

Research Article

Effects of soleus push-ups on lipid profile among young population

Mehnoor Butt^{1*}, Sara Noor¹, Obaid Baig Mirza², Abdul Quddoos³

Abstract

Background: Recent interest has emerged in soleus push-ups, due to the unique physiological characteristics to sustain prolonged activity. These exercises can be performed with minimal equipment, and may offer a practical alternative for sedentary individuals for acute lipid profile responses.

Objective: To evaluate the effects of moderate intensity and sustained soleus pushups on lipid profile level in sedentary young adults.

Method: A randomized controlled trail was conducted on n=33 sedentary healthy young, aged 18 to 35 years. Participants were placed into three groups: Group A did moderate-intensity soleus pushups, Group B did continuous soleus push-ups, and Group C served as a control group. The primary outcome measure was the change in lipid profile, including high-density lipoprotein, lower cholesterol, total cholesterol and triglycerides was gathered at baseline and after 4.5 hours of intervention.

Results: Within-group analysis revealed significant changes in lipid profiles. In MSPU, HDL (p=0.028), total cholesterol (p=0.024), and triglycerides (p=0.005) increased, while LDL was unchanged. SSPU showed reduced LDL (p=0.013) and increased triglycerides (p=0.005). Control group had increases in HDL (p=0.020), total cholesterol (p=0.010), and triglycerides (p=0.010), with non-significant LDL changes. Between-group differences were non-significant (p≥0.05).

Conclusion: The findings reveal that moderate and continuous push-ups have varied impacts on sedentary youth's lipid profile. Although HDL, triglycerides, and total cholesterol levels varied considerably across groups, LDL levels did not. Triglyceride levels changed significantly at baseline and four hours after the intervention. These findings emphasize the need of examining various attempts to promote lipid metabolic alterations in isolated individuals.

Keywords: High Density Lipoproteins (HDL), Lipid Profile, Low Density Lipoproteins (LDL), Moderate intensity exercise, Physical activity, Short duration exercise, Soleus push-ups, Sustained exercise, Triglycerides, Young population.

Clinical trial # NCT06326788

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Citation

Mehnoor Butt, Sara Noor, Obaid Baig Mirza, Abdul Quddoos. Effects of soleus push-ups on lipid profile among young population. T Rehabili. J. 2025;09(04); 26-31 doi: 10.52567/trehabj.v9i04.104.

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Article History

Received on: 08-05-2025

Revision on: 28-12-2025

Published on: 29-12-2025

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INTRODUCTION

The lipid profile with elevated triglycerides, low high-density lipoprotein cholesterol (HDL-C), and abnormal low-density lipoprotein cholesterol (LDL-C), is increasingly prevalent among young adults due to sedentary lifestyles, low physical activity and prolonged sitting[1]. Early alterations in lipid profile during youth are clinically significant, as they contribute to the early development of atherosclerosis and increase the long-term risk of cardiovascular and metabolic diseases[2].

The effects of exercise has been shown to induce desirable changes in plasma lipid levels, particularly an increase in high-density lipoprotein (HDL) and a decrease in triglycerides (TG)[3]. Endurance training (ET) offers metabolic benefits, including improved lipid profiles, body fat, and blood sugar control[4]. Physical activity is a well-established conservative management to improve lipid metabolism. However, moderate-to-vigorous aerobic activities are often emphasized[3]. These activities are usually difficult to adopt or sustain among young individuals due to time restraints, low motivation, or predominantly sedentary routines. Consequently, localized, low-threshold exercises are gaining interest, as can be frequently performed with minimal equipment[5,6]. Despite convincing evidence, challenges remain in the feasibility and accessibility of regular exercise.

Soleus push-ups, targeting the soleus muscle, improve oxygen consumption, blood sugar levels, and triglycerides. Sustained soleus push-ups involve prolonged, high-intensity contractions, enhancing endurance and stability, while moderate soleus push-ups are shorter and lower intensity, enhancing strength and flexibility[7]. This study compares moderate and sustained soleus push-ups, each exerting unique physiological impacts. By evaluating the effects of these exercises on lipid profiles among young people, this research aims to establish soleus

push-ups as a practical, low-cost strategy to improve metabolic health and reduce cardiovascular risks among young populations globally. This research fills critical gaps in understanding the acute impacts of soleus push-ups on lipid levels, providing insights into preventive health measures for chronic metabolic diseases.

METHODOLGY

Study design: A single blinded, crossover, randomized clinical trial was initiated after getting approval from the Research Ethic Committee (Riphah/RCRAHS-ISB/REC/MS-PT/01819) of Riphah International University, Islamabad. The study was conducted at Pakistan Railway General Hospital from March 2024 To June 2024. The purpose of the study was explained to the subjects and written informed consent in accordance with Declaration of Helsinki was obtained.

Selection criteria: A non-probability convenient sampling technique was employed for sample collection, focusing on participants who met specific inclusion criteria: adults aged 18-35, healthy BMI, gender equality, and a sedentary lifestyle. Exclusion criteria was individuals with a history of metabolic disorders, recent fractures, lower-limb injuries, knee injuries, those following a prescribed diet and exercise routine, any congenital abnormalities, deep vein thrombosis (DVT), lower limb amputations, or diagnosed hyperlipidaemia. Participants not meeting these criteria were excluded from the study.

Sample size: The total sample size was calculated by G-power. This study would contain a total of 33 participants, divided into two groups of 11 each. The effect size is 0.25, the alpha error probability is 0.05, and the power is 0.85. A total of n=33 participant was then randomly divided into three groups A (n=11), group B (n=11) and control group (n=11).

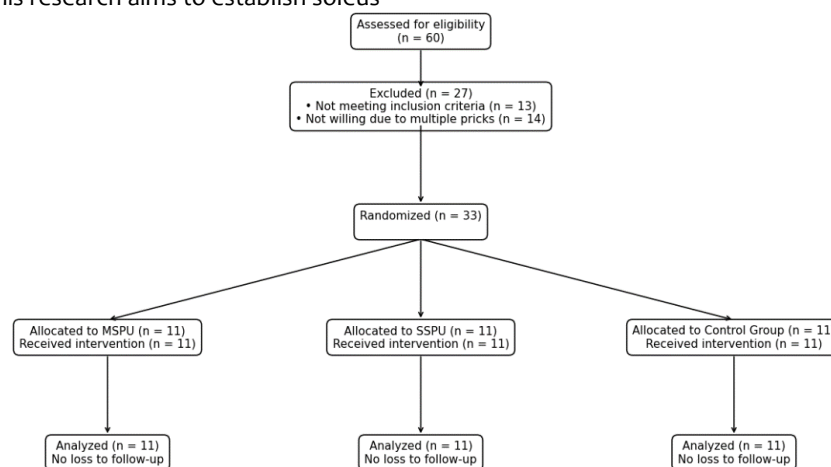


Figure 1: Consort Diagram

Randomization: To avoid selection bias and allow for group comparisons, individuals were assigned to one of three groups using random allocation software 2.0. Each participant was given a unique identification, and a random list was created to divide them into three groups: mid-soleus push-up (MSPU), sustained soleus push-up (SSPU), and control. The deployment order remains concealed until the intervention is deployed. Participants learned about group assignments only after the baseline exam was finished. The randomization list was kept hidden from the study coordinators, who assigned participants in sealed opaque envelopes following a specified methodology.

Intervention: The intervention detail was explained to subjects and none of the participants were harmed during the study. Participants were divided into three groups for the study. The intervention group, Group A, performed moderate soleus push-ups with resistance until they reached their maximum heart rate (MHR). Group B conducted sustained soleus push-ups for up to 270 minutes. While the control group did not receive any intervention. This design aimed to compare the effects of different durations and intensities of soleus push-ups on participants. These all exercises were performed by the participants actively under supervision after being demonstrated by the therapist, inside the physiotherapy OPD Pakistan Railway General Hospital. (Table 1)

Table 1: Intervention Protocol

Group A (MSPU)	Group B (SSPU)	Group C (Control)
Participants started soleus push-ups in sitting positions. To do so, the participants were seated position, the legs were at 90 degrees to the floor, feet placed flat on the ground. Participants then moved their heels up and down continuously. Soleus push-ups performed with moderate intensity using weights placed on their laps. The weight was calculated from 1RM of 30-40% of soleus muscle's strength for time till muscle fatigued.	Participants started soleus push-ups in sitting. To do so, the participants were in a seated position, the legs were at 90 degrees to the floor, and feet were placed flat on the ground. Participants then move their heels up and down continuously. Sustained soleus push-ups performed without any resistance, light intensity for up to 4.5 hours. Participants were provided with a maximum 4-minute break time after every 90-minute intervention.	No intervention

Data Collection Procedure: The purpose of the study explained to the participants. Written informed consent taken. All participants have had the same breakfast, and after 30 minutes of the breakfast, baseline data of lipid profile was taken. The participant then performed soleus push-ups as mentioned in table 1. The second sample for lipid profile was obtained after 4.5 hours. The blood sample was collected by qualified lab technologist.

Outcome Measures: The primary outcome measure of this study is the lipid profile, comprising total cholesterol (TC), HDL cholesterol (good cholesterol), LDL cholesterol (bad cholesterol), and triglycerides. These components are crucial

indicators of cardiovascular health and metabolic function.

Statistical methods: For within group changes after 4.5 hours, the paired sample test was used. While for group differences One-way ANOVA test was used. The level of significance was set at $p < 0.05$ and SPSS version 2 was used to analyse the data.

RESULTS

The mean age of participants as 23.88 ± 2.42 (min 18 and max 35) years. While the BMI ranges from 22.13 to 23.01, with a mean of 23.36 ± 4.91 . All descriptive statistics are based on a valid sample of $n=33$ individuals.

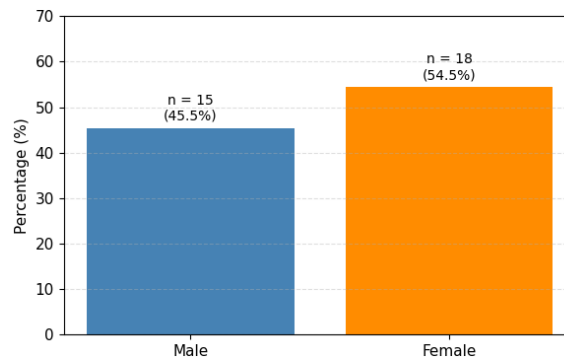


Figure 2: Gender

The paired sample t-test analysis showed different patterns of lipid profile changes across the three groups from pre- to post-intervention. In the MSPU group, statistically significant increases were observed in HDL ($p=0.028$, $d=-0.586$), total cholesterol ($p=0.024$, $d=-0.607$), and triglycerides ($p=0.005$, $d=-0.786$), while LDL showed no meaningful change ($p=0.820$). The SSPU group demonstrated a unique and favorable significant reduction in LDL ($p=0.013$, $d=0.709$) alongside a

highly significant increase in triglycerides ($p=0.005$, $d=-0.833$), with HDL and total cholesterol showing non-significant increases ($p \geq 0.05$). The Control group exhibited significant increases in HDL ($p=0.020$, $d=-0.627$), total cholesterol ($p=0.010$, $d=-0.710$), and triglycerides ($p=0.010$, $d=-0.711$), with LDL showing a non-significant ($p=0.056$) increase. (table 2) One-way ANOVAs showed no significant ($p \geq 0.05$) between-group differences for HDL, LDL, total cholesterol, or triglycerides. (Figure 3)

Table 2: Pre-post Results lipid profile

Group	Lipid Marker	Pre	Post	MD	p-value	Cohen's d
		Mean±SD	Mean±SD			
MSPU	HDL	33.80±8.01	35.07±8.75	-1.27	0.028*	-0.586
	LDL	152.13±39.88	152.99±34.89	-0.86	0.820	-0.056
	CHOL	157.18±21.21	164.12±23.43	-6.94	0.024*	-0.607
	TRIGLY	96.41±31.30	137.76±72.26	-41.35	0.005*	-0.786
SSPU	HDL	31.96±5.56	32.55±5.96	-0.59	0.176	-0.355
	LDL	173.84±35.15	165.21±38.95	8.63	0.013*	0.709
	CHOL	159.81±27.81	162.75±29.80	-2.94	0.176	-0.355
	TRIGLY	89.69±43.94	150.56±109.07	-60.88	0.005**	-0.833
Control	HDL	33.25±6.55	35.20±7.97	-1.95	0.020*	-0.627
	LDL	169.18±39.08	174.71±38.33	-5.53	0.056	-0.499
	CHOL	161.24±28.82	167.76±29.04	-6.53	0.010*	-0.710
	TRIGLY	82.18±34.51	100.12±35.68	-17.94	0.010*	-0.711

Statistical significance- $p < 0.05$ $p < 0.05$

Cohen's *d*- effect size- small (-0.2); medium (-0.5); large (-0.8); MSPU- mid-soleus push-up; SSPU- sustained soleus push-up; HDL- High-Density Lipoprotein; LDL-Low-Density Lipoprotein; CHOL-Cholesterol; TRIGLY -triglycerides

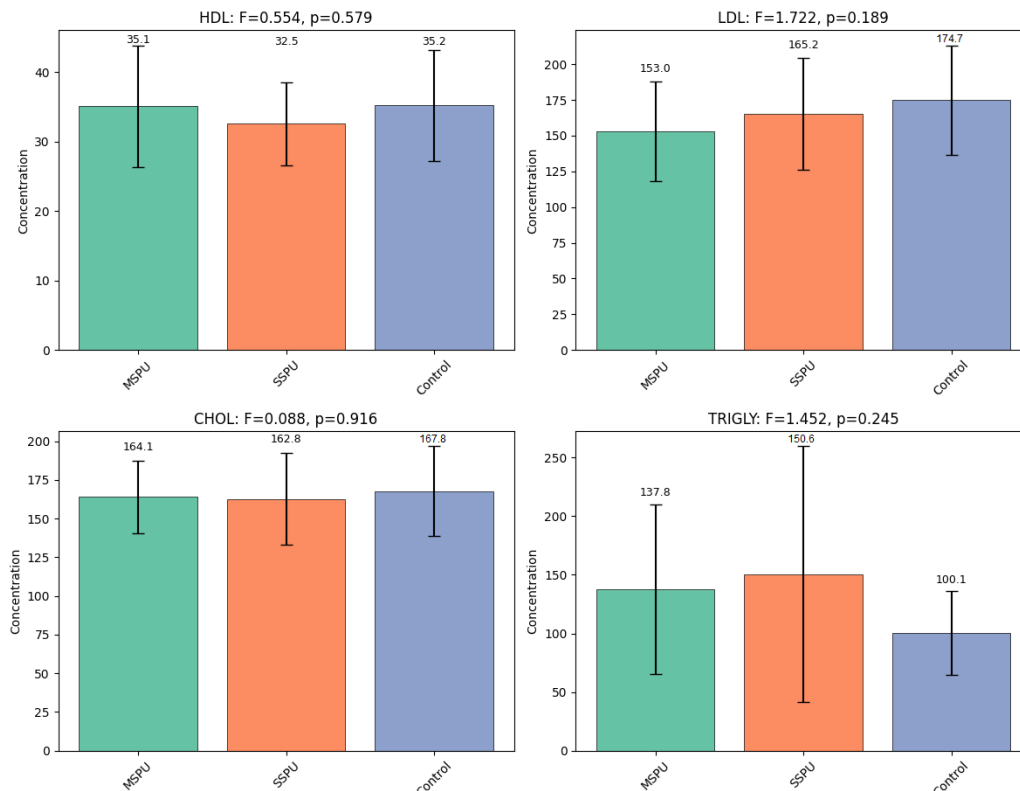


Figure 3: Group comparison on lipid profile (One Way ANOVA)

DISCUSSION

In the present single-session study involving sedentary young adults, paired t-tests showed significant within-group changes in triglycerides and

total cholesterol in MSPU and control groups, and an increase in LDL in the SSPU group. However, no statistically significant differences were found between the MSPU, SSPU, and control groups for most lipid outcomes. This result suggests that acute

soleus push up exercises may induce significantly changes in lipid profile within groups. But the magnitude of these changes may not be strong enough to differ significantly across intervention types in a single session.

The acute effects of short term on lipids are well-documented, especially on triglycerides. As these exercises enhances triglyceride clearance from the circulation due to increases muscle lipoprotein lipase activity. So even in single sessions, producing short-term TG reductions regardless of long-term training status in postprandial lipid response. The aerobic exercise decreases the rise in triglycerides after meals, due to increased Triglyceride-Rich Lipoprotein (TRL) clearance and reduced Very Low-Density Lipoprotein (VLDL) secretion from liver[8]. In many studies, triglyceride lowering occurs even with moderate or low-intensity exercise and does not require high intensity[9,10]. But a single session of soleus push-up exercises in healthy sedentary young adults led to within-group increases in triglycerides, alongside modest changes in HDL, LDL, and total cholesterol. Acute exercise performed within a few hours of a meal does not always reduce triglycerides; in fact, they can temporarily rise before exercise-induced clearance occurs[11].

On the other hand, acute changes occurred in HDL and LDL were not very clear, often requires more energy expenditure or repeated training. Meta-analyses show that chronic aerobic training modestly increases HDL and reduces LDL over weeks of regular training. But acute increase in HDL is not much consistent, and changes are smaller as compared to triglycerides[12]. Single-sessions often fail to show acute significant changes in HDL or LDL, as lipid measurements are taken only a few hours post-exercise[13]. This is consistent with the lack of significant between-group differences in HDL and LDL in the present study.

Similarly, a systematic review reported a wide range of lipid responses across different exercise types and intensities in LDL, HDL, or total cholesterol after short-term interventions[14]. Another explanation for the absence of significant between group differences is physiological variability and the acute, variable responses. Post-exercise lipid changes can be influenced by recent food intake, timing of blood sampling, and individual metabolic variability, so make group differences harder to detect the changes in a single session without tight dietary control. Even in studies with well-controlled aerobic exercise, often report mixed results for HDL and LDL immediately after[13].

Given these factors, our findings of within-group lipid changes in the absence of statistically significant between-group differences are not

unexpected and underscore the importance of study duration, energy expenditure, and repeated exercise stimuli for eliciting true interventional differences in lipid profiles.

CONCLUSION

Acute soleus-focused exercises may transiently modify lipid parameters in healthy young individuals especially in triglycerides. However, no statistically significant between-group differences were observed across MSPU, SSPU, and control groups for HDL, LDL, total cholesterol, or triglycerides. So, a single exercise session is insufficient to generate differential lipid responses between varying exercise intensities. to achieve clinically meaningful and sustained improvements in lipid profiles, repeated training sessions for longer durations with patient with abnormal lipid profile are likely required.

DECLARATIONS & STATEMENTS

Author's Contribution

MB and SN: substantial contributions to the conception and design of the study.

MB, OBM and AQ: acquisition of data for the study.

MB: interpretation of data for the study.

MB: analysis of the data for the study.

MB, SN, OBM and AQ: drafted the work.

MB, SN, OBM and AQ: revised it critically for important intellectual content.

MB, SN, OBM and AQ: final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

The study conducted in Pakistan railway general hospital from march 2024 to June 2024. Ethical approval was taken from Research Ethical Committee of Riphah College of Rehabilitation and Allied Health Sciences, Islamabad (Riphah/RCRAHS-ISB/REC/MS-PT/01819).

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Acknowledgments

None to declare.

Funding Sources

None to declare.

Conflicts of Interest

None to declare.

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