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Physiological response of exercise as modulation of lipid profile in young adults

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Abstract

Lifestyle modification based on exercise combined with listening to music is a physiological-therapeutic approach, interesting to study to improve the lipid profile. Considering the lipid profile is the most important risk factor for cardiovascular disease (CVD), which will have an impact on increasing morbidity and mortality. This study aims to analyze the physiological response of moderate-intensity exercise by listening to music as a modulator of improving lipid profile in young adult men. This study involved 45 young adult men aged 19-21 years, body mass index 19.5-24.0 kg/m^2, and met other criteria that have been determined. Participants were randomly divided into three groups: HIPE (high-intensity exercise, n=15), MIPE (moderate-intensity exercise, n=15), and MIPEM (moderate-intensity exercise + music, n=15). Examination of the concentration of low-density lipoprotein (LDL), high density lipoprotein (HDL), triglyceride (TG), total cholesterol (T-C), which is a picture of the lipid profile using the COBAS MIRA system method, was carried out before and after the intervention. One-way ANOVA and Tukey's honestly significant difference (HSD) post hoc test were used to analyse the data. The results showed that there were significant differences in the levels of LDL, HDL, TG, T-C and blood glucose concentrations between the three groups (HIPE, MIPE, and MIPEM) (P<0.05). The results of the Tukey's HSD post hoc test showed that MIPEM increased HDL concentrations and decreased LDL, TG, T-C and higher blood glucose compared to HIPE and MIPE, which is effective and without causing an increase in cortisol secretion and blood pressure. Therefore, MIPEM deserves to be recommended for a physiologic therapeutic approach as a lipid profile modulator.

Keywords: blood glucose, exercise, lipid profile, music

1. Introduction

Lipid profile as an illustration of the concentration of low-density lipoprotein (LDL), high density lipoprotein (HDL), triglyceride (TG), total cholesterol (T-C) in the blood (Ahmeti *et al.*, 2020), a major risk factor for cardiovascular disease (CVD) (Albarrati *et al.*, 2018). Lipid profile is also associated with health problems including hypertension (Kannan, 2014), various metabolic disorders, including coronary artery disease (CAD) and stroke (Antunes *et al.*, 2020; Brenachot *et al.*, 2017; Leritz *et al.*, 2016). In addition, the lipid profile is also associated with increased mortality and morbidity, which pose a serious threat to public health (Jastrzebski *et al.*, 2021), which increases the mortality rate (Albarrati *et al.*, 2018). Previous research stated that around 50% of death is related to the poor lipid profile (Ahn and Kim, 2020). Research in cancer patients estimates that 8/1000/year of death is also associated with a poor lipid profile (low HDL) (Li *et al.*, 2019). Therefore, improvement of the lipid profile is becoming increasingly popular and interesting to explore. However, little is known about the existence of other physiological approaches based on exercise as a lifestyle modification strategy.

Many approaches done employed drugs (Brenachot *et al.*, 2017) or without medication (Man *et al.*, 2020), balanced nutrition (Man *et al.*, 2020), and psychological approach (Bekele *et al.*, 2020). Empirically speaking, there have been many attempts to improve the lipid profile (Ruiz-Ramie *et al.*, 2019), but the result is inconclusive (Antunes *et al.*, 2020) and have limitations (Khalafi *et al.*, 2020). Therefore, a physiological approach based on exercise as a lifestyle modification strategy is used in the present study as a new breakthrough to improve the lipid profile, by increasing HDL concentration and decreasing LDL, TG, T-C, and blood glucose concentrations. Exercise as a strategy lifestyle modification is an attractive and effective approach as the main and first intervention to improve the lipid profile, inflammatory and reduce risk factors for CVD (Pranoto *et al.*, 2023a,b; Ruiz-Ramie *et al.*, 2019). Exercise causes changes in fat metabolism (Jastrzebski *et al.*, 2021), improves lipid profile improvement (Wang and Xu, 2017), more effective and physiological (Murphy *et al.*, 2019), and can prevent risk factors for CVD (Albarrati *et al.*, 2018). Therefore, adequate exercise will improve the lipid profile and have an impact on reducing physical stress and inflammatory (Assadi, 2017; Pranoto *et al.*, 2023a,b). But exercise is a complex, systemic and integrative process, which involves all the body's metabolic systems (Gonçalves *et al.*, 2020). Inaccuracy determines the intensity of the exercise (Kannan, 2014), can be a stressor for the body (Skurvydas *et al.*, 2017). Stressors have a negative impact on the body (Antunes *et al.*, 2020), not only causing bad mood swings (Mirizio *et al.*, 2020) but also accelerating fatigue (Mirizio *et al.*, 2020), cause inflammation (Gonçalves *et al.*, 2020), interfere with fat metabolism (Bigliassi *et al.*, 2018) and energy balance (Xiao *et al.*, 2020). Exercise as a lifestyle modification, should be packed in interesting, enjoyable, physiological and motivating physical activities (Mirizio *et al.*, 2020). Previous research data showed 23.3% of people failed to meet the recommendations for exercise caused by disinterest, boredom, lack of motivation and mood conditions during exercise (Murphy *et al.*, 2019).

Exercise as a lifestyle modification strategy, in improving the lipid profile and reducing risk factors, is carried out with the right intensity, duration, and method and interesting, enjoyable, and causes pleasant mood changes (Kannan, 2014). Previous research has shown that moderate and enjoyable exercise increases myokine secretion and regulates fat mobilisation (Laurens *et al.*, 2020), controlling and maintaining energy balance (Graf and Ferrari, 2019). Myokine physiologically increases energy expenditure by changing and regulating fat mass (Thompson *et al.*, 2012). Other evidence also shows that moderate-intensity exercise increases HDL (Ruiz-Ramie *et al.*, 2019) and reduces the concentration of LDL, TG, and T-C, preventing cardiometabolic risk (Antunes *et al.*, 2020). Collaboration Exercise by listening to fun music, which can improve the mood, enjoy it, so that it changes a pleasant mood (Arazi *et al.*, 2015). Several previous studies have shown that listening to music during exercise can increase pleasure, reduce fatigue (Bigliassi *et al.*, 2018), improve exercise performance (Karageorghis *et al.*, 2018), cause harmonisation of movement (Maddigan *et al.*, 2019), encourage rhythmic movement (Arazi *et al.*, 2015). The training atmosphere is thought to increase muscle metabolism, improve fat metabolism (Bigliassi *et al.*, 2018) and body mass index (BMI) (Seo, 2017). Listening to music is also considered to reduce stress and relaxation, which is believed to improve metabolism and energy balance (Yamasaki *et al.*, 2012). Previous research has shown that listening to music during exercise improves calm (Tayagi *et al.*, 2020) and reduces cortisol secretion (Bigliassi *et al.*, 2018).

Collaboration with listening to music during exercise causes the release of endorphin molecules, endogenous opioid neuropeptides that will reduce stress and increase metabolism (Padulo *et al.*, 2019). A study by Jong-Won *et al.* (2012) which examined exercise with exercise performance and body fat, concluded that jumping rope by listening to music was proven to increase lean body mass, muscle strength, and flexibility. Therefore, the focus of this study is the collaboration of exercise with listening to music, which will be used as a modulator of lipid profile. Our hypothesis collaboration Exercise as a lifestyle modification of moderate intensity by listening to music modulates lipid profile. The results of this study are expected to be a model of a physiological therapeutic approach and a new breakthrough by using exercise as a modification of a healthy lifestyle.

2. Materials and methods

Experimental design

This study involved 45 young adult men aged 19-21 years, body mass index (BMI) 19.5-24.0 kg/m^2, normal blood pressure, normal resting heart rate (RHR), maximum oxygen volume (VO_{2max}) 40-50 ml/kgbb/min, normal hemoglobin (Hb), no smoking habits, alcoholic beverages, healthy based on a doctor's examination, and willingness to voluntarily become a participant, which is stated in writing. Participants were randomly divided into three intervention groups: HIPE (high-intensity exercise (80-85% HR_{max}, n=15)), MIPE (moderate-intensity exercise (70-75% HR_{max}, n=15)), and MIPEM (moderate-intensity exercise + music (70-75% HR_{max}, n=15). All the procedures of this study have been explained to the participants, orally and in writing, and have received approval from the Health Research Ethics Commission, Faculty of Medicine, Brawijaya University, Malang, East Java, Indonesia (No. 106/EC/KEPK/04/2018).

Exercise protocol

Exercise in each group was carried out on a different day, every 06:00-10:00 AM at the Laboratory of the Department of Sports Science, Faculty of Sports Science, State University of Malang. Exercise was carried out at room temperature between 21-24 °C (Jia *et al.*, 2016). Exercise was done by running on a treadmill for 30 min (Rejeki *et al.*, 2021; Tsuchiya *et al.*, 2014) 80-85% HR_{max} with high intensity, 70-75% HR_{max} moderate-intensity

(Sugiharto *et al.*, 2022; Williams *et al.*, 2019), and 70-75% HR_{max} moderate-intensity in collaboration with listening to instrumental classical music (De Witte *et al.*, 2019). Music tempo 108-120 bpm and ±80 dB deci decibel (Palit and Aysia, 2015). Music player 5 headphones (MP5) is used to listen to music during exercise (Jia *et al.*, 2016). Heating and cooling were each performed for 5 min with light intensity (50-60% HR_{max}) (Rejeki *et al.*, 2022; Sugiharto *et al.*, 2023). Maximum heart rate prediction was carried out using the 220-age (in years) formulation (Sugiharto *et al.*, 2021; Murphy *et al.*, 2019). Heart rate monitoring during exercise using a polar heart rate monitor (Polar H10 Heart Rate Sensor; Polar, Kempele, Finland). Participants were advised not to do physical activity and/or strenuous exercise 48 h before the study.

Anthropometric measurements and physical fitness

Measurement of height using a stadiometer (SECA, Chino, CA, USA), measurement of weight and BMI using TANITA (Body Composition Analyzer DC3607601(2)-1604 FA, TANITA Corporation of America, Inc., Arlington Heights, IL, USA). Blood pressure measurement using an automated device (OMRON, HEM-7130 L Model; Omron Co., Osaka, Japan) at the nondominant arm 3 times consecutively with a 1-2 min interval between two measurements while participants were in a seated position. Body temperature was measured using a digital thermometer (OMRON MC-343F Model). VO_{2max} was measured using a 20 m multistage fitness test (MFT) (Paradisis *et al.*, 2014).

Blood collection and blood analysis

Blood samples were taken after participants fasted overnight (±8 h), blood samples were taken from the cubital vein before exercise and 5 min after exercise (Huh *et al.*, 2014). Examination of fat and blood glucose profiles was carried out at the Laboratory of Clinical Pathology, Faculty of Medicine, Brawijaya Malang. Examination of blood lipid and glucose profiles was carried out using the standard COBAS MIRA system. Examination of cortisol levels using the ELISA kit (Cat. No E-EL-0157; Elabscience Biotechnology Co. Ltd., Houston, TX, USA) with a standard curve range of 6.25-400 ng/ml and a sensitivity level of cortisol in the kit is 2.92 ng/ml. Hb concentration was measured using Mission Hemoglobin (Mission® Hb Test Strips (Whole Blood), ACON Laboratories, Inc., San Diego, CA, USA). The measurement range of the Mission® Hb Hemoglobin Testing System is 4.5-25.6 g/dl and accuracy Hb 5-10±0.4 g/dl.

Statistical analysis

Statistical analysis used the Statistical Package for the Social Sciences (SPSS) software (Chicago, IL, USA). The normality test used the Shapiro-Wilk test, while the homogeneity test used the Levene test. The different test used Paired Sample T-Test, One-WayANOVA and continued with Tukey's Honestly Significant Difference (HSD) post hoc test. All data were presented with mean ± standard error of mean (SEM). All statistical analyses used a significant level ($P<0.05$).

3. Results

The results of the One-way ANOVA analysis showed that there were no significant differences in the characteristics of the study subjects between groups (HIPE, MIPE, and MIPEM) as well as baseline of lipid profiles, including HDL, LDL, TG, T-C, and blood glucose concentrations ($P>0.05$) (Table 1 and 2). Therefore, the modulation response of fat, glucose and hormone profiles is strongly suspected not to

Table 1. Characteristics of research subjects.[1,2]

Variable	n	HIPE	MIPE	MIPEM	*P*-value
Age (years)	15	19.87±0.22	20.13±0.24	19.93±0.23	0.690
Body height (m)	15	1.67±0.01	1.66±0.01	1.66±0.01	0.826
Body weight (kg)	15	60.47±1.58	60.07±1.19	57.87±1.09	0.326
BMI (kg/m^2)	15	21.65±0.35	21.79±0.37	20.94±0.32	0.192
RHR (bpm)	15	71.20±1.74	67.47±2.07	65.47±1.45	0.079
SBP (mmHg)	15	114.87±0.83	114.93±0.94	114.53±0.80	0.940
DBP (mmHg)	15	75.87±0.92	74.87±0.91	75.93±0.91	0.656
VO_{2max} (ml/kg bb/min)	15	40.85±0.94	41.06±0.86	40.94±0.83	0.986
Body temperature (°C)	15	36.01±0.11	35.78±0.14	35.97±0.10	0.341
Hb (g/dl)	15	14.83±0.29	14.71±0.32	14.83±0.27	0.953

[1] BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; RHR = rest heart rate; VO_{2max} = maximum oxygen volume; Hb = haemoglobin; HIPE = high-intensity exercise; MIPE = moderate-intensity exercise; MIPEM = moderate-intensity exercise + music.
[2] Data are presented as mean ± standard error of the mean. *P*-values were obtained using one-way ANOVA.

Table 2. Results of analysis of lipid profile, blood glucose, blood pressure, and cortisol.[1,2]

Time	HIPE (n=15)	MIPE (n=15)	MIPEM (n=15)	*P*-value
HDL levels (mg/dl)				
Pre-physical exercise	47.33±1.67	46.93±2.50	47.27±1.85	0.989
Post-physical exercise	49.67±2.75	51.87±2.38	59.67±2.26*	0.017
Δ Post – Pre	2.33±2.80	4.93±3.18	12.40±3.71	0.087
LDL levels (mg/dl)				
Pre-physical exercise	82.27±5.62	82.67±3.46	84.93±5.81	0.923
Post-physical exercise	105.60±5.23	83.33±4.65*	79.40±5.62*	0.002
Δ Post – Pre	23.33±8.27	0.67±-7.70#	-5.53±-21.15#	0.006
Triglyceride levels (mg/dl)				
Pre-physical exercise	110.07±7.78	103.27±11.99	109.27±15.67	0.912
Post-physical exercise	112.20±9.70	111.13±15.49	75.60±5.76*	0.038
Δ Post – Pre	2.13±14.56	7.87±14.12	-33.67±13.03	0.085
Total cholesterol levels (mg/dl)				
Pre-physical exercise	154.93±5.08	154.67±4.39	153.73±6.59	0.987
Post-physical exercise	165.87±6.82	159.53±5.71	151.20±7.24	0.301
Δ Post – Pre	10.93±6.61	4.87±4.16	-2.53±9.45	0.411
Blood glucose levels (mg/dl)				
Pre-physical exercise	83.47±4.87	85.60±2.77	84.53±5.84	0.949
Post-physical exercise	73.07±2.04	74.87±2.35	68.40±3.16	0.195
Δ Post – Pre	-10.40±5.50	-10.73±3.05	-16.13±6.70	0.695
Systolic blood pressure (mmHg)				
Pre-physical exercise	117.33±2.48	115.33±2.15	116.67±1.26	0.779
Post-physical exercise	149.33±2.28	142.00±2.00	134.67±2.91*	0.001
Δ Post – Pre	32.00±3.27	26.67±2.70	18.00±2.62#	0.005
Diastolic blood pressure (mmHg)				
Pre-physical exercise	80.00±2.18	79.33±1.53	78.67±1.65	0.874
Post-physical exercise	83.33±2.52	81.33±2.15	80.67±2.06	0.687
Δ Post – Pre	3.33±3.19	2.00±2.96	2.00±2.62	0.933
Cortisol levels (ng/ml)				
Pre-physical exercise	7.70±0.28	7.88±0.22	7.82±0.22	0.866
Post-physical exercise	9.15±0.12	8.21±0.16*	6.74±0.29*	0.000
Δ Post – Pre	1.45±0.30	0.33±0.26#	-1.08±0.33#	0.000

1 HIPE = high-intensity exercise, MIPE = moderate-intensity exercise, MIPEM = moderate-intensity exercise + music; LDL = low-density lipoprotein; HDL = high density lipoprotein.

2 Data are represented as Mean ± standard deviation. *P*-values were obtained using one-way ANOVA. Tukey's HSD post hoc test was used to compare lipid profile, and blood glucose. Post-physical exercise (*) significant vs HIPE ($P \leq 0.05$). Δ Post – Pre (#) significant vs HIPE ($P \leq 0.05$).

be caused by characteristic factors and lipid profiles before exercise but is the effect of the intervention carried out.

Exercise response as a modulator of lipid profile, which was described at the levels of HDL, LDL, TG and T-C concentrations, showed significant differences between groups (HIPE, MIPE, and MIPEM) ($P<0.05$), but there was no significant difference between the levels of LDL concentrations between groups ($P>0.05$) (Table 1).

Further analysis using the Paired Sample T-Test on the lipid profile in each group showed the effect of HIPE as a response to lipid profile modulation, between before and after the intervention on HDL concentration levels (47.33±1.67 vs 49.67±2.75 mg/dl, P=0.419, TG concentration level (110.07±7.78 vs 112.20±9.70 mg/dl, P=0.886), T-C concentration level (154.93±5.08 vs 165.87±6.82 mg/dl, P=0.120) did not show a significant difference, while for the LDL concentration level (82.27±5.62 vs 105.60±5.23 mg/dl, P=0.005) there was a significant difference.

The results of the analysis of the effect of MIPE as a response to lipid profile modulation before intervention and after intervention, there was no significant difference in HDL concentration levels (46.93±2.50 vs 51.87±2.38 mg/dl, P=0.143, LDL concentration levels (82.67 ±3.46

vs 83.33±4.65 mg/dl, P=0.867, TG concentration level (103.27±11.99 vs 111.13±15.49 mg/dl, P=0.586, and T-C concentration level (154.67±4.39 vs 159.53±5.71 mg/dl, P=0.262. Response analysis of TG concentration levels before vs after intervention in each group is shown in Table 2.

The results of the analysis of the Paired Sample T-Test in the MIPEM group as a response to lipid profile modulation before and after the intervention HDL concentration level (47.27±1.85 vs 59.67±2.26 mg/dl, P=0.005), TG concentration level (109.27 ±15.67 vs 75.60±5.76 mg/dl, P=0.022) there was a significant difference. But there was no significant difference in LDL concentration levels (84.93±5.81 vs 79.40±5.62 mg/dl, P=0.460), and T-C (153.73±6.57 vs 151.20±7.23 mg/dl, P=0.792. Response analysis of T-C concentration levels before vs after intervention for each group shown in Table 2.

The intervention response to the level of blood glucose concentration between groups (HIPE, MIPE, and MIPEM), there was a significant difference (P<0.05) (Table 2). Further analysis of the response to the level of blood glucose concentration before and after each group's intervention is shown in Table 2.

The results of the paired t-test analysis, on the response to the level of blood glucose concentration before and after the intervention in each group: HIPE, did not show a significant difference (83.47±4.87 vs 73.07±2.04 mg/dl, P=0.080), but blood glucose concentration levels (85.60±2.77 vs 74.87±2.34 mg/dl, P=0.003) and MIPEM (84.53±5.84 vs 68.40±3.16 mg/dl, P=0.030 there is a significant difference in MIPE. The results of the analysis of the response modulation of lipid profile, blood glucose levels, cortisol concentration, and blood pressure in each group are shown in Table 2, while the relationship between lipid profile with cortisol concentration and blood pressure is shown in Table 3.

4. Discussion

The findings of our study indicate that the physiological response to exercise is a modulation of the lipid profile, as indicated by (1) an increase in HDL concentration levels in the HIPE, MIPE and MIPEM groups. (2) decreased levels of LDL, TG, T-C concentrations in the MIPEM group; (3) there was a decrease in blood glucose after the intervention in the HIPE, MIPE and MIPEM groups. However, our data showed that there were differences in response to an increase in HDL concentration and a decrease in LDL, TG, T-C, and blood glucose concentrations between the HIPE, MIPE, and MIPEM groups. The MIPEM group had a higher level of HDL concentration and decreased levels of LDL, TG, T-C, blood glucose concentrations compared to the HIPE and MIPE groups. This study also shows a difference in the effect of modulating changes in lipid profile between severe intense exercise, moderate intensity exercise without listening to music and moderate intensity exercise by listening to music. This difference is thought to be caused by the effect of music listened to during exercise, which affects psychological and physiological changes. These psychological changes may be caused by stressors during exercise, which causes disturbances in physiological balance and the metabolic system (Assadi, 2017).

Conditions of training, individual physical fitness (Ahmeti *et al.*, 2020), and mood swings during exercise can trigger increased psychological changes that lead to unfavorable stress (Mirizio *et al.*, 2020). However, in our study, the level of physical fitness and level of training of participants were trained people, not athletes. The level of training and physical fitness of participants in this study was used as an indicator of requirements as participants. Our data shows the level of physical fitness and level of training with indicators VO_{2max}, and resting heart rate (Table 1), did not show a significant difference. Our study showed an increase in cortisol concentrations and blood pressure in the HIPE and MIPE groups, with no significant changes

Table 3. Univariate correlations between lipid profiles with cortisol levels and blood pressure.[1,2]

Parameter	HDL (mg/dl)		LDL (mg/dl)		TG (mg/dl)		T-C (mg/dl)	
	r	*P*-value	*r*	*P*-value	*r*	*P*-value	*r*	*P*-value
SBP (mmHg)	-0.364	0.014*	0.304	0.042*	0.149	0.328	0.103	0.503
DBP (mmHg)	-0.362	0.015*	0.926	0.014*	0.039	0.800	0.112	0.464
Cortisol (ng/ml)	-0.587	0.000**	0.307	0.040*	0.154	0.313	0.086	0.573

[1] Significant with Pearson correlation test. * P≤0.05; ** P≤0.01.
[2] LDL = low-density lipoprotein; HDL = high density lipoprotein; TG = triglycerides; T-C = total cholesterol; SBP = systolic blood pressure; DBP = diastolic blood pressure.

in the lipid profile, which was indicated by an increase in HDL and a lower decrease in LDL, TG, T-C and blood glucose compared to the MIPEM group (Table 2). Possible changes in lipid profile in HIPE and MIPE are influenced by increased cortisol and blood pressure. Previous studies have also found an increase in cortisol and blood pressure, followed by a decrease in HDL concentration, an increase in LDL concentration, and very low density lipoprotein (VLDL) (Wirtz *et al.*, 2009), which disrupts glucose balance (Muscella *et al.*, 2020). Other studies have also stated that an increase in cortisol concentrations and blood pressure causes a decrease in the function of HDL as an anti-oxidant, to protect the effects of fat peroxidation (Li *et al.*, 2019), and prevent atherosclerosis (Brenachot *et al.*, 2017).

Increased cortisol concentrations and blood pressure in the HIPE and MIPE groups indicate of the body experiencing stress (Mirizio *et al.*, 2020). Stress may come from exercise, which can cause physical stress and psychological stress (Assadi, 2017). Stress can cause mood swings to become not good (Mirizio *et al.*, 2020) and have an impact on all systems body (Rabasa and Dickson, 2016). Stress also has a broad impact on energy balance disorder, and energy metabolism (Priyadarshini and Aich, 2012), thereby can affecting changes in lipid profiles, and blood glucose (Noerman *et al.*, 2020), interfering with the level of insulin sensitivity (Skurvydas *et al.*, 2017), and insulin resistance (Ruiz-Ramie *et al.*, 2019).

Our findings showed that cortisol concentrations and blood pressure decreased significantly in the MIPEM group, whereas the lipid profile improved, as indicated by an increase in HDL concentrations, and a decrease in LDL, TG and T-C concentrations, as well as glucose, which was higher than in the HIPE group. and MIPE (Table 2). So we believe that music listened to during exercise has a significant effect on reducing stress and improving lipid profiles. The results of this study are supported by several previous studies. Study Wuttke-Linnemann *et al.* (2019), using male and female subjects who were given the intervention to listen to music, concluded that there was a decrease in cortisol concentrations. The results of the correlation analysis showed a negative relationship between cortisol concentrations with HDL (r=-0.587; P=0.000), systolic blood pressure with HDL (r=-0.364; p=0.014), diastolic blood pressure with HDL (r=-0.362; P=0.015), and there was a positive relationship between cortisol concentration with levels of LDL (r=0.307; P=0.040), systolic blood pressure with LDL (r=0.304; P=0.042), diastolic blood pressure with LDL (r=0.926; P=0.014), while cortisol concentrations, dan blood pressure did not show a significant relationship with TG, and T-C (Table 3). Music listened to during exercise can function as dissociation and increase enjoyment during exercise (Maddigan *et al.*, 2019). Physiologically, listening to music reduces sympathetic nerve activity and the HPA-axis (Kühlmann *et al.*, 2016), thereby lowering cortisol concentrations (Thoma *et al.*, 2013). However, these two nerves do not only play an important role in physiological changes (Ballmann, 2021) and psychological (Maddigan *et al.*, 2019), which will change a pleasant mood (Rane and Gadkari, 2017), but also responsible for regulating energy balance and metabolism (Yamasaki, 2012). HPA-axis reduction also improves exercise performance (Maddigan *et al.*, 2019) and improves metabolic performance (Ballmann, 2021).

Previous research has also proven an improvement in metabolic performance and an increase in HDL concentrations and a decrease in LDL, TG, and T-C concentrations after 45 min of skipping exercise by listening to music (Jong-Won *et al.*, 2012), an increase in metabolic rate and weight loss in the elderly after doing electromyostimulation (EMS) exercise by listening to music (Kim and Jee, 2020). The study by Seo (2017) also found an increase in energy metabolism and lung vital capacity, which was better in static exercise for 30 min by listening to music compared to static exercise without listening to music. Another study involving 17 healthy people as research subjects also found a higher increase in gastric muscle contraction in the group given exercise for 30 min by listening to music, compared to exercise without listening to music (Lin *et al.*, 2007). Based on the findings of our study and supported by several previous studies, it is proven that music listened to during exercise has an effect on increasing metabolic ability to improve lipid profiles. Other findings also conclude that music listened to during exercise is a trigger for fat oxidation (Kim and Jee, 2020), an increase lipoprotein lipase activity (Tayagi *et al.*, 2020), which can increase fat metabolism (Muscella *et al.*, 2020) so that it can improve the lipid profile (Mirizio *et al.*, 2020). Therefore, the exercise by listening to music is considered an oxidative exercise and contributes greatly to changes in fat metabolism (Kim and Jee, 2020). Music is also considered to have the ability to distract (Rane and Gadkari, 2017), perceive fatigue (Ballmann, 2021), physiologically improve motor coordination (Mirizio *et al.*, 2020), motion becomes more economical, and hormonal (Maddigan *et al.*, 2019), thereby increasing metabolism more optimally (Arazi *et al.*, 2015), and improve energy efficiency (Nikol *et al.*, 2018), so that it can improve the lipid profile (Catalano-Iniesta *et al.*, 2020).

Lipid profile plays an important role as a starting point for disease, which is associated with an increased risk of CVD and increased atherosclerosis. (Brenachot *et al.*, 2017), which increases cardiovascular mortality and morbidity (Li *et al.*, 2019). Therefore, the collaboration of exercise by listening to music becomes a therapeutic approach to improve lipid and blood glucose profiles. This model can be used as a strategy to modify a healthy and active lifestyle in the community to improve the lipid profile. In addition, adequate exercise becomes a stimulator of the body to increase physiological capacity in increasing metabolism, especially in fat metabolism. However, we do not recommend exercise as a potential stressor as a therapeutic approach. Aside from being not physiological, it also has the potential for systemic damage and interferes with the improvement of the lipid profile (Muscella *et al.*, 2020). Based on the findings of this study, we recommend that collaboration of moderate-intensity exercise with listening to music can be a physiological therapeutic approach to improve the lipid profile. Collaborative model exercise by listening to music is expected to attract people to modify a healthier lifestyle.

The limitations of our study lie in the study participants. Our study participants used young adult men who had a background in exercise habits, although not athletes. Besides that, there has not been a clear similarity in listening to music during moderate-intensity exercise in participants who do not have exercise habits, female adolescent participants, obesity, or at an older or younger age. Both interventions in our study were performed acutely, not chronically. In the long term, we do not know the adaptive response caused the long term to improve the lipid profile. Interestingly, the results of this study will be an important starting point, and interesting to take advantage of exercise in collaboration with listening to music as a physiological therapeutic approach to improving lipid profile as a strategy to reduce factors CVD risk. The development of the results of this study is very open by providing chronic intervention to vulnerable groups at young and old ages in improving the metabolic system, and perhaps collaborating some exercise intensity with ith several tempos and types of music.

5. Conclusions

The physiological response of collaboration with moderate-intensity exercise by listening to music is a modulation of lipid profile, which is described by an increase in HDL concentration and a decrease in LDL, TG, T-C, and glucose concentrations in young adult men. Decreased cortisol and blood pressure on exercise with collaboration listening to music proved to be effective as a modulator of lipid profile improvement. Therefore, the collaborative model of exercise by listening to music can be a new approach and physiological breakthrough in modulating the improvement of lipid profile and preventing the increase of risk factors. This model is also expected to be an active and healthy lifestyle modification for the community in preventing risk factors for lipid profile problems.

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Conflict of interest

The authors declare that they have no competing interests.

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