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Fasting Total Cholesterol with HIIT: Acute Response 20 Minutes after a Single 20-Minute HIIT Ergocycle Session in Young Men

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Abstract: This study aimed to determine whether total cholesterol levels differed between 10 minutes before exercise and 20 minutes after a single session of high-intensity interval training (HIIT) performed on an ergocycle under overnight fasting conditions. This quantitative study employed a one-group pretest–posttest design. The participants were 41 healthy male university students aged 20–21 years with a body mass index of 20–23.9 kg/m² who met the inclusion criteria. All participants underwent overnight fasting for at least 8 hours, with water intake permitted, and avoided strenuous physical activity for 48 hours before testing. Total cholesterol was measured using an EasyTouch point-of-care device from capillary blood samples collected before and after a 20-minute HIIT ergocycle session. Data were analyzed using the Shapiro–Wilk normality test and a paired-samples *t*-test, with statistical significance set at $p < 0.05$. The results showed that 97.6% of participants experienced a decrease in total cholesterol, with mean values declining from 183.93 ± 12.10 mg/dL before exercise to 168.78 ± 12.77 mg/dL after exercise. The difference was statistically significant, $t(40) = -13.43$, $p < 0.001$, with a large effect size (Cohen's *d*_z = −2.10). In conclusion, a single HIIT ergocycle session was associated with an acute reduction in measured total cholesterol concentration during early recovery under overnight fasting conditions.

Keywords: HIIT ergocycle; total cholesterol; acute exercise; overnight fasting; capillary blood point-of-care device

INTRODUCTION

Dyslipidemia is a disorder of lipid metabolism characterized by abnormal concentrations of circulating lipids, including elevated total cholesterol (Andi Makbul Aman, 2021). This condition contributes to an increased risk of cardiovascular disease. Although discussions of dyslipidemia are often focused on clinical populations, young adults may also present with suboptimal lipid profiles. Lifestyle-related factors such as low physical activity, high-sugar dietary patterns, and irregular sleep habits may further worsen these profiles. Therefore, sport science research examining cholesterol responses in young adults is relevant within the framework of primary prevention and health promotion.

Lifestyle modification remains the primary strategy for reducing cardiometabolic risk, and physical exercise is an important component because it affects energy regulation and metabolic response. One type of exercise that has received widespread attention is high-intensity interval training (HIIT), which consists of repeated periods of high-intensity exercise interspersed with recovery periods. Intervention studies of HIIT over several weeks have reported changes in cardiometabolic indicators, including lipid parameters, although the magnitude of these effects varies depending on the protocol design and participant characteristics (Racil et al., 2023; Stankovic et al., 2025; Yamaner et al., 2025). Findings in diverse populations suggest that the relationship between HIIT and lipid profiles has been primarily understood through chronic study designs.

However, a single session of HIIT may also produce immediate physiological effects during early recovery, such as greater sympathetic stimulation, increased energy demand, and short-term hemodynamic and metabolic shifts. Because recovery is a highly dynamic period, fluctuations in plasma volume, hemoconcentration, and hemodilution may alter the interpretation of blood biomarkers, including total cholesterol. Therefore, the timing of post-exercise blood sampling may represent a key factor explaining discrepancies among findings in acute studies.

In addition to sampling time, pre-analytical factors, particularly fasting status, also determine result stability. In lipid research, overnight fasting (at least 8 hours) is commonly used to reduce variability caused by recent food intake and to improve comparability both between participants and across measurement time points. Non-uniform fasting duration may alter the interpretation of certain lipid parameters;

therefore, a clear definition of fasting is important in an acute pre-post design (Ercan & Manav, 2025). In the present study, standardized fasting was implemented, with plain water intake still permitted to maintain participant safety and compliance.

Previous studies have indicated that rapid capillary blood-based testing devices, commonly referred to as point-of-care (POC) devices, are frequently used because they are practical and rapid, although their accuracy may be lower than that of standard laboratory analysis. (Robert Lourdes et al., 2024). Given that the EasyTouch device provides total cholesterol readings, the present study focused on total cholesterol as an indicator that can be obtained directly through a standardized POC procedure. However, acute changes in total cholesterol after a single HIIT session remain unclear. Existing findings have been inconsistent, likely because the response is influenced by metabolic conditions and the timing of post-exercise blood sampling. Similarly, glucose and lipid responses to acute exercise do not appear to be consistent across measurement settings (Kazeminasab et al., 2025).

Based on this background, it remains unclear how total cholesterol changes under standardized fasting conditions when measured during early recovery, particularly around 20 minutes after a single 20-minute HIIT ergocycle session. The selection of the 20-minute time point was considered relevant because blood sampling was not performed immediately at exercise cessation, thereby potentially reducing the influence of very rapid hemodynamic fluctuations that occur during the first few minutes after exercise. (Bjerre-Bastos et al., 2022), while also improving procedural uniformity across participants. Therefore, this study aimed to determine the difference in total cholesterol levels between 10 minutes before exercise and 20 minutes after a HIIT ergocycle session in male students aged 20–21 years under overnight fasting conditions of at least 8 hours. The working hypothesis of this study was that a difference in total cholesterol levels would be observed between the pre- and post-single-session HIIT measurements.

METHOD

This study employed a quantitative approach with an acute experimental design using a one-group pretest–posttest model. The primary variable of interest was total cholesterol, which was measured twice under overnight fasting conditions, namely before and after a single session of HIIT performed on an ergocycle. The participants comprised 41 male university students aged 20–21 years with a body mass index (BMI) ranging from 20 to 23.9 kg/m². Participants were recruited using purposive sampling based on predefined eligibility criteria. All participants were in good health and had no illness, injury, or physical complaint that could interfere with their ability to complete the ergocycle exercise protocol. Before participation, each participant received a detailed explanation of the study procedures, potential risks, and benefits and provided written informed consent. The study protocol was approved by the [name of the research ethics committee (Komisi Etik Penelitian, KEP), Institute for Research and Community Service (Lembaga Penelitian dan Pengabdian kepada Masyarakat, LPPM), Universitas Negeri Malang, under approval number 12.02.01/UN32.14.2.8/LT2032, dated February 12, 2026. The study was conducted at the Sport Science Laboratory, Faculty of Sport Science, Universitas Negeri Malang.

The inclusion criteria were as follows: male, aged 20–21 years, BMI 20–23.9 kg/m², healthy, and willing to complete all research procedures. The exclusion criteria were illness or injury, complaints that limited ergocycle exercise performance, or non-compliance with fasting requirements and exercise restrictions before measurement. To standardize the pre-analytical conditions for lipid measurement, all participants underwent overnight fasting for at least 8 hours prior to data collection; however, plain water intake was permitted during the fasting period. Participants were also instructed to avoid vigorous physical exercise for 48 hours before testing in order to minimize the residual effects of prior exercise on biomarker responses.

All procedures were completed during a single visit. Pre-test total cholesterol measurement was performed 10 minutes before the HIIT session. Participants then completed a 20-minute HIIT session. Post-test measurement was conducted 20 minutes after the completion of exercise in order to capture the response during the early recovery phase using a standardized procedure across all participants.

The intervention consisted of a single acute session of high-intensity interval training (HIIT) performed on an ergocycle, based on a short-interval cycling HIIT model previously used in earlier studies. HIIT is characterized by a series of high-intensity work intervals interspersed with active or passive recovery periods. A 20-minute HIIT protocol with a 10:50-second work-to-recovery ratio at high intensity has been previously reported (Alansare et al., 2018). Based on this reference, this study applied 20 interval cycles on an ergocycle (1 cycle = 60 seconds), with each cycle consisting of 10 seconds of exercise at 100 rpm, followed by 50 seconds of active recovery at 50 rpm, resulting in a total exercise duration of 20 minutes. Heart rate was monitored throughout the training session using a Polar H9 heart rate monitor, and exercise intensity was targeted at approximately 90% of maximum heart rate (HRmax), with 179 beats per minute (bpm) used as the operational target during the HIIT session (Vigriawan et al., 2022).

Heart rate targets were estimated from maximum heart rate (HRmax) using the formula 220 − age. For participants aged 20–21 years, the estimated HRmax was 199–200 bpm; thus, 90% HRmax corresponded to approximately 179–180 bpm. Therefore, the target intensity was set at 179 bpm to ensure a high-intensity training stimulus throughout the HIIT session. Ergocycle resistance was set at 1.5 kp during the work and active recovery phases to standardize the mechanical load.

Total cholesterol is measured using an EasyTouch point-of-care (POC) device with a capillary blood sample, and the results are reported in mg/dL. Capillary blood is taken from the fingertip using a sterile disposable lancet and applied directly to a compatible total cholesterol test strip according to the manufacturer's instructions. The same procedure is followed for measurements before and after the test to maintain measurement consistency.

Point-of-care (POC) devices used in quantitative studies have been evaluated for reliability through repeatability and agreement with standard laboratory reference methods. Previous evaluations of lipid POC devices have shown that such instruments may demonstrate good correlation with reference methods and acceptable repeatability for total cholesterol measurement; however, the level of agreement may vary across devices, thereby requiring quality control procedures and cautious interpretation (Kim & Yoon, 2021; Robert Lourdes et al., 2024; Yu et al., 2023). In addition, a recent rapid review emphasized the heterogeneity of the evidence regarding cholesterol POC devices, as well as the importance of assessing potential bias and analytical precision (Mutepfa et al., 2025). Data were presented as mean ± standard deviation (SD) or median [interquartile range (IQR)], depending on the distribution. Normality was assessed using the Shapiro-Wilk test. Differences in total cholesterol between the pre-test and post-test were analyzed using a paired t-test when the data were normally distributed, or the Wilcoxon signed-rank test when the normality assumption was not met. Statistical significance was set at $p < 0.05$. Effect sizes were reported as Cohen's d for the paired t-test or r for the Wilcoxon test.

RESULT AND DISCUSSION

Result

The analysis of 41 male students showed that most participants experienced a reduction in total cholesterol after a single session of HIIT performed on an ergocycle. At the individual level, 40 of 41 participants (97.6%) demonstrated a decrease in total cholesterol, whereas 1 participant (2.4%) showed a slight increase. Descriptively, mean total cholesterol decreased from 183.93 ± 12.10 mg/dL at pre-test to 168.78 ± 12.77 mg/dL at post-test. The mean difference in total cholesterol (post–pre) was −15.15 ± 7.22 mg/dL (Table 1).

Table 1. Descriptive statistics and direction of change of fasting total cholesterol before and after HIIT

Variable/Indicator	N	Minimum	Maximum	Mean	Std. Deviation
TC Pre (mg/dL)	41	160	204	183.93	12.10
TC Post (mg/dL)	41	138	190	168.78	12.77
ΔTC (Post–Pre) (mg/dL)	41	-29	3	-15.15	7.22

The normality test for the difference in total cholesterol using the Shapiro-Wilk test indicated a normal distribution ($p = 0.451$); therefore, the comparison between pre-test and post-test values was conducted using a paired-samples t-test (Table 2).

Table 2. Normality test

Analysis	Statistic	df	p
Shapiro–Wilk normality test	W = 0.974	41	0.451

The paired-samples t-test revealed a highly significant difference in total cholesterol before and after HIIT, with $t(40) = -13.43$ and $p < 0.001$ (Table 3). These findings indicate that total cholesterol after HIIT was significantly lower than before HIIT. The effect size was also very large (Cohen's dz = −2.10), indicating a substantial reduction in total cholesterol relative to the variability of change across participants. The 95% confidence interval for Cohen's dz (−2.64 to −1.54) lay entirely in the negative direction, further supporting the consistency of the reduction in total cholesterol within this sample (Table 3).

Table 3. Paired Samples t-test and Effect Size 95% Cl for Cohen's dz

Outcome (Paired)	t	df	p	Cohen's dz	(Lower)	Upper
Total cholesterol (TC)	-13.43	40	< 0.001	-2.10	-2.64	-1.54

Discussion

The present study showed that mean total cholesterol concentration decreased from 183.93 ± 12.10 mg/dL before exercise to 168.78 ± 12.77 mg/dL at 20 minutes after a single HIIT ergocycle session. However, the magnitude of this change over a relatively short recovery period should be interpreted cautiously. The observed decrease represents an acute and time-specific change in measured capillary total cholesterol concentration and should not be interpreted as evidence that a single HIIT session permanently reduced whole-body cholesterol. Acute high-intensity exercise can induce rapid alterations in plasma volume and fluid distribution between the intravascular and interstitial compartments. Hemoconcentration may occur during exercise, whereas fluid redistribution during early recovery may contribute to relative hemodilution. These dynamic changes may influence the measured concentration of circulating biomarkers, including total cholesterol (Bjerre-Bastos et al., 2022). Because plasma volume, hematocrit, and hemoglobin were not assessed in the present study, it was not possible to determine whether the observed reduction reflected a metabolic response, a transient change in blood concentration, or a combination of both.

The findings may also have been influenced by hydration status, peripheral perfusion, capillary fluid dynamics, and variability in finger-prick blood sampling. In addition, although the EasyTouch point-of-care device provides a practical and rapid assessment of total cholesterol, its analytical accuracy and agreement with laboratory reference methods may vary according to the device, sampling conditions, blood volume, and testing procedure (Kim & Yoon, 2021; Mutepfa et al., 2025; Robert Lourdes et al., 2024; Yu et al., 2023). Recent evidence has also highlighted heterogeneity in the analytical performance of cholesterol point-of-care devices, supporting cautious interpretation of short-term changes measured using these instruments (Mutepfa et al., 2025; Vigriawan et al., 2024).

Therefore, the present findings indicate a temporal association between a single HIIT session and a lower measured capillary total cholesterol concentration at 20 minutes of recovery, rather than definitive evidence of an immediate or sustained reduction in body cholesterol. Further studies using a control group, repeated post-exercise measurements, plasma-volume correction, and laboratory-based lipid analysis are required to confirm the physiological significance and duration of this acute response.

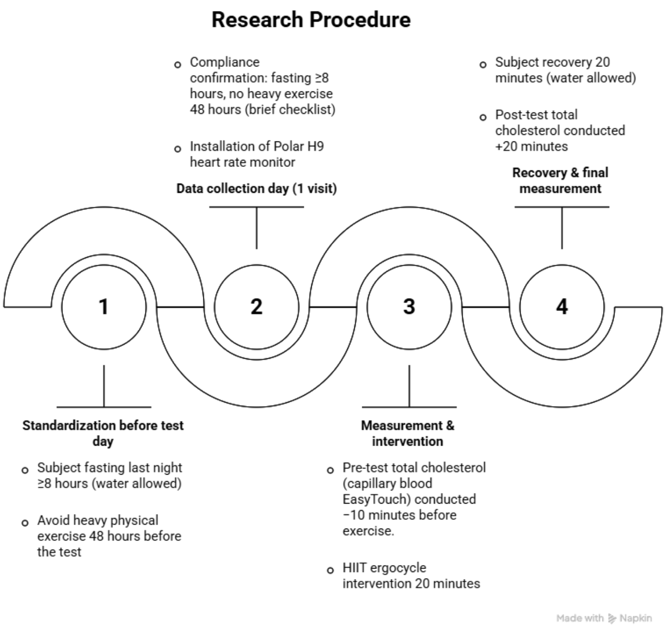

Figure 1. Research Procedure

CONCLUSION

A single 20-minute HIIT ergocycle session under overnight fasting conditions was associated with a significant decrease in total cholesterol levels during the early recovery phase. These findings suggest that acute lipid responses may be detectable within 20 minutes after HIIT. However, interpretation should remain cautious given the absence of a control group and the use of a point-of-care capillary device rather than a laboratory reference method. Further studies involving controlled designs, repeated sampling after exercise, and laboratory-based measurements are needed to clarify the kinetics and physiological mechanisms of the acute total cholesterol response to HIIT.

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