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Effect of an Interval Progressive (Pyramidal) Aerobic Training On Lipid and Lipoprotein Profiles in San Shou Athletes

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Abstract

The aim of this study was to obtain an insight into the influence of an interval progressive (pyramidal) aerobic training on serum lipid and lipoprotein profiles in San-Shou athletes. 13 national levels male San Shou player were (23.23 ± 2 years and 66.27±2.75kg,171.8 ± 2.8 cm in high and 22.42± 0.51 BMI) were voluntarily participated in this study. Blood samples (10ml) were taken from an arm vein before and after training program. All blood samples were prepared for glucose TC, TG, HDL-C LDL-c VLDL-C and some other blood factors and atherogenic indexes measurement. The results of this study show that there were a significant decrease in serum TG , VLDL-C concentrations and TC/HDL-C and LDL/HDL-C ratios and a significant increase in serum HDL-C levels after an interval progressive (pyramidal)aerobic training for 14 weeks. The present date indicate that this training program was able to changes lipid and lipoprotein metabolism toward an cardiovascular indexes improvement independent to any significant changes in TC and LDL-C levels.

Key words: an interval progressive, (pyramidal), aerobic training, San-Shou athletes, TC,TG ,HDL-C, LDL-C lipid and lipoproteins

San Shou is one of the Chinese traditional martial arts, which is sometimes called modern Wushu. Today, this sport has been accepted as combating sports by more than 80 countries and it is working at professional levels by most of San Shou players in some western countries. With respect to the nature of San Shou, it is a physical, technical demanding sport. It is also classified as a weight categories sports with power-anaerobic based. During San Shou practicing and competition, most reliance of this sport is on anaerobic glycolysis system. The competition time in San Shou is 2 x

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2min, but an extra 2min is being granted, when two competitors have the same score. It has been generally accepted that active people have higher and better cardiovascular conditions in comparison to them counterparts (1,2). It has been Found that aerobic activity and endurance training are more effective to change lipid and lipoprotein profiles in people with different ranges of age and physical fitness. There are also a general agreements about the positive effects of aerobic and endurance types of training on lipid and lipoprotein metabolism (3,4,5,6,7,8,9,10). In contrast to aerobic physical activities and regular endurance training, there is no agreement about the effects of anaerobic-power based sports/physical activities or maximal (high) intensity -short term exercise training on serum/plasma lipid and lipoprotein profiles.

In this regard Thomas et al (11) who examined the effect of different running program (4-mile, 2-mile, interval at 75 %maximal heart rate) on lipid profiles in men and women. They found that total cholesterol (TC) and Triglyceride (TG) of plasma generally were unaffected by training. As with other lipid variables, exercise had similar insignificant effects on HDL-C in men and women. In other study, Thomas et al (12) examined the effect of two mode of running (Interval versus Continuous, 5mile, 4minutes, 2minutes) on plasma HDL-C and lecithin cholesterol acyltransferase (LCAT), they observed no significant differences among groups for TC and HDLC, and LCAT activity. However, acute exercise showed increase serum HDL-C and in HDL2-C (17.4%) and HDL3-C (19%) in wrestlers [13]. There are very few studies, which have just compared serum or plasma lipid and lipoprotein profiles in selected power-anaerobic based sports, but not Chinese martial arts, particularly, San Shou (14,15). With regard to the effect of martial arts on the prevention of CHD and cardiovascular fitness, particularly on serum lipid and lipoprotein profiles, there is a few studies and investigators havefocused on lipid and lipoprotein profiles. In this regard, some researchers who reported [(16,17,18)] that Tai Chi Chuan (TCC) participants showed unchanged total cholesterol (TC) levels after 1month of training, HDL-C levels and TC increased significantly in the TCC group .To date, there is no information about the effect of San Shou training and the effect of an interval progressive (pyramidal) aerobic training program on serum lipid and lipoprotein profiles. On the basis of the above studies and and due to lack of any information about San Shou effect on lipid profiles, the aims of the current study were the evaluation of the effect of an interval progressive (pyramidal) aerobic training program on serum lipids and lipoprotein profiles as wellas to provide new information in this matter.

Methods

Subjects: Thirteen national level male San Shou players [mean age (SE ± 23.2 ± 2 years), mean body mass at the beginning 66.27± 2.75 kg. Mean height 171.8±2.8 cm, and mean body mass index 22.42±0.51) volunteered to participate in this study. They have been involved in regular San Shou training for 5 ±2.5 years. All the subject gave their informed consent prior to inclusion in this study. The local technique committee approved the protocol.

Biochemical Analysis:s Pre-test as well as post-test blood sample (10 ml) were drawn from an arm vein keeping the subject in a sitting position throughout the procedure. Pre-test blood was drawn before starting an interval progressive (Pyramidal) aerobic training and post-test blood was taken at the end of 14 weeks. All blood samples were prepared for serum glucose, lipids (TC, TG), and lipoprotein profiles (HDL-C, LDL-C, VLDL-C) measurements. Serum glucose, TG and TC were obtained by enzymatic methods (glucose oxidase, LPL, and Glycerol kinase and cholesterol esterase, respectively by using kits with serial numbers 428, 337 and 258, which were purchased from Men an Iranian Com). Serum HDL-C was measured by using Phosphotungstic acid- Magnesium chloride method (kit serial number 100, Men Com). Serum LDLC was obtained by an enzymatic method (kit was purchased from Pars Azma another Iranian Com). LDL-C was also calculated two equations as previously (19,20) described (TC-[VLDL-C + HDL-C]=LDL-C or (LDL-C= TC-(TG/5 + HDL-C) The TC/HDL-C and LDL/HDL-C ratios were adopted according to the atherogenic and CAD (CHD) risk factor indexes were calculated.

Experimental Design

Following the completion of the pretraining measurement, the group of 13 male voluntarily selected to participate in the training program began at 14 week interval progressive (Pyramidal) walking-running exercise program. Subjects trained 80-90 min/day, 3 times/week and maintained individual training HRs within a prescribe range[HR lower limit=HR rest +25%(HR max –HR rest) and HR upper limit =HR rest +%75 to near maximum(%100) (HR max –HR rest), as suggested by Karvonen et al.(21) the maximal HR was taken to be the peak HR obtained during the maximal field /technical skill {three inconsecutiv) tests prior to training. Each 80-90 min training session was preceded by a 5 min warm up stretching and main joint mobility period followed by a 5 min cool-down stretching period. Exercise HRs monitored by the subject for a 6 or 10 second count at the end of each given intensity (every intensity change point). Subjects were periodically checked by the investigators to insure accuracy in HR determination. Exercise intensity was adjusted to maintain the HR within the target (in each intensity point) range. All training session were supervised and any session missed were made up by the subject to provide 100% attendance. The length of each exercise session to the nearest minutes, the proximate distance covered each session, and the HR attained at each of the designated check times were recorded in a daily exercise. Subjects were followed through 14 weeks of an interval progressive (pyramidal) aerobic training [walking-running] that was divided into three phase which are as follows:• Phase I or accommodation Phase (1-3 weeks, 2days/ week, and by 30-31minutes time for each set, 2set per session. Ten minutes of active rest [San Shou drill (25%-%50 HR max intensity) , joint motion, and stretching exercise] were allowed between each set of an interval accelerative aerobic training.• Phase II or lading phase (4-8 weeks) [walking-running from 25% up to near maximal HR max(100%) 3days/week, 3 set per session, 16minutes time period and 8min active rest such as mentioned above. •Phase III or maintenance/final phase (9-14 weeks) [progressive running from 25% up to near maximal(100 HR max) 3days/week, 3 set per session, 16minutes time period and 8min active rest such as mentioned above. Of course, more emphasis has put on %75-85% of HR max (Figure 1).

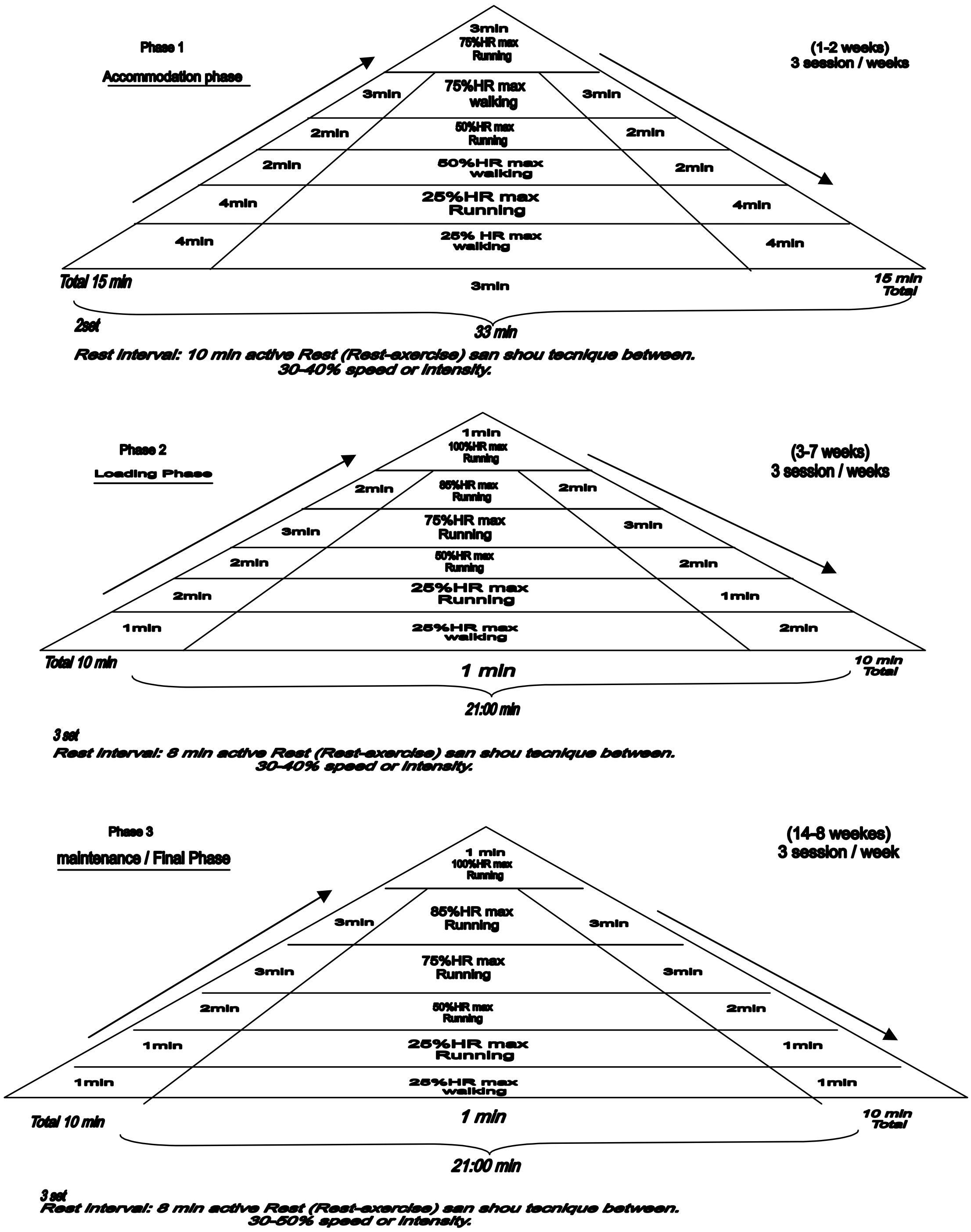

Figure 1 Phases of progressive aerobic training

Training: San Shou training sessions were normally 2h duration, in which San Shou specific skill and drills, mat work and fighting practice were performed 3d/week[1] (nonconsecutivedays).

Statistics: Statistics were performed by using Statistica software (version 5.1); a one-way ANOVA was also performed. All data were expressed as mean (SE±) and the alpha level for statistical significant was set up at $P<0.05$.

Results

Table 1 presents the mean , standard error and ANOVA results of age, height, body weight ,BMI., glucose, Hb, Hct. and LDL-C levels of the subjects for before and after training. ANOVA Showed that there were no significant differences among the pre and post test in BW, BMI, LDL-C, TC, and serum glucose, HCT, Hb. On the other hand, 14 weeks of an interval progressive (Pyramidal) aerobic training period resulted in significant decrease in serum TG ($p<0.035$) and VLDL-C ($p<0.04$)(Fig.2). A significant increase was also observed in serum total HDL-C ($p<0.02$)(Fig.2). According to our findings LDL/HDL-C and TC/HDL-C ratios ($p<0.045$, $p<0.04$,respectively) as two main indexes for CAD disease were significantly lower after 14 weeks of training period in San Shou players.

Table 1 Physical characteristics and some serum biochemical variables of the subject before and after an interval progressive (pyramidal) aerobic training.

variables	Pre-training	Post-training	P values	signification
Age (year)	23.23± 2.00	23.23± 2.88	0.882	NS
Height (cm)	171.8± 2.8	171.1 ± 4.1	0.797	NS
Weight (kg)	66.27 ± 2.85	66.35 ± 4.03	0.981	NS
BMI(kg/m2	22.41 ± 0.51	21.88 ± 0.59	0.541	NS
Glucose(mg/dl)	83.35 ± 2.26	82.11 ± 4.52	0.785	NS
Hb (g/dl)	13.73 ± 0.17	13.94 ± 0.21	0.477	NS
Hct (%)	41.74 ± 0.45	43.38 ±1.05	0.123	NS
LDLC(mg/dl)	96.92 ±7.44	89.2 ±5.40	0.481	NS

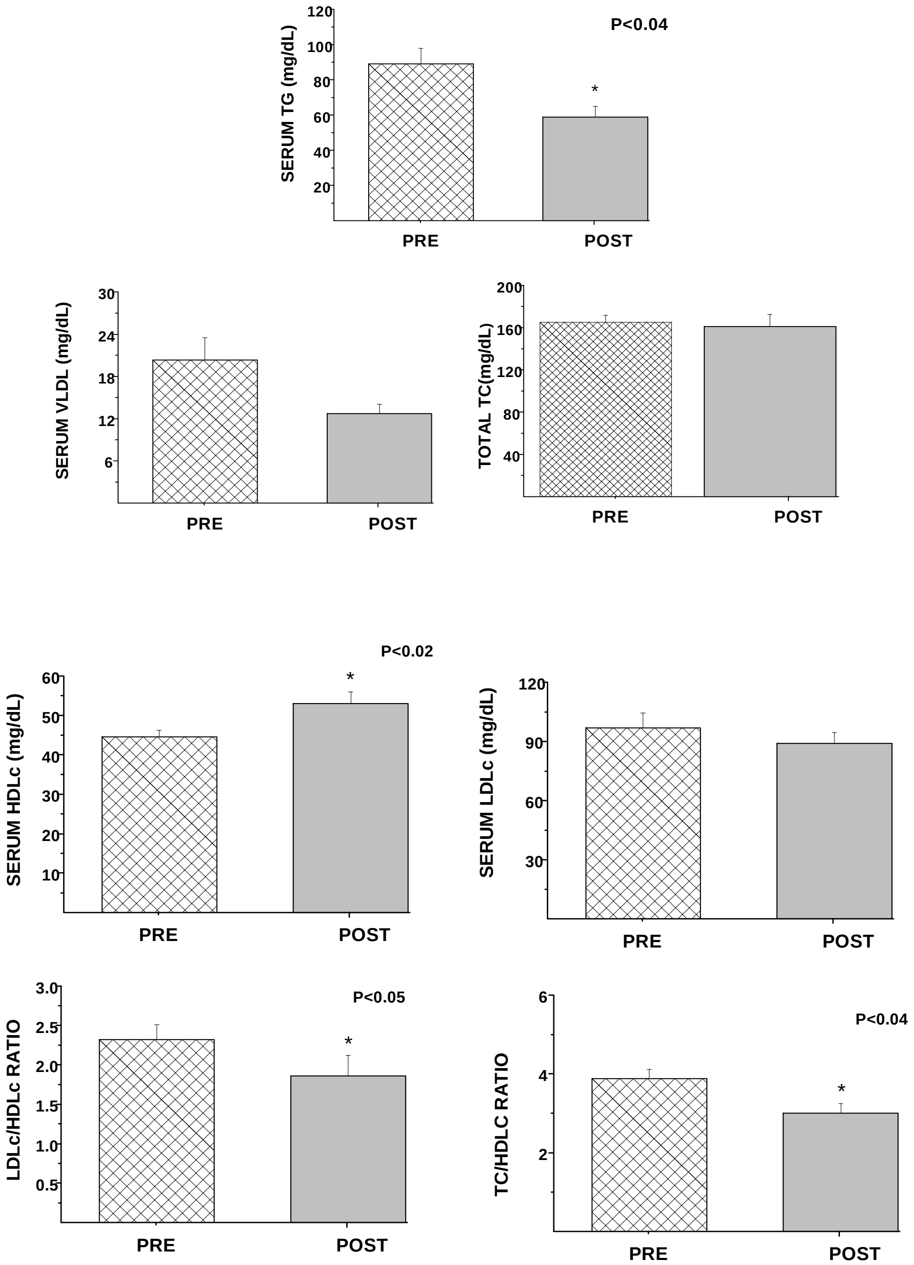

Figure 2 Significant in erease observed in serum

Discussion

This study is the first to provide new information about the effect of an interval progressive(pyramidal) aerobic training on lipid and lipoprotein profiles in San Shou players. The main purpose of this study was to examine the effect of an interval progressive (pyramidal) aerobic training program on serum lipid and lipoprotein profiles in san Shou players. To attain this purpose ,serum glucose Hb, HCT, TC , TG, LDL-C, HDL-C levels an TC/HDL-C and LDL/HDL-C ratio were determined prior and after a 14 weeks training period. Fourteen weeks of an interval progressive (pyramidal) aerobic training did not result in significant changes in body mass, body mass index, Hb, HCT, serum glucose, TC, and LDLC levels, but resulted in significant changes in serum TG[from 89.8 ± 8.9 to 58.5 ± 5.94 mg/dl (P<0.03, -31 mg/dl)], HDL-C levels [from 44.66± 1.67 to 53.28 ± 2.98 mg/dl(+ 9mg/dl)] and also in LDL/HDL-C , TC/HDL-C ratios. A significant (P<0.03 and P<0.05) reduction were also found in two main indexes for CHD, that is LDL/HDL-C and TC/HDL-C ratio respectively.

Serum Triglyceride (TG) in this study showed a significant decrease in serum TG following an interval accelerative (pyramidal) aerobic training for 14 weeks. Our finding is in agreement with Farrell &Barboriak (22) who found a significant change in serum TG after 8 weeks of endurance training (70%.VO2 max, 30min/day, 3-4days/week). They also noted that a reduction in serum TG was more pronounced during 4-8 weeks. Tasi et al (18) who reported that Tai Chi Chuan exercise program for 12 weeks resulted in a favorable changes in the mean TG levels decreased from 172.4 to 148.6 mg/dl. Park et al (23) who observed a significant decrease in TG levels (from 177.6 to 132.5mg/dl) after an aerobic exercise training program(60min/day, at 50%-60% intensity, 3day/week for 36 weeks). The concentrations of TG were not showed a significant differences in some other published articles (24,25,26). In contrast to serum TG, serum TC levels in the present study was unchanged. This finding is in consistence with Tolaria (27) who observed no significant change in serum TC after 12 weeks jogging(1.6,3.2,4.8 km,3time/week at 85% of Maximal heart rate for 12 weeks). Frey et al (28) observed no significant changes in serum TC after 10 weeks. The same result was reported by Schwartez et al(29). In contrast to our results, Gastmann et al (30) found a significant changes in serum TC (from 208 to 167mg/dl). In a study by Tsai et al (18) a significant changes in serum TC(from 205 to 190mg/dl) after a Tai Chuan training program was observed. Serum VLDL-C levels in the present study showed a significant (p<0.04) decrease from 20.12 to 12.7mg/dl. Our result is in agreement with Gastmann et al (30) who observed a significant decrease in serum VLDL-C from 8±3 to 3±2 after an ultra-triathlon race. Baker et al (31) who did not find significant changes in VLDL-C levels (26.30 vs 17.47mg/dl). to LDL-C as a chief risk factor showed a slightly changes (~ 6.5mg/dl) but this change did not reach to significant levels. In agreement with our date, Schawrtz et al (32) who observed no significant change in LDL-C in young and older men after 6months endurance training. LeMura et al(32) reported that LDL-C concentration did not show any significant differences after 16 weeks in their studies groups. A slight increase in LDL-C levels even observed by Frey et al (28) at the end of training program which was also reported by some other researchers(33,34,35). In contrast to our finding, Gastmann et al (30) found a significant changes in LDL-C from 127 to 93 mg/dl reported that serum LDL-C was significantly decreased to about 3.78mg/dl per 3weeks in their exercise group. and the same result was reported by Tsai et al (18). As we can see there is a discrepancies between our date with other published results. These are could be attributed to some major and minor factors such as exercise intensity, the type and duration of training program, nutritional status, physical fitness, high cholesterol status, gender and the time for sampling (36,37,38,39) who are able to affect LDL-C concentrations.

The ratios of LDL-C/HDLC and TC/HDL-C have been considered better discriminators of patients at risk for the development of CAD than either TC or HDL-C. A decrease in either ratio is thought to lower one’s risk for CAD. Our findings show that LDL/HDL-C ($p<0.045$, 27.15%) and TC/HDLC ($p<0.04$, 22.16%) ratios were significantly decreased after 14 week period of training. Baker et al (40) demonstrated significant ($p<0.045$, 0.04) decrease in the exercise subjects for both the TC/HDLC (6.46 to 5.34 for a 17.3% decrease) and the LDLC/HDL-C ratio(5.28 to 4.30 for a 18.6% decrease). Motoyama et al (41) however reported that TC/HDLC decreased significantly after only 3 months aerobic training. The same results was also reported by other studies (34,37). This pattern has also been reflected in several epidemiological studies which have suggested find when LDL/HDL and TC/HDLC ratios are reduced a corresponding decrease in the risk of CHD (41). Thus, the results of our study would seem to indicate a decreased risk of CHD.

With more focus on serum HDL-C changes and its metabolism, our result is in agreement with numerous other studies which find an improvement in HDL following an endurance/ aerobic training, such as running, walking and intensive endurance training in young men, women, middle-aged and elderly people (18,30,32,36,37,42). In this regard, Schwartz et al (32) demonstrated that an intensive endurance training (walking/jogging/biking) for 27 weeks resulted in a 15% increase in HDLC, and a 63% increment in HDL2-C. Yu et al (43) observed an increase in mean HDL-C from 43 to 56 mg/dl (30% increases) after the completion of the triathlon race. Thomas et al (11) suggested that, exercise had similar insignificant effects on HDL-C in men and women. The result of serum HDLC levels in the present study is also disagree with some other studies(44,45,46).

With regard to HDL-C metabolism, it has also been reported that there are several factors, which can influence HDL metabolism such as: ATP-binding Cassette AI (47) Lecithin: cholesterol acyltransferase (LCAT), Cholesteryl-ester transfer protein (CETP), Hepatic lipase (HLa), Lipoprotein lipase (LPLa), Phospholipid transfer protein (PLTP),and pre ß1-HDL(48,49,50,51,52). On the other hand, it has been reported that regular aerobic exercise may influence blood lipid and lipoprotein profiles by modifying the activities of intravascular enzymes and transfer proteins (61,62,). Elevation in the activities of lipoprotein lipase (LPLa)(32) and lecithin: cholesterol acyltransferase (LCAT)(11,42) have been shown after exercise, as have reductions in hepatic Triglyceride lipase (HTGLA)(53). In this regard, Tsopanakis et al(54) reported that plasma LCAT activity levels in the athletes from 8 selected sports[volleyball, judo, sprinting, wrestling, throwing, cycling, water polo and tennis) were significantly 2.2-7 times higher than the controls in the most sports. In addition, a reduction in cholesterol ester transfer protein (CETP) concentration, which is closely related to CETP activity (CETPa), has been demonstrated after exercise training. A greater LPLa or LCATa brought about by exercise training may reduce TG concentrations and facilitate an increase in high density lipoprotein cholesterol (HDLC)((55,56). Similarly, an exercise suppression of HTGLa or CETPa may slow the catabolism of HDL particles, thereby enhancing the accumulation of cholesterol in all HDL subfraction. It is well documented that plasma HDL play a pivotal role in the reverse cholesterol transport process form extrahepatic tissues toward liver and the initial step in this process involves cholesterol efflux from peripheral cells (57,58). Gupat et al (59) have shown that the net mass of free cholesterol transport out of cultured human fibroblasts into athlete's serum was greater than that of sedentary controls. This indicates that physical exercise may promote RCT by increasing cholesterol efflux from peripheral tissues(60). As specific subfractions of HDL, such as the prebeta-1 HDL fraction, may be especially efficient at mediating cholesterol removal from peripheral cells. Prebeta-1 HDL is a molecular of high density lipoprotein (HDL) species, which is converted to HDL species of large diameter very fast (52). Physical exercise would be anticipated to increase plasma prebeta-1 levels. Very recent, Sviridov et al (61) who examined the effect of a single session exercise on rebeta-1 HDL. They reported that acute exercise stimulated the formation of prebeta-1HDL by 6.6 fold when the increase in flows is considered. A single bout of moderate (60 ± 2% pulmonary oxygen uptake (VO2) peak for 25minutes) exercised raised the concentration of prebeta-1 HDL in both arterial and venous blood in both absolute term and as a proportion of total apo A-I. Jafari et al (62) observed an increase in prebeta-1 HDL in exercise trained group. In sum, although we did not measure some main variables which are related to HDL metabolism and exercise-induced increase in serum HDL in trained and physically active people, the results of the present study indicate that an interval progressive (Pyramidal) aerobic training in San Shou players with our research conditions was able to promote a changes in plasma lipoprotein (HDL, VLDLC), TG and TC/HDL and LDL/HDL ratio patterns in a direction that may reduce the risk of CHD/CAD.

Conclusion.

On the basis of the present study, it can be concluded that serum HDLC ,VLDLC and TG changes in San Shou players are independent to any significant changes in TC and LDL-C which can be improved after an interval progressive (Pyramidal) aerobic training. It appears that there is a threshold for serum TC reduction and HDL raise in response to physical activities and aerobic training(63,64,65,66,67). Our suggestion is to put more stress on an intensity around 70% to85% heart rate reserve (HRR). A further studies is needed to find out the precise effects of each phase of an interval progressive (Pyramidal) aerobic training program on serum TC, LDLC, HDLC and its subclasses. Our last suggestion is to measure the effect of this training program on prebeta-1 HDL and some plasma factors which are involve in HDL remodeling.

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اثر تمرین هوازی فزاینده(هرمی) تناوبی بر نیمرخ چربی و لیپوپروتئین های سرم در ورزشکاران سان شو

عباس قنبری نیاکی[1]

چکیده

هدف از این تحقیق بررسی اثر یک تمرین هوازی فزاینده تناوبی و نیمرخ چربی و لیپوپروتوئینهای سرم ورزشکاران سان شو بوده است. سیزده مرد جوان سان شوکار در سطوح ملی و بین المللی(۲±۲۳/۲۳ سال،۲/۷۵±٦٦/۷۲ کیلوگرم وزن،۲/۷۸±۱۷۱/۸ سانتیمتر قد و ۰/۵۱±۲۲/٤۲ شاخص توده بدنی(BMI) و داوطلبانه در این تحقیق شرکت کردند. به میزان ۱۰ میلی لیتر خون از ورید بازویی افراد در وضعیت نشسته راحت درحالی‌که ١٤–۱۲ ساعت ناشتا بوده‌اند، گرفته شد. تمامی نمونه‌های خونی برای اندازه‌گیری قند، کلسترول تام، تری گلیسرید(TC,TG)،لیپوپروتئین خیلی کم چگال، کم چگال و پرچگال(HDL-C,LDL-C,VLDL-C) و نسبتهای LDL/HDL و TC/HDL آماده شدند. نتایج کاهش معناداری را در غلظتهای TG,VLDLو نسبتهای TC/HDL و LDL/HDL نشان می‌دهد. افزایش سطوح HDL-C پس از یک تمرین هوازی معنادار بوده است. یافته های حاضر حاکی از آن است که تغیرات درغلظت های TC و LDL-C معنادار نبوده است. بنابراین از تحقیق حاضر می توان نتیجه گرفت این نوع تمرین قادر است که سوخت و ساز چربی و برخی از لیپوپروتئینهای سرم به ویژه HDL-C و شاخصهای سلامتی قلبی را مستقل از تغییرات معناداری در سطوح TC و LDL-C بهبود بخشد.

کلیدواژگان: تمرین هوازی فزاینده تناوبی، کلسترول تام، تری گلیسرید سرم، لیپو پروتئینها، ورزشکاران سان‌شو

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