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Acute Plasma Glucose and Lipoproteins Responses to a Single Session of Wrestling Techniques-Based Circuit Exercise (WTBCE) in Male Elite Wrestlers

Abbass Ghanbari-Niaki [1], Amir Rashidlamir [2]

[1] Exercise Biochemistry Division, Faculty of Physical Education and Sport Sciences University of Mazandaran, Babolsar, Iran
[2] Faculty of Physical Education and Sport Sciences, Ferdowsi University of Mashhad, Mashhad, Iran.

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Abstract

Introduction: It has been shown that regular endurance exercise is a widely recognized modality to raise plasma high-density lipoprotein cholesterol (HDL-C) levels, but the results reported in studies of the effect of supra-maximal /maximal high intensity or power and anaerobic based sports and exercise on lipoprotein are conflicting. **Objectives:** The purposes of the present study were to investigate the effect of a single session of wrestling technique–based circuit exercise (WTBCE) on acute responses of glucose and lipoprotein profiles and the time course change of these metabolites. **Methods:** Twenty young, male elite wrestlers (age 20 ± .6 year, height 172.6 ± 2.10 cm, weight 71.05 ± 3.71 kg., and 24.54 ± 0.63 kg/m2 in BMI) volunteered to participate in the present study. **Design and Exercise Protocol:** Subjects were asked to complete a single WTBCE (10 techniques or stations separated by 10m, 3 non-stops circuits for 2 sets and one competitive wrestling practice). Blood samples were collected 30min before, immediately after the exercise, and 30min after the exercise. Repeated Measures Analysis of variance was used to analyze the data**. Results:** Plasma glucose and HDL-C were significantly (p <0.001, 0.04) changed. There was no significant change in TG and TC concentrations. **Conclusion:** The present data indicate that a WTBCE was able to generate an acute change in HDL-C and glucose concentration and it can be considered as a stimulus for improvement of plasma HDL-C levels.

Keywords : Plasma glucose, Lipoproteins, HDL-C, Wrestling technique-based circuit exercise.

Introduction

Regular endurance exercise is a widely recognized modality to raise plasma high-density lipoprotein cholesterol (HDL-C) levels [1-3], which is one of the metabolic adaptations contributing to the reduced risk of coronary heart disease (CHD) observed among physically active and fit individuals [4-6]. Although a low plasma HDL-C concentration is often accompanied by an elevated triglyceride (TG) level associated with abdominal obesity and insulin resistance-hyperinsulinemic states [7, 9], some individuals are characterized by low HDL-C levels without hypertriglyceridemia; a condition that has been referred to as isolated hypoalphalipoproteinemia [10, 11]. In addition, a low HDL-C has been reported in cigarette smoking [12], low fat /low cholesterol diet [13,14], self-administrated exogenous testosterone anabolic and androgenic steroids [15, 16] and physical inactivity [17, 18].

∗ Coresponding author E-mail:
aghanbariniaki@gmail.com

There is an agreement about the effects of an aerobic-based sports/endurance exercise on lipid and lipoprotein profiles, particularly on LDL-C, TG, TC, and HDL-C and its subfractions [19, 20, 21, 22, 23]. In contrast to aerobic-based physical activity, the results from the effects of acute exercise (aerobic or anaerobic) and also a power -anaerobic-based exercise/sports on lipid and lipoprotein profile are inconsistent [24, 25, 26, 27, 28, 29] . Additionally, a low level of HDL-C in power athletes, particularly wrestlers has been reported by some investigators [30, 31, 32]. In this regard, Eliakim et al. [30] suggested that in their study only one of the athletes had high levels of HDL-C (75mg/dl) and 24 athletes had mild low HDL-C (35-45mg/dl). They also reported that hypercholesterolemia and low HDL-C were found mainly in power sports (i.e., weight lifting, boxing, wrestling and judo) and anaerobic sports (i.e., tennis, sprints, and jumps, gymnastics, ice skating). According to a comparison by Tsopanakis and et al [26] a lower HDL- concentration has been observed in elites athletes in Olympic sports such as; wrestling, boxing, and sailing (46mg/dl, 41mg/dl, and 45mg/dl respectively). Sgouraki et al [31, 32] reported that after the maximal exercise bout [the ergometric test on treadmill ergometer), a preparation phase and then 5% inclination of the treadmill until the end of exercise test (100% VO2 max, 12-14min the maximum), all groups from basketball, swimming, long distance running and wrestling- the control included showed statistically significant increase in HDL-C levels as compared to rest values (11.4%, 17.1%, 15.0%, 12.7%, and 13.7%). Wallace et al [33] were studied 10 healthy, trained males (25.4 +/- 3.1 yr) before and after 90 min of resistance exercise to determine the acute effects of high volume (HV) and low volume (LV) sessions on alterations in lipid and lipoprotein concentrations as well as the activity of lecithin: cholesterol acyltransferase (LCAT). A significant changes were only found following the HV session. These included increases in HDL-C (11%) and HDL3-C (12%) 24 h post-exercise. Jurimae et al [34] were studied the lipid and lipoprotein responses to a single-circuit weight-training session in 15 untrained male students. In this study subjects performed three circuits using a work-to-rest ratio of 30 s:30s at 70% of one-repetition maximum and the whole program lasted 30 min. The HDL-C increased in 1-h period of recovery compared with the initial level. In the study by Hill et al [35] two intensities of 1RM were employed. To date, in our knowledge, a single wrestling technique-based circuit exercise has not been considered as a stimulus to bring about a change in lipid and lipoprotein metabolism in wrestlers. Thus, the first aim of this study was to see lipid and lipoprotein profiles in elite wrestlers. The second purpose was to investigate the acute responses of plasma glucose and lipoproteins to a single session of WTBCE program in this subjects.

Material and Methods

Subjects and Research Design

The study was approved by the ethic committee of the School of Medical Sciences of Tarbiat Modares University and conducted in accordance with the policy statement of the Declaration of the Iranian Ministry of health. Written consent was obtained from the twenty male young elite wrestlers (age 20 ± .6 year, height 172.6 ± 2.10 cm, weight 71.05 ± 3.71 kg, and 24.54 ± 0.63 kg/m2 in BMI, 5± 1.5 years history in wrestling) who volunteer to participate in the present study. The wrestlers had a high experiences in the national and international wrestling competitions. All subjects were asked to complete a medical examination and a medical questionnaire to ensure that they were not taking any medication, were free of cardiac, respiratory, renal, and metabolic diseases, and were not using steroids. Also, all the subjects were completely familiarized with all of the experimental procedures.

Exercise Testing Procedures

Before the main trial, participants were taken to the wrestling club three times. The first and second visits of all the participants performed a practice a wrestling-technique-based circuit exercise (WTBCE) (8 techniques/or stations) for familiarization. On the third visit, the subjects completed a practice session to insure that each participant was able to complete the entire exercise session and also to confirm that the program was producing fatigue at the end of the session. This was confirmed by visual and verbal feedback from the participants. The subjects were allowed to take as long time as they felt necessary to recover from each attempt. The experiment protocol was started at 08.30 AM and finished at 11.30 AM to avoid the effects of circadian rhythm. Subjects were asked to perform 2sets of 3 non-stop circuits exercise (8 techniques/stations with one- repetition for each exercise at their maximum speed) with a 4 minute rest between sets which followed by one competitive wrestling (2×3min with 30s rest between)(Figure.1). In meantime, the distance between each station was 10 meters and whole WTBCE exercise session lasting for 25 min the maximum (Fig.1). All the exercises were conducted after an overnight fast state. The subjects were instructed to follow a normal lifestyle maintaining daily habit-s, to avoid any medications, and to refrain from exercise 3 days before the experimental day**.**

Biochemical analyses: Blood samples were obtained from antecubital vein 30 minutes before exercise, immediately after the exercise and 30min following the exercise. Plasma was separated by centrifugation within 15 minutes of collection and divided into three aliquots. The aliquots were frozen and stored at -20°C and -80ºC for subsequent analyses (within 3-4 weeks). The samples were analyzed for glucose, TG, TC, HDL-C and LDL-C and VLDL-C. High density lipoproteins (HDL-C) by precipitation method with MgCl2-Na Phosphotungstate (Men Com Cat No 100, Tehran Iran) , Serum glucose(glucose oxidase, Men Com Cat No 428), TG (lipoprotein lipase and glycerolkinase, Men Com Cat No 337) and TC (Cholesterol esterase, Men Com Cat No 258). LDL-C was also calculated by using two equations as previously described (36, 37). **[** (TC-[VLDLC + HDLC]=LDLC or (LDLC= TC-(TG/5

+ HDLC)]. The TC/HDLC and LDL/HDLC ratios were adopted according to the atherogenic and CAD (CHD) risk factor indexes were calculated.

Statistics: the data were analyzed using SPSS package (version 10.1) by personal computer. The obtained data for plasma HDL-C glucose, GTG, TC, LDL-C, and VLDL-C were analyzed using analysis variance (ANOVA) with repeated measure variables. Statistical significance was accepted at $p<0.05$. Significant effects were followed by appropriate planned comparison.

Results

Table 1 shows the mean values (±SE) of age, height, body weight (BW), body mass index and other physiological, physical performance, and related parameters. Plasma glucose concentrations significantly changed (P<0.001) from 91 ±1.2 mg/dl to 153.68 ± 7.5 mg /dl immediately after exercise and still higher and significant (P<0.023) when compared with pre-exercise value (Fig.1). A significant changes were observed in HDL-C levels (F=5.018, P<0.025). HDL-C increased from 43.5 ± 2 mg/dl to 48.2 ± 1.5 mg/dl immediately after exercise. However, an insignificant (P<0.4) reduction was observed in HDL-C levels following 30 min of the exercise recovery period (Fig.1). As presented in Table.2, plasma TG, TC, LDL-C, VLDL-C levels showed an insignificant increase after a single session of WTBCE. An insignificant reduction in LDL/HDL (-0.681 or 20.4%) and in TC/HDL (-0.12) ratios were also observed.

Discussion

The purpose of the present study was to investigate acute plasma glucose and lipoprotein responses to a single session of WTBCE program. The main findings of this study were a significant increased plasma glucose and an elevation in HDL-C level (+ 4.2mg/dl) immediately after exercise. An insignificant changes in plasma TC and TG, and LDL-C concentrations in the present study are in disagreement with Sgouraki et al [32] who observed a significant increase in TG, TC, and LDL-C concentrations after an acute treadmill ergometer test. Hughes et al [38] found no significant difference in TC, TG, and LDL-C measures after 15, 30, and 45 min of an acute exercise at VO_{2max} 20% blow VT. Davis et al [39] did not observed any significant changes in blood lipid variables and LDL-C after an acute exercise at 50% (lasting 90min) and 75% VO_{2max} (lasting 60min). As reported by Imamura et al [40] the concentrations of serum TC, TG, and LDL-C showed no significant changes after an acute moderate exercise intensity (60%VO_{2max}) for 30 or 60min in duration in sedentary young women. Our results also are in agreement with Jürimäe et al [34] and Wallace et al [33]. In the present study a significant increase in plasma glucose was observed immediately after the exercise program and still significantly higher during 30min of recovery period when compared to before exercise value. Increased in blood glucose are consisted with some of the previous studies using different resistance exercise protocols [34, 43, 44, 45] and it also is disagreement with other reported results [46, 47]. Robergs et al. [43] reported glucose increases due to plasma volume shifts. In regards to HDL-C, post-exercise increased in HDL-C have previously been reported following prolonged endurance events lasting ≥2hr [41, 42]. Sgouraki et al [31] reported that after the maximal exercise bout of the ergometric test on treadmill for 12-14min the maximum, wrestling and control groups showed statistically significant increase in HDL-C levels as compared to rest values (12.7%, and 13.7%). In other study by Sgouraki et al [32] reported that after maximal effort wrestling and control groups showed significant increase in HDL-C levels compared to rest values (13% and 14.4% respectively). Gordon et al [42] reported no significant change sin HDL-C levels immediately and 1h after a single exercise on tread mill at 60 and 75% VO2 max. the same results also were reported by Gordon et al (1996)[48]. Angelopoluos et al [49] evaluated the effect of single bout and repeated bouts (30min) of treadmill exercise on HDL-c and its subfractions. They pointed out that total HDL-C remained higher significantly than the pre-exercise values 5 min after the exercise. In the study by Hughes et al [38] who used different exercise duration (15, 30, 40min) at certain intensity (VO2max 20% below ventilatory threshold) to investigate any changes in serum lipoprotein metabolism. They were found no significant changes in HDL in all exercise durations. Davis et al [39] studied the effects of acute exercise intensity on plasma lipid s in well trained runner in a high-intensity (at 75% VO2max and for 60min) and low intensity session (at 50% VO2max and for 90min). They did not observed any significant changes in HDL-C and HDL-C2 levels after exercise. Ferguson et al [51] who reported that HDL-C concentration was significantly elevated immediately after and 48h after exercise in the 1500kcal session. An increase in HDL-C levels (2 ± 4mg/dl) after a bicycle ergometer exercise at 80% of HR max in trained men was reported by Kantor et al [52]. Wallace et

Set	Rounds	Stations	Total preformed Techniques
1	3	8	24
3min rest (semi-active recovery)			
2	3	8	24
3min rest (semi-active recovery)			
3	2x3min (30s rest between) Competitive wrestling		

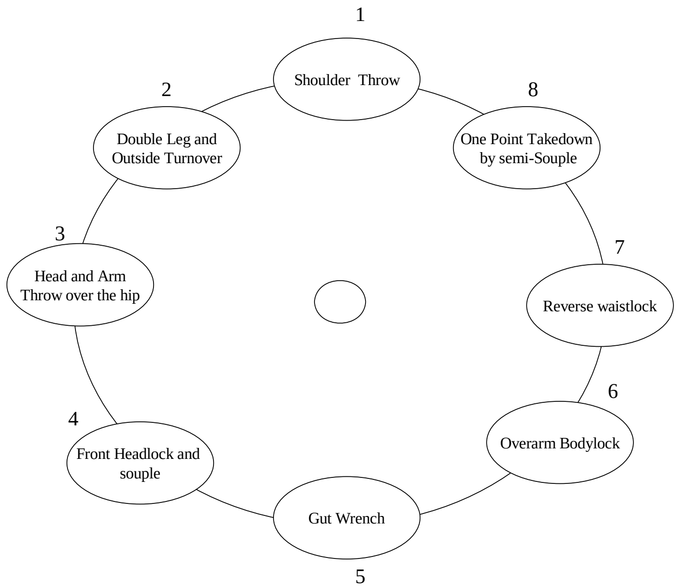

Figure 1: An experimental working plan

Table1: Physical characteristics of the participants (mean ± standard error, n =20)

Variables	**Values**
Age (year)	20 ± 0.69
Weight (kg)	74 ± 3.71
Height (cm)	172.5 ±2.10
BMI (Kg/m^2)	24.54± 0.63
HR_{Rest} (beat/min^{-1})	69 ± 2
$CHR_{max\ 1}$(beat/min^{-1})	173 ± 3
CHR_{max2} (beat/min^{-1})	177.0 ± 2
Wrestling HR_{Rest}	126.71± 4.35
Wrestling HR_{max}	179.23± 3.87
Avrage Time1 (min)	1.40 ± 0.029
Avrage Time2 (min)	1.42 ± 0.042
Practice sessions/week	3-4
Wrestling Experiences (y)	7.62±1.23

Table2: Biochemical variables: plasma TC, TG, LDL-C, VLDL-C concentrations and TC/HDL and LDL/HDL-C ratios. Values are mean ± SE. * p<0.05, ** p<0.01 compared with pre-exercise. + p<0.05, 30-Postexercise compared with pre-exercise value.

Variables	Pre-Exe	Post-Exe	30 min Post-Exe
TC (mg/dl)	163 ± 5.6	175 ±6.3	165 ± 5.6
TG (mg/dl)	108 ±11	121 ±11	115 ±12
LDL-C (mg/dl)	99 ± 6.4	102 ±7.4	97 ± 6
VLDL-C(mg/dl)	21.7 ±2	24.3 ±2	22.5 ±2.4
TC/HDL-C Ratio	3.9 ±0.3	3.8 ±0.2	4.1 ±0.2
LDL/HDL-C Ratio	2.4 ±0.22	3 ± 0.8	2.5 ± 0.2

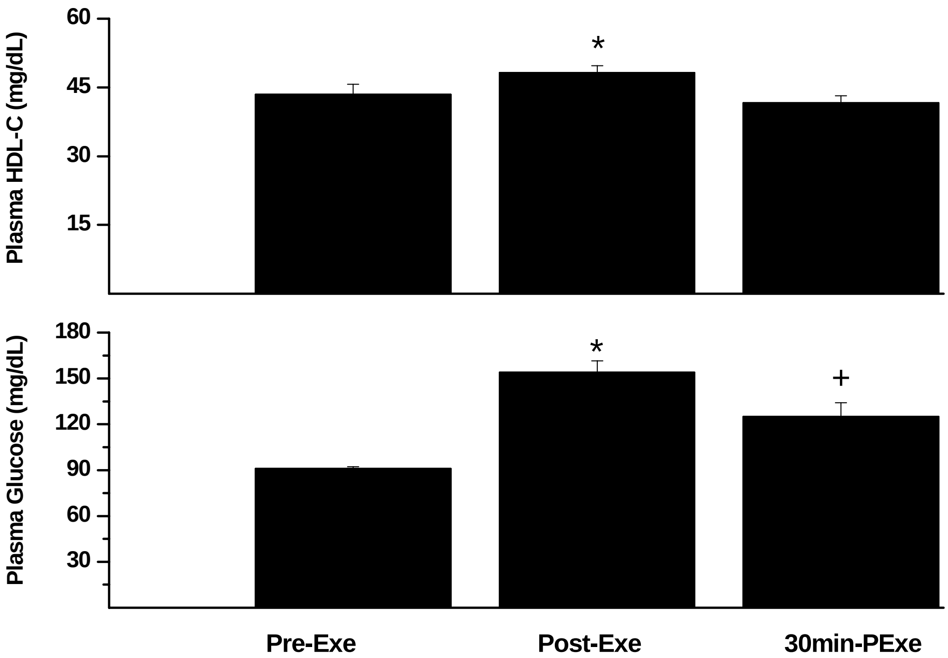

Figure 2: Plasma glucose and HDL-C concentrations to a single wrestling technique-based circuit exercise (WTBCE) plus a competitive wrestling practice before, immediately after exercise, and after 30min of recovery. Values are mean ± SE. * p<0.05, ** p<0.01 compared with pre-exercise. + p<0.05, 30min Post-exercise compared with pre-exercise value.

al [33] were studied the effects of 90 min of resistance exercise with different volumes (high volume and low volume) on alterations in lipid and lipoprotein concentrations as well as the activity of lecithin: cholesterol acyltransferase (LCAT). A significant changes were only found following the high volume session. These included increases in HDL-C (11%) and HDL3-C (12%) 24 h post-exercise. Jürimäe et al [34] who reported that the plasma HDL-C levels were insignificantly increased during a circuit resistance exercise(ten exercises, three circuits using a work-to-rest ratio of 30 s:30s at 70% of one-repetition maximum and for 30min)., but after a 1-h period of recovery the concentration was significantly higher than before exercise. As reported by Burns et al [53] plasma HDL-C concentration were significantly lower after a single resistance exercise trail than in the control trail. Wooten et al [54] did not find a significant change in HDL-C after an acute circuit resistance exercise and training. Our result is also in agreement with by Hill et al [35] who pointed out that the only significant effect of exercise in their experimental condition was to acutely increase in HDL-C in the immediate post exercise sample compared with the control. A discrepancies between our results with other previous reported findings, first of all could be explained by the general factors such as duration , intensity or energy expenditure per session [39, 55], interest resting period, mode of exercise [56], and diet [57]. The initial levels of plasma HDL-C is also can be considered as a determining factor. As reported by Eliakim et al [30] how suggested that in their study the hypercholesterolemia and low HDL-C were found mainly in power sports (i.e., weight lifting, boxing, wrestling and judo) and anaerobic sports (i.e., tennis, sprints, and jumps, gymnastics, ice skating). The same result was reported by Tsopanakis et al [25]. The underlying biochemical mechanism responsible for acute increase in HDL-C after a single WTBCE plus wrestling practice session is complex . Enzymes such as lipoprotein lipase (LPL), hepatic triglyceride lipase (HL) , and lecithin : cholesterol acyltransferase (LCAT) and cholesterol ester transport protein (CETP) play a role in mediating HDL-C concentration change. Acute increase in HDL-C probably related to catabolism of triglyceride rich lipoproteins via lipoprotein lipase[58, 52, 59, 51]. It has been suggested that the increases reported for HDL-C after endurance exercise, may be partly due to reduce recycling and catabolism velocities of lipoprotein in athletes compared to controls, than to lipoprotein increases *per se* (60). In addition to lipoprotein lipase (LPL), lecithin: cholesterol acyltransferase (LCAT) is known as a plasma factor in HDL-C remodeling which estrifies cholesterol in HDL particles, permitting its transports in HDL core and increase in cholesterol per HDL particles. An increased LCAT activity was reported by several investigators [61, 62, 63]. A post-exercise higher level of HDL-C has been attributed to a significant changes in HDL-C subpopulations ,such as HDL2-C and HDL3-C [4, 58, 49, 42, 48, 27,55 , 51, 31, 32, 64, 65, 66]. The HDL-C increased HDL-C concentration immediately after exercise may have been related to decrease CETP activity or concentration. CETP is responsible for the shuttling of lipid between HDL and other lipoproteins, and has been shown to decrease after exercise [67, 68]. The reverse cholesterol transport (RCT) has been reported after physical exercise in untrained subjects and athletes [69, 70, 71, 72, 73]. In this regard, Campaigne et al [74] reported that HDL-C was significantly increased after exercise for 30min on a cycle ergometer at 60% VO_{2max}. They also pointed out that cholesterol efflux was higher to HDL-C obtained from sedentary group compared with runner group before exercise. They conclude that acute exercise increased HDL's ability to act as an acceptor of cellular cholesterol in runner, whereas it decreased in sedentary group. In addition to above factors, the effects of exercise on apolipoproteins, particularly Apo-AI and AII [26,75,76] and pre beta-HDL has been reported by recent studies [77, 78]. This is the first report demonstrating that wrestling technique -based circuit exercise plus a competitive wrestling practice

resulted in an increased HDL-C and glucose concentrations.

Our results suggested that as single wrestling technique-based circuit exercise plus a competitive wrestling was able to bring a change in plasma glucose , lipid and lipoprotein profiles. Although we found an insignificant increase in TC, TG, and LDL-C, but the exercise program was more effective on the plasma HDL-C concentration. The HDL-C concentration between subjects was varied from 29-64 mg/dl with averages 41-47mg/dl. Thus, our data partially initially low HDL-C in wrestlers. The present results also suggest that this exercise program can be considered as a stimulus for lipid and lipoprotein changes. It has pointed out that we did not measure HDL-C changes during the exercise program and other plasma factors which are involve in HDL-C remodeling. Further work should investigate the possible role of pre-beta HDL and ATP-binding cassette transporter (ABC) family, particularly A-I (ABCA1) in cholesterol efflux and RCT processes during and after the WTBCE program.

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