i 8 žena), uzrasta od 19 do 50 godina. Trajanje programa u proseku je iznosilo 87,56 dana, tokom kojih su ispitanici šest dana nedeljno primenjivali režim ishrane sa niskim glikemijskim opterećenjem, dok su sedmog dana imali slobodan izbor namirnica. Trening snage sprovođen je pet puta nedeljno, u poslepodnevnim časovima, i obuhvatao je zagrevanje, glavni deo i hlađenje. Merenja su izvršena metodom bioelektrične impedanse (Tanita BC-587) i standardnom krojačkom trakom. Rezultati su pokazali statistički značajna poboljšanja u svim praćenim parametrima (p < 0,05), uključujući smanjenje telesne mase, procenta masti, obima i metaboličkog doba, kao i povećanje procenta telesne vode. Analizom po polu utvrđeno je da, osim u visini i brzini metabolizma (u korist muškaraca), ne postoje statistički značajne razlike u ostvarenom napretku. Kombinacija niskoglikemijske ishrane i strukturanog treninga snage može dovesti do značajnih pozitivnih promena u telesnoj kompoziciji kod rekreativaca, nezavisno od pola.

Ključne reči*: ishrana sa niskim glikemijskim indeksom; trening snage; telesna kompozicija; bioimpedansa; rekreativno vežbanje.*