SJIF Impact Factor (2025): 8.688| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 10 | Issue: 10 | October 2025 - Peer Reviewed Journal

EFFECT OF LOW-CARB HIGH-FAT DIET AND 16:8 INTERMITTENT FASTING VERSUS FAST CONTINUOUS TRAINING AND HIGH INTENSITY INTERVAL TRAINING ON BODY FAT PERCENTAGE AND RESTING HEART RATE OF PHYSICALLY ACTIVE ADULTS OF PUNJAB

Manish Acharjee[1]*, Priyanshu Prabal Dutta[2], Reshma Rai[3]
[1]*Student, Department of Physical Education, Swarnim Gujarat Sports University, Gujarat*
[2]*Scholar, Department of Physical Education, Punjabi University, Punjab*
[3]*Scholar, Department of Physical Education, Punjabi University, Punjab*
**Corresponding Author*

Article DOI: https://doi.org/10.36713/epra24284
DOI No: 10.36713/epra24284

ABSTRACT

Background: *While structured exercise and targeted nutrition independently improve body composition and cardiovascular health, their comparative and combined effects in already active individuals remain underexplored. This study examined the independent and interactive impacts of a Low-Carb High-Fat (LCHF) diet, 16:8 Intermittent Fasting (IF), High-Intensity Interval Training (HIIT), and Fast Continuous Training (FCT) on body fat % and resting heart rate (RHR) in physically active adults.*

Methods: *Sixty participants (aged 24-27) were randomized into four groups in a 2 × 2 factorial design: LCHF + HIIT, LCHF + FCT, IF + HIIT, IF + FCT. Interventions lasted six weeks. Body Fat Percentage and RHR were measured pre-and post-intervention. Two-way ANCOVA was used by controlling for pre-test measures for analysis.*

Results: *All groups exhibited modest reductions in body fat (1.3–2.1%) and RHR (3-5 bpm). However, no statistically significant main effects were observed for diet or training, and the diet × training interaction was non-significant, though a trend toward interaction for body fat percentage (p = .096) was noted.*

Conclusion: *Both dietary and training strategies showed comparable benefits, suggesting that in well-trained individuals, short-term interventions may produce limited differential effects due to pre-existing adaptations. The findings highlight the value of flexible, preference-based approaches for sustainable health outcomes. Longer trials in more diverse populations are warranted to clarify the potential synergistic effect.*

KEYWORDS: *Low-Carb High-Fat Diet, Intermittent Fasting (IF), High-Intensity Interval Training, Fast Continuous Training, Body Fat Percentage, Resting Heart Rate, and Active Adults.*

INTRODUCTION

Despite engaging in regular physical activity, the prevalence of obesity and metabolic diseases is still on the rise. Up to 46% of adults worldwide suffer from metabolic syndrome, which is characterized by abdominal obesity, dyslipidaemia, hypertension, and hyperglycaemia (Noubiap et al., 2022). Excess visceral fat and mild metabolic inefficiencies continue to exist even in those who reach fitness standards, which raises the risk of cardiovascular disease. This paradox emphasizes the necessity for varied lifestyle interventions beyond exercise alone, since physical activity alone is not a complete defence against metabolic dysfunction in contemporary surroundings (Chomiuk et al., 2024; Funderburk et al., 2018). Since they alter energy balance, metabolic efficiency, and autonomic function without having negative drug-related side effects, dietary changes and exercise routines have become essential non-pharmacological methods for reducing extra body fat and enhancing cardiovascular health. According to recent research, when combined with endurance or high-intensity training, structured dietary approaches—like low-carbohydrate or intermittent fasting protocols—improve fat oxidation, decrease adiposity, and lower cardiovascular risk factors (Inoue et al., 2022; Kazeminasab et al., 2024). Thus, these lifestyle-based tactics offer long-term, scientifically supported paths to health optimization. Since body fat percentage offers a more accurate representation of body composition than body mass index (BMI), it is commonly considered a crucial indication of both metabolic health and athletic performance. While healthy body fat levels contribute to improved endurance, strength, and recovery, elevated body fat is significantly linked to insulin resistance, cardiovascular risk, and decreased physiological efficiency (Lee & Gallagher, 2020; Muller et al., 2022). Maintaining a suitable body fat percentage is crucial for athletes and physically active adults in order to balance performance and health. A simple, non-invasive indicator of cardiovascular effectiveness and autonomic nervous system (ANS) balance is resting heart rate (RHR). Better cardiovascular fitness

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and autonomic modulation are characterized by increased parasympathetic (vagal) tone and higher cardiac efficiency, which are often shown by a lower RHR. On the other hand, elevated RHR is linked to stress, greater cardiovascular risk, and increased sympathetic activity (Oh et al., 2024). RHR is essential for determining a person's level of fitness, state of recovery, and general health in both general health and sports science contexts. Lower RHRs are frequently seen in athletes, which is indicative of effective cardiac function and a well-adapted ANS. Tracking RHR patterns can help identify overtraining, direct training volume, and assess the success of cardiovascular health-improving therapies.

The Low-Carb High-Fat (LCHF) diet is becoming more and more well-known for encouraging metabolic changes that improve performance and overall health. The body moves toward greater fat oxidation when carbohydrate intake is drastically decreased and dietary fat is increased. This improves metabolic flexibility and lessens the body's need for glucose as its main fuel source (Hallberg et al., 2018). Better glycaemic management, increased insulin sensitivity, and advantageous changes in body composition have all been linked to this adaptation (Ebbeling et al., 2018). According to recent studies, LCHF diets may lower blood insulin levels, promote lipolysis, and help reduce visceral fat, which could have a positive impact on weight control and long-term cardiometabolic health (Krebs et al., 2012). An 8-hour meal window follows a 16-hour fasting window in the popular 16:8 intermittent fasting program, which promotes extended periods of low insulin activity and increased lipolysis. Body fat loss and improved cardiometabolic outcomes are made possible by this nutritional rhythm, which promotes metabolic flexibility and facilitates a more effective transition between carbohydrate and fat oxidation. Recent evidence suggests that 16:8 fasting not only augments fat utilization but also supports cardiovascular health in active populations (Ludwig et al., 2023; Manoogian & Laferrere, 2023). Recent studies suggest, dietary changes by themselves may result in significant gains in cardiovascular health and body composition. It has been demonstrated that low-carb, high-fat (LCHF) diets improve fat oxidation and lower body fat percentage while preserving lean muscle (Hall et al., 2018). Time-restricted eating, such as the 16:8 intermittent fasting regimen, has also been shown to reduce adiposity, enhance insulin sensitivity, and have positive effects on blood pressure and resting heart rate (Jamshed et al., 2019; Lowe et al., 2020).

STATEMENT OF THE PROBLEM

Despite nutritional imbalances and a variety of training techniques, many adults still struggle to achieve optimal body fat percentage and cardiovascular efficiency even when they engage in regular physical activity. While structured exercise modalities like high-intensity interval training and continuous training are well known for their role in improving cardiovascular adaptations, particularly resting heart rate, low-carb, high-fat diets combined with time-restricted intermittent fasting have emerged as effective ways to enhance fat metabolism and improve metabolic health. The relative efficacy of diet-based therapies and exercise regimens in active populations has, however, not been explicitly compared in many studies. This disparity is especially noticeable in Punjab, where dietary habits and lifestyle choices may have an impact on cardiovascular and metabolic outcomes.

OBJECTIVES OF STUDIES

1. To assess the effect of the Low-Carb High-Fat diet and 16:8 Intermittent Fasting on the body fat percentage and resting heart rate of physically active adults of Punjab.
2. To assess the effect of Fast Continuous Training and High Intensity Interval Training on the body fat percentage and resting heart rate of physically active adults of Punjab.
3. To assess the combined effect of the Low-Carb High-Fat diet vs. 16:8 Intermittent Fasting and Fast Continuous Training vs. High Intensity Interval Training on the body fat percentage and resting heart rate of physically active adults of Punjab.

SIGNIFICANCE OF THE STUDY

By assessing the combined effects of a Low-Carb High-Fat (LCHF) diet with 16:8 intermittent fasting against fast continuous training and High-Intensity Interval Training (HIIT), this study fills a significant research gap by examining the effects on resting heart rate and body fat percentage in physically active adults. Although a great deal of research has been done on individual therapies, little is known about how they work together in this particular population. Understanding these effects can help develop more effective, culturally appropriate health measures, especially in areas like Punjab, where dietary and cultural patterns are distinct. The results could provide information on how to improve cardiovascular health and body composition, which would help active people adopt more individualized wellness strategies.

METHODOLOGY

Research Design: This was a 6-week, parallel-group, 2 × 2 factorial, randomized trial testing the independent and combined effects of (Factor A) diet strategy—Low-Carb High-Fat (LCHF) vs. 16:8 Intermittent Fasting (IF)—and (Factor B) training mode—Fast Continuous Training (FCT) vs. High-Intensity Interval Training (HIIT)—on body fat percentage and resting heart rate (RHR) in physically active adults. The factorial design yields four intervention groups: LCHF+FCT, LCHF+HIIT, IF+FCT, and IF+HIIT. The primary focus was the change in body-fat % and the change in RHR from baseline to week 6 of the physically active adults.

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Participants: Participants were selected from universities and sports organizations of Punjab. The eligibility requirements include participants aged 24 to 27, engaging in moderate-to-intense physical activity for at least 150 minutes per week for at least six months, and not having any musculoskeletal, metabolic, or cardiovascular conditions. Additionally, participants must not adhere to any particular training plans or restricted diets. Smoking, metabolic diseases, drugs that interfere with metabolism, and previous usage of intermittent fasting or ketogenic diets were excluded. Screening of subjects was conducted via a health history, and informed consent was obtained from each subject before inclusion.

Sampling Process: A multi-staged approach that combined institutional outreach and probability allocation was used to recruit 60 participants. First, a pool of physically active adults (ages 24–27) who were free of cardiometabolic or musculoskeletal diseases and were not currently on restrictive diets or specialized training was screened from universities and sports academies. Second, following baseline screening and written informed consent, participants were randomly assigned in a 1:1:1:1 to the four cells of the 2 × 2 factorial design, with 15 subjects per group: (i) Low-Carb High-Fat + High-Intensity Interval Training (LCHF+HIIT), (ii) LCHF + Fast Continuous Training (LCHF+FCT), (ii) Intermittent Fasting + HIIT (IF+HIIT), and (iv) IF + FCT. This was done using computer-generated permuted blocks (sizes 4 and 8) with stratification by sex and sport/discipline to maintain balance on key prognostic factors.

Intervention **(Factor A × Factor B)**
Factor A (Diet Strategy)
1. **Low-Carb High Fat Diet:** Target macronutrients 10–15% CHO (≤50–75 g/day, individualized by body mass), 60–70% fat, 20–25% protein. Foods emphasized: eggs, fish, paneer, full-fat dairy, ghee/olive oil, nuts/seeds, low-starch vegetables; grains, sugar, and ultra-processed foods minimized. A 60-minute onboarding plus weekly 20-minute checks, 7-day rotating meal plans, and monitored adherence via 3×/week photo-assisted food logs.
2. **16:8 Intermittent Fasting:** Daily 16-hour fasting window and 8-hour feeding window (e.g., 12:00–20:00) maintained consistently, 7 days/week. Participants were not prescribed specific macros beyond standard balanced choices; total energy was ad libitum, but mindful eating was coached. Zero-calorie drinks permitted during fasting; resistance to snacking outside the window was reinforced with adherence prompts and logs.

Factor B (Training Schedule)
1. **High Intensity Interval Training:** 3 sessions/week of intervals at 85–95% HRmax: 10-min warm-up; 6–10 work bouts of 1 min high intensity with 1–2 min active recovery at 50–60% HRmax; 5-min cool-down. Total session time 28–40 min, progressed by adding bouts across weeks.
2. **Fast Continuous Training:** 5 sessions/week of continuous running at 65–75% HRmax for 35–45 min/session (progression: weeks 1–2 = 35 min; weeks 3–4 = 40 min; weeks 5–6 = 45 min).

Outcomes and Measurements
1. **Body Fat Percentage:** Measured at baseline and week 6 using multi-frequency bioelectrical impedance analysis, following standardized pre-test controls: morning, fasted, no vigorous exercise or alcohol for 24 h, and stable hydration.
2. **Resting Heart Rate:** Using a digital heart-rate monitor, the resting heart rate was measured at baseline and at week 6 following ten minutes in a quiet seated position in the morning, within 7:30 to 8:00 am.

Statistical Analysis: All statistical tests were conducted using the IBM SPSS Statistics Version 27. Before inferential statistics, the normality of the data was checked through the Shapiro-Wilk Test at 0.05%. Descriptive statistics (mean ± standard deviation) were computed for pre- and post-intervention values across all four intervention groups. To evaluate the independent and interactive effects of diet strategy (Low-Carb High-Fat vs. 16:8 Intermittent Fasting) and training modality (High-Intensity Interval Training vs. Fast Continuous Training) while controlling for baseline differences, a two-way Analysis of Covariance (ANCOVA) was performed for each outcome variable, with pre-test scores entered as covariates. Effect sizes were reported as partial eta squared (η^2), and statistical significance was set at an alpha level of $p < .05$ (two-tailed)

FINDINGS

Table No. 1: Descriptive Statistics of Body Fat % & Resting Heart Rate (Pre- and Post-Test) across Groups

Group	N	Body Fat % (Pre, Mean ± SD)	Body Fat % (Post, Mean ± SD)	Resting HR (Pre, Mean ± SD)	Resting HR (Post, Mean ± SD)
LCHF + HIIT	15	23.73 ± 1.10	21.60 ± 1.24	77.13 ± 1.72	72.53 ± 2.03
LCHF + FCT	15	23.00 ± 1.41	21.33 ± 1.49	78.07 ± 1.28	73.40 ± 2.19
IF + HIIT	15	22.93 ± 1.38	21.00 ± 2.00	78.20 ± 1.56	74.00 ± 1.77
IF + FCT	15	23.13 ± 1.35	21.00 ± 1.69	77.00 ± 2.03	72.40 ± 2.58

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Table No. 2: Two-Way ANCOVA (Analysis of Co-Variance) Table for Body Fat % & Resting Heart Rate (Controlling for Pre-Test Values)

Dependent Variable	Group	SS (Type III)	df	MS	F	*p* value	Partial η²
Body Fat %	Diet (LCHF vs. IF)	0.179	1	0.179	0.264	.609	.005
	Training (HIIT vs. FCT)	0.342	1	0.342	0.505	.480	.009
	Diet × Training	1.943	1	1.943	2.868	.096	.050
	Error (Residual)	37.26	1	0.677	-	-	-
Resting Heart Rate	Diet (LCHF vs. IF)	0.817	1	0.817	0.612	.437	.011
	Training (HIIT vs. FCT)	0.726	1	0.726	0.544	.464	.010
	Diet × Training	0.051	1	0.051	0.039	.845	.001
	Error (Residual)	73.410	1	1.335	-	-	-

The descriptive statistics presented in Table 1 provide an overview of the body fat percentage and resting heart rate of participants across the four intervention groups before and after the six-week program. The pre-test values indicate that the groups were relatively comparable at baseline, with body fat percentages ranging from approximately 22.9% to 23.7% and resting heart rates between 77 and 78 beats per minute. Following the intervention, reductions were observed in both parameters across all groups. Specifically, body fat percentage decreased modestly, with post-test means ranging from 21.0% to 21.6%, while resting heart rate also showed a decline, with values dropping to approximately 72–74 bpm across conditions. These results suggest that both dietary strategies (LCHF and IF) and training modalities (HIIT and FCT) contributed to favourable changes in body composition and cardiovascular indicators at the descriptive level.

Table 2 presents the results of the two-way ANCOVA, which examined the independent and interactive effects of diet and training on body fat percentage and resting heart rate while controlling for baseline values. For body fat percentage, neither diet ($F = 0.264$, $p = .609$, $\eta^2 = .005$) nor training ($F = 0.505$, $p = .480$, $\eta^2 = .009$) exerted a statistically significant main effect. However, the diet × training interaction approached significance ($F = 2.868$, $p = .096$, $\eta^2 = .050$), suggesting a potential trend for combined influences that did not reach the conventional alpha level. Similarly, for resting heart rate, no significant main or interaction effects were found for diet ($F = 0.612$, $p = .437$), training ($F = 0.544$, $p = .464$), or their interaction ($F = 0.039$, $p = .845$), with all partial η^2 values indicating small effect sizes. Taken together, the inferential analysis indicates that although improvements were evident descriptively across groups, the observed differences were not statistically robust, implying that both dietary and training strategies produced comparable benefits rather than distinctly superior outcomes.

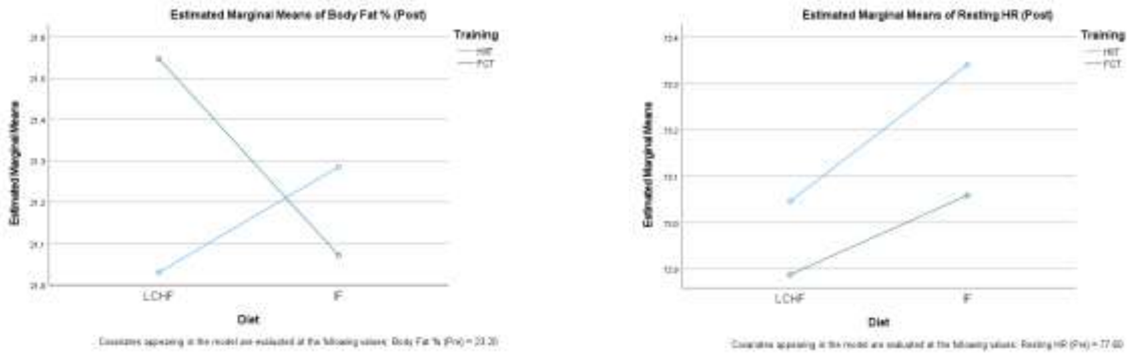

Figure No. 1: Estimated Marginal Means of Body Fat % and Rest Heart Rate of Adults undergoing Diet (LCHF vs. IF) and Training (HIIT vs. FCT)

DISCUSSION

The current study assessed and compared the effects of 16:8 Intermittent Fasting (IF), Fast Continuous Training (FCT), High-Intensity Interval Training (HIIT), and Low-Carb High-Fat (LCHF) diets on body fat percentage and resting heart rate (RHR) in physically active adults of Punjab. After six weeks, results showed improvements in body fat percentage and RHR in all groups, demonstrating the value of both dietary and exercise-based therapies for enhancing cardiovascular health and body composition indicators in this population.

Despite the positive results, the two-way ANCOVA showed that neither the primary effects of training (HIIT vs. FCT) nor diet (LCHF vs. IF), nor their combination, were statistically significant in affecting resting heart rate or body fat %. These results imply that both types of dietary modification and structured training provide similar advantages in a group that is already physically active, with no obvious advantage of one approach over the other. This finding is consistent with earlier studies showing that, in healthy young adults who engage in regular physical activity, the physiological benefits of dietary and exercise changes may plateau or become negligible during brief intervention periods (usually less than three months) because of preexisting adaptations like improved cardiovascular efficiency and metabolic flexibility (Antoni et al., 2023; Gibala et al., 2012; Hallberg et al., 2018).

The absence of significant results on inferential analysis and the small effect sizes may potentially suggest a possible ceiling effect, in which the participants' baseline levels of fitness and metabolic health restricted the amount of change that could be shown after additional intervention. Comparing sedentary or metabolically impaired populations to trained or physically active individuals, previous research has documented comparable limitations, demonstrating that the former frequently show reduced responsiveness to additional food or exercise modifications (Laursen, 2010; Morton et al., 2009). Additionally, because larger studies or longer interventions may still reveal synergistic effects that are not detected within the limitations of the current study design, the trend towards significance seen in the diet × training interaction on body fat percentage (p =.096) opens up a possibility for future research (Francois & Little, 2015; Sutton et al., 2018). Another consideration is that six weeks may be insufficient to elicit more pronounced changes, especially in parameters like body fat, which often require longer durations to show substantial shifts in well-conditioned individuals (Sloth et al., 2013; Tinsley & La Bounty, 2015).

However, these findings have practical implications for both individual well-being and public health. The findings highlight the effectiveness of several evidence-based approaches for controlling body composition and cardiovascular risk, particularly in active people. These include HIIT and FCT exercise regimens, as well as both LCHF and IF nutritional prescriptions. For practitioners and consumers looking for interventions that can be tailored to cultural preferences, lifestyle limitations, and individual motivation, this flexibility is beneficial. According to earlier studies, long-term health results are more influenced by intervention adherence and personalization than by the particular diet or exercise regimen used (Johnston et al., 2014; Keating et al., 2017). Clinicians and trainers should thus encourage consistency and adherence, as the magnitude of benefit appears more strongly linked to overall compliance rather than to a specific intervention model (Arnett & Laity, 2021; Ludwing et al., 2023).

Overall, the study confirms that small, consistent dietary and activity changes are still effective means of maximizing health, particularly when customized to the tastes and circumstances of the individual, even though no single technique was statistically superior. The results need to be investigated further in larger populations where differences between therapies may be more noticeable and clinically meaningful, such as sedentary people, older adults, or people with metabolic problems (Lowe et al., 2020). Future research should also consider longer intervention periods, larger sample sizes, and the inclusion of additional biomarkers to clarify the long-term and mechanistic impacts of combined diet and exercise interventions.

CONCLUSION

This six-week factorial study showed that among physically active young adults in Punjab, both training modalities—High-Intensity Interval Training (HIIT) and Fast Continuous Training (FCT)—and dietary strategies—Low-Carb High-Fat (LCHF) and 16:8 Intermittent Fasting (IF)—produced modest but positive reductions in body fat percentage and resting heart rate. Inferential analysis showed no statistically significant main or interaction effects, indicating similar efficacy across therapies, despite descriptive trends suggesting gains across all groups. According to these results, physiological adaptations in people who are already well-conditioned may plateau, reducing the amount of change that may be made in a short period of time. However, the findings highlight how adaptable evidence-based strategies are, enabling people to choose regimens that fit their own tastes, cultural background, and lifestyle limitations. To better understand the possible synergistic benefits of combined nutrition and exercise methods, future studies should include less-trained or metabolically at-risk people, expand sample sizes, and lengthen intervention periods.

Funding: Self-Funded

Conflict of Interest Statement: The authors declare no conflict of interest.

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