Asia-Pacific Journal of Science and Technology: Volume: 29. Issue: 05. Article ID.: APST-29-05-14. Research Article

APST

Asia-Pacific Journal of Science and Technology

https://www.tci-thaijo.org/index.php/APST/index

Published by the Research Department,
Khon Kaen University, Thailand

Short-term impact of mini-marathon running on alteration of blood lipoproteins

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Received 14 November 2023
Revised 14 March 2024
Accepted 25 April 2024

Abstract

Individuals are increasingly aware of their health and often engage in various exercises to improve it. Mini-marathon running has become particularly popular due to its minimal equipment needs and its benefits for both physical and mental well-being. Lipoproteins, different forms of adipose tissue, are crucial indicators of general health. However, studies on how mini-marathon running affects lipoprotein levels are limited. Therefore, this study involved ten healthy volunteers who participated in a mini-marathon to investigate potential changes in their lipoprotein levels. Blood samples were collected before and after the test to measure any changes. The results indicated that participating in a single mini-marathon significantly reduced weight, body fat percentage, body mass, cholesterol, high-density lipoprotein (HDL), and low-density lipoproteins (LDL) levels (Z= -1.972, -2.002, -2.275, -3.05, -2.468, -2.200 with *p*-values of 0.049, 0.045, 0.023, 0.002, 0.014, and 0.028, respectively). However, the effects on lipoprotein patterns varied among individuals, likely due to the unique physiological responses triggered by the run. Consequently, the researchers recommend further studies to explore the long-term effects of physical activity on lipoprotein fluctuations.

Keywords: Mini-marathon, Lipoprotein, Blood, HLD, LDL, Running

1. Introduction

Exercise is the physiological process through which muscles engage in coordinated contractions to facilitate bodily movement [1]. This activity not only enhances individuals' well-being through various benefits but also improves cardiovascular and circulatory system functions, acting as a preventive measure against cardiovascular diseases, diabetes, obesity, and knee osteoarthritis. Furthermore, exercise aids in weight management, enhances body equilibrium and mobility, supports excretory system functionality, reduces stress levels, and promotes restful sleep. Studies have shown that regular physical activity contributes to a decrease in the incidence and risk of coronary artery disease (CAD) by lowering low-density lipoprotein (LDL) levels [2–5] and correlates with reduced CAD occurrences [6–8]. Incorporating physical activity into daily routines is recommended, with a guideline of 30 minutes per day, three days a week. Short-term exercise can induce increases in high-density lipoproteins and decreases in triglycerides [9]. In contemporary times, exercises requiring minimal equipment, such as marathon or mini-marathon running, have gained popularity. The mini-marathon, a 10.5-kilometer run, is particularly appealing in health-conscious communities, like those in Thailand, due to its manageable distance and minimal equipment needs, promoting health and well-being effectively [10]. Regarding the impact of exercise on cholesterol levels, it was found that although exercise can influence total cholesterol, the effect is modest, about 10 mg/dL or 2%, varying with the type and intensity of the exercise. Endurance exercises, categorized as aerobic activities, tend to have a positive impact, whereas walking workouts may not be as effective. Studies by Kelley et al. [11] on walking workouts and lipoprotein changes in 1,176 individuals aged 18 and older showed no significant changes in total cholesterol. However, Kelley and Kelley [12] reported that regular aerobic exercise over eight

weeks could decrease cholesterol levels by 2% with statistical significance. Furthermore, Dressendorfer et al. [13] found that effects of marathon running on high-density lipoprotein (HDL) level in blood of 12 male volunteers was increased the HDL level, consistent with a studied of Adner et al. [14] showing that marathon running significantly increased HDL level in blood of marathon volunteers.

Nevertheless, a limited number of research have been conducted to examine the short-term effects of marathon and mini-marathon running on blood lipoproteins. The increasing significance of mini-marathons as a form of exercise among health-conscious individuals in Thailand has prompted the researcher to investigate the impact of mini-marathon running on alterations in blood lipoprotein profiles among Thai volunteers.

2. Materials and methods

2.1 Subjects

The total number of subjects was determined using the G*Power program (version 3.1.9.7) according to the following parameters Test family: T-test; Statistical test: Means: Difference from constant (one sample case); Type of power analysis: Compromise; Effect size: 0.6; β /α ratio : 1; Power of test (1- β err prob): 0.82; Total sample size: 10. Then, ten volunteers [15,16] were randomly selected from 240 students according to the following criteria:

2.1.1 Inclusion criteria

1. Volunteers must be between the ages of 18 and 22 years old and enrolled at Thailand National Sports University, Trang Campus.
2. Optimal health is required, with no pre-existing medical conditions that could impede physical activity, as determined by the Physical Activity Readiness Questionnaire (PAR-Q). Responses to all queries in the PAR-Q must be "never."
3. Volunteers must have signed an informed consent form prior to participation in the experiment. The study was approved by the Research Ethics Committee of Thailand National Sports University, meeting all ethical standards.
4. Regular exercise engagement or previous participation in mini-marathon running (1-2 times per year) is necessary, although current engagement in such activities should be minimal.

2.1.2 Exclusion criteria

1. Individuals who run longer than 1 hour and 30 minutes.
2. Individuals who walk more than 4 laps around the field/track (approximately 1,600 meters).
3. Volunteers who are unwilling or unable to participate consistently in the research activities or who get injured during the test.

All volunteers were required to provide data related to their age, height, weight, and body mass index (BMI). Body composition assessments were conducted using a TANITA Body Composition Analyzer, model DC-360 [17-19]. These measurements, including weights, BMI, and body composition values, were collected in three replicates before and after the mini-marathon running event.

2.2 Experimental design

The study's objective was to assess the short-term effects (single bout exercise) of participating in a 10.5 km mini-marathon, completed within 1 hour and 30 minutes, on alterations in blood lipid profiles. All ten volunteers collected a 3 cc blood sample from either the cephalic vein or basilica vein, both before and after the mini-marathon event. It was required for volunteers to abstain from food and drink for 6 hours prior to blood collection. These samples were then analyzed to determine levels of cholesterol, triglycerides, LDL, and HDL.

2.3 Analysis of the data

Three milliliters of whole blood were collected into EDTA-treated tubes for each volunteer. These samples were centrifuged at 3000×g for 10 minutes at 4°C to prepare them for blood lipoprotein analysis. The fasting blood lipid profiles, including triglycerides, total cholesterol, LDL cholesterol (LDL), and HDL cholesterol (HDL) were quantified using a BioSystems BA200 analyzer, following the manufacturer's instructions. Measurements were taken in three replicates. Data were expressed as mean ± standard deviation (Mean ± SD). The Shapiro-Wilk method was used to test the normality of the data distribution. Statistical analysis was conducted using the

Wilcoxon Signed Rank Test to compare lipid levels before and after the mini-marathon. A *p*-value of <0.05 was considered statistically significant. Data analysis was performed using the SPSS® statistics package v.21.0 (IBM Inc., Chicago, IL, USA). The results of the analysis are presented in tables, heat maps, and bar charts.

3. Results and discussion

The study aimed to investigate the impact of participating in a mini-marathon on blood lipoprotein changes among ten volunteers, consisting of seven men and three women. Prior to the mini-marathon, comprehensive data were collected on each volunteer, including age, height, weight, BMI, percentage of body fat (% Fat), and total fat mass.

Table 1 Physiological characteristics of subjects

	Subjects *(n=10)*
Age (year)	20.9 ± 0.70
Height (cm.)	165.9 ± 6.32
weight (kg.)	60.2 ± 5.79
Body Mass Index (BMI)	21.9 ± 1.94
Fat percentage (%)	19.1 ± 6.92
Fat mass (kg.)	12.3 ± 4.81

Remark: after normal distribution test by Shapiro-Wilk method, there is no any data set that $p > 0.05$.

According to Table 1, the mean age of the participants was found to be 20.9 ± 0.07 years. The average height was measured at 165.9 ± 6.32 centimeters, while the mean weight was recorded as 60.2 ± 5.79 kg. The participants' body mass index (BMI) had a mean value of 21.9 ± 1.94. Additionally, the mean fat percentage was determined to be 19.1 ± 6.92%, and the mean fat mass was calculated as 12.3 ± 4.81 kilograms. Subsequently, all participants underwent testing for mini marathon running. Each participant was allotted a 15-minute period for pre-running warm-up and an additional 15-minute period for post-running cool-down [20].

Table 2 The comparison before and after mini-marathon running data after Wilcoxon signed rank test analysis.

	n	Before	After	Z	*p*-value
Weight (kg)	10	60.2 ± 5.8	59.9 ± 5.3*	-1.972	.049
BMI	10	21.9 ± 1.9	21.8 ± 1.8	-1.927	.054
Fat %	10	19.1 ± 6.9	18.4 ± 7.0*	-2.002	.045
Fat mass (kg)	10	12.3 ± 4.8	11.8 ± 4.5*	-2.275	.023
Cholesterol (mg/dL)	10	220.3 ± 42.1	208.7 ± 34.2*	-3.050	.002
Triglyceride (mg/dL)	10	95.9 ± 52.6	94.9 ± 46.5	-0.947	.344
HDL (mg/dL)	10	71.3 ± 13.5	68.1 ± 12.0*	-2.468	.014
LDL (mg/dL)	10	106.1 ± 30.0	100.1 ± 25.3*	-2.200	.028

The asterisk (*) on after data means significantly different of the results at 95% ($p \leq 0.05$) after compared with before running by Wilcoxon signed rank test analysis.

Table 3 Individual heatmap comparison of the lipoprotein level results between before and after mini-marathon running.

	Weight (kg.)	Body Mass Index (BMI)	Fat Percentage (%)	FAT mass (kg.)	Cholesterol (mg/dL)	Triglycerides (mg/dL)	HDL (mg/dL)	LDL (mg/dL)
Sub01	-0.005	-0.005	0.006	0.000	-0.126	0.198	-0.062	-0.145
Sub02	0.028	0.028	0.058	0.088	-0.130	-0.200	-0.034	-0.120
Sub03	-0.020	-0.020	0.027	0.022	-0.003	-0.447	-0.138	0.083
Sub04	-0.025	-0.025	-0.256	-0.118	-0.327	-0.263	-0.220	-0.361
Sub05	0.024	0.024	-0.060	-0.042	0.145	-0.254	0.087	0.190
Sub06	-0.007	-0.007	-0.019	-0.023	-0.113	0.439	0.011	-0.257
Sub07	0.003	0.003	-0.087	-0.083	-0.008	0.868	-0.126	0.006
Sub08	-0.033	-0.033	-0.122	-0.160	-0.012	-0.419	-0.115	0.034
Sub09	-0.027	-0.027	-0.117	-0.149	-0.065	-0.104	-0.251	-0.138
Sub10	-0.009	-0.009	0.010	-0.018	-0.073	-0.039	0.231	-0.024

Remark: The values show as Log2 of the after-running/before-running results. Which indicates the results changing pattern of the experiment. The red color indicates the decrease of the value and green color indicates the increase of the value.

Blood samples were drawn from ten volunteers both before and after the mini-marathon to measure the levels of various lipoproteins. The results regarding body composition and blood lipoproteins, before and after the mini-marathon, were compared. According to Table 2, it was observed that after the mini-marathon, weight, body fat percentage, body fat mass, and lipoproteins including cholesterol, HDL, and LDL generally decreased significantly

($p \leq 0.05$) in most volunteers. However, there were exceptions, such as Sub 02 and Sub 05, whose weight and BMI increased. Specifically, Sub 02 also showed a slight increase in BMI, fat percentage, and fat mass. Sub 05 exhibited a marked increase in cholesterol, HDL, and LDL. Additionally, Sub 06 and Sub 07 experienced a significant increase in triglyceride levels, and Sub 10 saw a notable increase in HDL (Table 3). The data from all ten volunteers were averaged to compare the changes in body composition-namely weight, BMI, fat percentage, and fat mass-and lipoproteins including cholesterol, triglyceride, HDL, and LDL, before and after the test. It was found that after the mini-marathon, the mean of all data sets significantly decreased ($p \leq 0.05$) except for BMI and triglycerides, which only slightly decreased when compared with the values before the mini-marathon (Table 2). However, two volunteers showed slight increases in weight (1.03-1.13 kilograms), possibly due to excessive water intake during the run, prompted by exhaustion. Moreover, after the mini-marathon, the volunteers' BMI significantly decreased, which aligns with the findings of Österdahl et al. [21], who studied the effects of short-distance running on 20 volunteers following a Paleolithic diet. Their research revealed that BMI significantly decreased ($p<0.001$) as a result of the regimen and exercise. Furthermore, this study indicated that both fat percentage and fat mass significantly decreased, echoing findings from Leal-Cerro et al. [22], who observed a considerable reduction in fat mass among 29 volunteers after marathon running ($p<0.05$). Similarly, additional studies have consistently shown significant decreases in volunteers' fat mass following marathon participation [23,24]. Consequently, the results suggest that the reductions in fat percentage and fat mass may be influenced by significant decreases in cholesterol, HDL, and LDL levels ($p<0.05$). While the level of triglycerides appeared to decrease, the change was not statistically significant. The significant decrease in LDL aligns with findings by Kuusi et al. [25], who noted that VLDL-C significantly decreased following marathon running, although the levels of different types of HDL varied, increasing, decreasing, or remaining unchanged inconsistently. This suggests that lipoprotein changes in blood are associated with hormonal fluctuations in the body. Short-term or sudden running does not significantly affect body hormones, leading to unclear changes in blood lipoprotein levels, but generally results in a reduction in total fat. Notably, the HDL levels significantly decreased ($p<0.05$), potentially due to the mini-marathon being an exercise regimen that demands total energy but does not last long enough to increase HDL levels, such as insufficient exercise time, frequency, or duration. An energy expenditure of 1,000 – 2,000 Kcal per week is recommended to increase HDL levels among those who do not regularly exercise [26–28]. This finding is consistent with Durstine et al. [29], who reported that to increase HDL cholesterol levels by 2-3 mg/dL and to reduce triglyceride levels by 8-20 mg/dL weekly, an energy expenditure of 1,200-2,000 Kcal per week is required. However, in this study, the energy expenditure was calculated based on a single mini-marathon event. Moreover, further research indicates that HDL levels increase if exercise is maintained for more than 12 weeks, while HDL levels remain unchanged if the exercise duration is 12 weeks or less [30]. Additionally, a study by Ballantyne et al. [31] demonstrated that moderate-intensity aerobic exercise conducted three days a week for six consecutive months was unable to raise HDL levels but was effective in lowering LDL levels among middle-aged female volunteers.

Based on all test results, it is evident that mini-marathon running significantly influences a decrease in weight, body fat percentage, and body fat mass, which contributes to a marked decrease in various types of blood lipoprotein levels, including HDL, LDL, and cholesterol. However, the effects of these changes in lipoprotein forms were found to be unclear and inconsistent, potentially due to individual differences in physical and biological factors such as gender, hormones, metabolism, and dietary habits. Additionally, the impact of shorter, time-limited running sessions on the body's responses can vary, leading to ambiguous outcomes. Therefore, the researcher recommends conducting further studies on the effects of exercise and long-distance running to more comprehensively explore how such activities influence changes in blood lipoproteins.

4. Conclusion

Mini-marathon running significantly contributes to reductions in weight, body fat percentage, and body fat mass. These physical changes coincide with a significant decrease in the overall levels of lipoproteins in the blood.

5. Ethical approval

This research was conducted at the Thailand National Sports University, Trang Campus, Thailand, from October 2021 to September 2023. The study received ethical approval from the Research Ethics Committee of Thailand National Sports University (Reference number: SCI 010/2566).

6. Acknowledgements

This work supported by Thailand National Sports University, Trang Campus, Thailand. Grant no. 20/8.6/2565.

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