EFFECTS OF RESISTANCE TRAINING ON THE BLOOD LIPID VARIABLES OF YOUNG ADULTS

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Abstract

This study investigated the effects of a-12 week resistance training regimen on the blood lipid variables of young adults in Ekiti state, Nigeria. It was hypothesized that there would be no significant effect of a 12- week resistance training program on the lipid profile of young adults in Ekiti state. Sixty young college students were randomly assigned to two groups (resistance training and control). Pre-test, mid-test and post-test measurements were taken and analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA) statistics at 0.05 level of significance. Following significant differences, the Multiple Classification Analysis (MCA) was computed. These statistical analyses revealed significant differences in the lipid profiles of the resistance training group following the 12-week training program; with a decrease in total cholesterol from 4.88 $\pm$ 0.85 to 3.78 $\pm$ 0.63 mmol/l, triglycerides from 0.64 $\pm$ 0.16 to 0.57 $\pm$ 0.15 mmol/l and Low density lipoprotein (LDL) from 2.74 $\pm$ 0.52 to 2.04 $\pm$ 0.52 mmol/l. High density lipoprotein (HDL) increased from 1.63 $\pm$ 0.27 to 2.00 $\pm$ 0.37 mmol/l in the training group and no appreciable changes in the control group. The study concluded that training regimen of this nature is capable of lowering LDL and raising HDL cholesterol levels in healthy young adults and can be a useful adjunct to therapeutic measures for prevention of coronary heart diseases (CHDs.)

Keywords: Young adults, low density lipoprotein, high density lipoprotein, resistance training, total cholesterol and triglycerides

Introduction

The enthusiasm and interest in the health benefits of resistance training continues to spark compelling new researches in the area. Lipids according to Maughan, Gleeson and Greenhaff (1997) contain the same structural elements as carbohydrates although its ratio of hydrogen to oxygen is considerably higher in compounds classified as lipids. In other words, Lipids contain carbon hydrogen and oxygen and sometimes phosphorous. It is the general name for a number of different water-insoluble compounds found in the body. Of great dietary importance to human amongst these compounds are triglycerides and cholesterol. In the words of Williams (2003), triglycerides are the true fats, the type people normally consume in their meals and they are of two different compounds namely glycerol and fatty acids. Robbins, powers and Burgees (2002) in their own research confirmed cholesterol as not being a true fat but a waxy substance found in the bloodstream and that because it is soluble in fats rather than in water, is classified as a lipid.

Meanwhile, since lipids are insoluble in water, which makes their transportation difficult, they combine with another food component in the body to form lipoprotein which therefore allows the lipids to be transported in the blood. Lipoprotein is classified into the different group based on their sizes and composition. The two that are of importance to this study are the low density lipoprotein cholesterol (LDL-c) and the high density lipoprotein cholesterol (HDL-c). As claimed by Durstine, and Haskell (1994), the low density lipoprotein cholesterol (LDL-c) is the “bad” or “lousy” cholesterol which transport cholesterol to various body cells and deposit excess of it in the artery walls increasing the risk of heart diseases while the high density lipoprotein cholesterol (HDL-C) is the “good” or “healthy” cholesterol responsible for the transportation of cholesterol from the blood and artery walls to the liver where it is converted to bile to be used for digestion or disposed off by the body. This reverse cholesterol transport process is believed to be helpful in preventing or reversing heart disease.

A person’s total cholesterol level is usually determined by the amount of LDLs and HDLs in a measured sampled of blood. A high level of LDLs is a significant cause of arthrosclerosis because they carry the greatest percentage of cholesterol in the bloodstream with the potential of depositing excess cholesterol into the artery walls.

Physical inactivity has been implicated in the development of Coronary Heart Diseases (CHDs) and adequate doses of exercises on a regular basis are an antidote to CHDs mortality. This is justified by the link of exercise training with increased concentrations of HDL-c which in turn is associated with reduced risk of CHDs. To the best of our knowledge, there is an acute dearth of information on exercise training and the lipid profile of men and women in this country. It is on this basis that this study investigated and reported the effects of a 12- week resistance training program on the lipid profile of college students in Ekiti State.

Hypothesis

There will be no significant effects of a 12-week resistance training program on the lipid profile of young adults in Ekiti State.

Methods

The participant in the study were sixty (60) certified healthy college students from College of Education, Ikere-Ekiti recruited from about seven hundred and ten (710) who made themselves available after a request to participate in the exercise training program was done to all the students from various academic departments in the college. Some of them were excluded due to health conditions that can interfere with the vigorous physical exercise and age above 40 years. All of them were given informed consent forms before the commencement of the study and none gave a history of any participation in any type of structured physical activity other than routinized ones. The participants were then randomly assigned to both the resistance training and control groups with 30 participants each.

The resistance training and the control groups were involved in both the pre- test, mid-test and post-test measurements. However, only the physical training group was involved in the 12 week, 3 sessions per week strength training program.

The participants assigned to resistance training (group A) were exposed to a well structured, supervised and progressive 12-week strength training program with 30-60 minutes session 3 times per week designed around isometric and isotonic contractions following the recommendations of Sale (1989) strength training program.

The program involved a 15-minute calisthenics as a form of warm-up before and 10 minute cool down activity period after the 30-minutes weight training sessions. Six to ten (6-10) different weight exercises that condition the major muscle groups of the body with 2-3 sets in a workout were performed. All the training sessions were adequately supervised and necessary adjustments made in the training program. However, the participants in the control group (group B) were asked to maintain their usual routinized activities during the experimental period.

Table 1

Resistance	Exercise Programme
Frequency	3 times per week
Intensity	8-12 RM per set for upper limb exercises 15-20 per set for lower limb exercises
Duration	30-60 minutes
Set	2-3 sets
Type	Weight Training

Adapted Recommendations in Sale (1989) Strength training programme.

Statistical Analysis

Descriptive statistics of mean and standard deviation and inferential statistics of Analysis of covariance (ANCOVA) (using the pre-test as covariate) were employed to treat the data gathered to determine the significance of the adaptations resulting from the 12-week structured resistance exercise training programme at 0.05 level of significance. A post-hoc analysis was also applied on significant variables using the Multiple Classification Analysis (MCA) to ascertain the magnitude of the adaptation which was accounted for by the 12-week structured resistance exercise training programme. The pattern of changes was studied from the results of measurements taken every six (6) weeks. This was also illustrated in graphs for each of the studied variables.

Results

Table 2 below presents the results of the resistance training effects on the blood lipid variables which include, Total cholesterol, Triglycerides, High Density Lipoprotein-cholesterol and low density Lipoprotein-cholesterol. The descriptive statistics of the pre-test, mid-test and post test values of the resistance training (group A) and the control (group B) were also presented.

Table 2 Pre-test, Mid-Test and Post-test values of the Lipid profile of the Resistance training (group A) and Control (group B).

Variables	Group	Pre-test Values X sd	Mid-test Values X sd.	Post-test Values X sd.
Total Cholesterol (mmol/L)	Resist. Training	4.88 ± 0.85	4.23 ± 0.65	3.78 ± 0.63
	Control	4.29 ± 0.89	4.54 ± 0.77	4.72 ± 0.74
Triglycerides (mmol/L	Resist. training	0.64 ± 0.16	0.60 ± 0.15	0.57 ± 0.15
	Control	0.84 ± 0.13	0.87 ± 0.14	0.94 ± 0.15
High Density Lipoprotein (HDL) (mmol/L)	Resist. training	1.63 ± 0.27	1.73 ± 0.32	2.00 ± 0.31
	Control	1.57 ± 0.32	1.61 ± 0.40	1.42 ± 0.33
Low Density Lipoprotein (LDL) (mmol/L)	Resist. training	2.74 ± 0.52	2.33 ± 0.50	2.04 ± 0.52
	Control	2.90 ± 0.93	2.91 ± 1.02	3.06 ± 0.99

Fig. 1

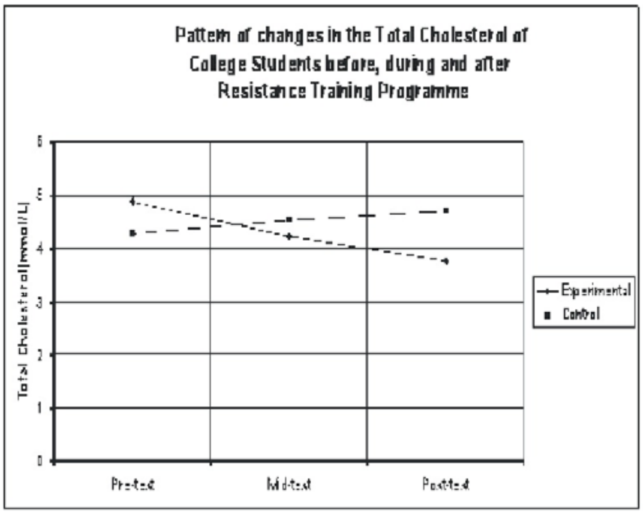


Fig. 2

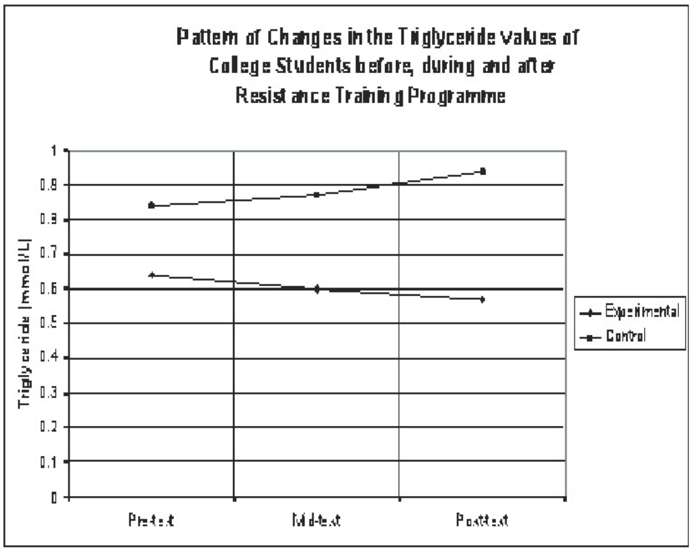


Fig. 3

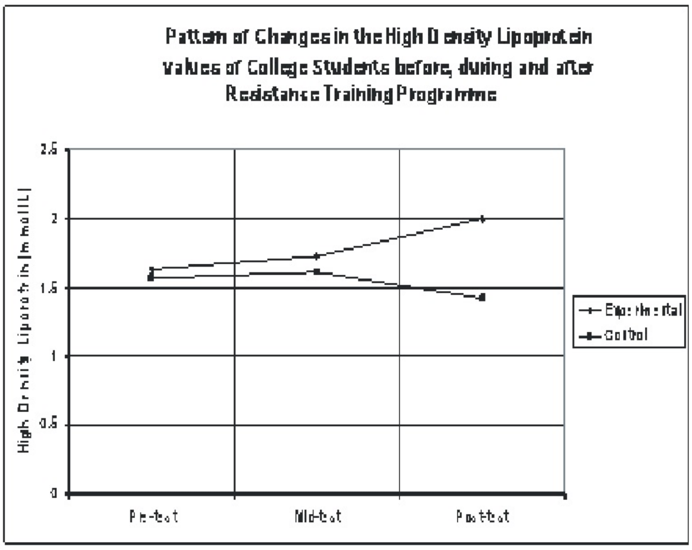
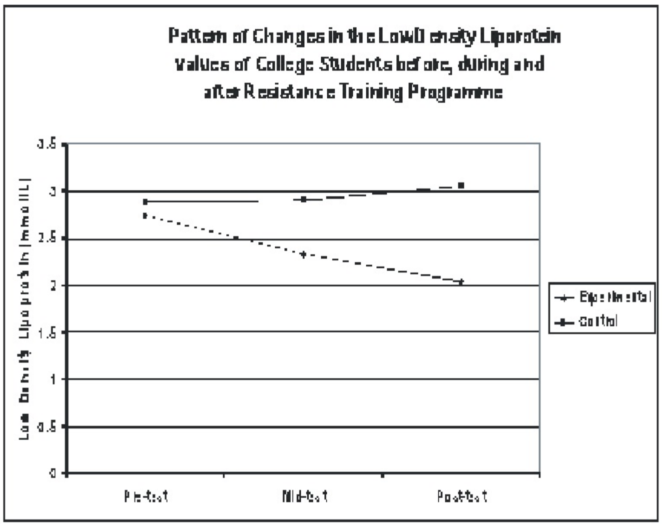


Fig. 4



Effect of Training Programme on Total Cholesterol Level (mmol/L).

The mean pre-training value of the total cholesterol which was 4.88 ± 0.85 mmol/L for the resistance training group was greater than that of the control group at 4.29 ± 0.89 mmol/L. This variable showed a declining tendency in the resistance training group at the mid training measurement value of 4.23 ± 0.68 mmol/L. also to a post-training value of 3.78 ±= 063 mmol/L. The total cholesterol mean values increased in the control group from 4.29 ± 0.89 mmol/L to 4.54 ± o.77 mmol/L at mid-training and 4.72 ± 0.74 mmol/L at the post training measurements. The mean difference in response of this variable to resistance training and no training were 1.1mmol/L and 0.43 mmol/L in both the resistance training group and the control group.

Effects of Training programme on Triglyceride Concentration (mmol/L).

The calculated mean pretest value of triglyceride for the resistance training group was 0.64 ± 0.16 mmol/L with a mild decrease at the mid-test and post-test values of 0.60 ± 0.15 mmol/L and 0.57 ± 0.15 mmol/L respectively. While the control group showed a modest increase from a pre-test mean value of 0.84 ±0.13 mmol/L to a mid test value of 0.87 ± 0.14 mmol/L and a post-test of 0.94 ± 0.15 mmol/L. The mean difference between the pre-test and post-test mean values showed a decrease to 0.07 mmol/L in the resistance and training group and an increase of 0.1 mmol/L in the control group.

Effect of Training on High Density Lipoprotein (HDL) (mmol/L)

The baseline measurements of High Density Lipoprotein presented mean values that was higher in the resistance training group than the value obtained for the control group. While the resistance training had a mean value of 1.63 ± 0.27 mmol/L, the control group obtained a mean value of 1.57 ± 0.32 mmol/L. Table 2 showed an increase in the mean values obtained on the resistance training group at both the mid and post training measurements respectively. While the control group demonstrated a decline in the mean values (1.61 ± 0.40, 1.42 ± 0.33 mmol/L) at both (1.73± 0.32, 2.00±0.31mmol/L) the mid and post training measurements.

The observed mean difference showed an increase of 0.37mmol/L in the resistance training group, whereas a mean decrease of 0.15 mmol/L was obtained on the control group after in the post training measurements.

Effect of Training Programme on Low Density Lipoprotein (LDL) (mmol/L).

The pre-training mean value of 2.74 ± 0.52 mmol/L for the resistance training group as presented on table 2 was lower than the mean value of the 2.90 ± 0.93 mmol/L for the control group. This variable showed a decline in the resistance training group from a pre-training mean value of 2.74 ± 0.57 mmol/L to 2.33 ± 0.50 mmol/L at the mid-training measurement and finally-reducing to 2.04 ± 052 mmol/L at the post training measurement. However, the LDL showed a slight increase in the control group from a pre-training measurement value of 2.90 ± 0.93 mmol/L to 2.91 ± 1.02 mmol/L and 3.06 ± 0.99 mmol/L respectively at the post-training measurements.

The observed mean difference showed a decrease of 0.7mmol/L in the resistance training group and an increase of 0.16 mmol/L in the control group after the completion of the resistance training programme.

Table 3 Summary of Analysis of Covariance (ANCOVA) for the Lipid Profile of the Resistance Training Group.

	Source	**Total Cholesterol**	**Triglyceride (mmol/L**	**High Density Lipoprotein (mmol/L**	**Low Density Lipoprotein (mmol/L**
SS	Covariate	24.355	1.077	3.148	29.989
	Main Effect	25.748	0.370	4.297	11.201
	Explained	3.247	0.238	4.089	6.136
	Residual	1124.323	37.454	187.988	442.698
	Total	40.997	3.327	12.370	51.782
MS	Covariate	24.355	1.077	3,.148	29.989
	Main effect	25.748	0.370	4.297	11.201
	Explained	5.696	4.171	7.173	0.108
	F. Ratio	452.013	88.687	59,900	104.056

F (0.05) = 4.03

Table 4 Multiple Classification Analysis (MCA) of ANCOVA on the Lipids profile.

Parameters	Grand Mean	Group	N	Unadjusted Development	Eta	Adjusted for in depended + Covance Devn	Beta	Multiple R2
Total cholesterol (mmol/L	4.2492	1	30	-0.4725	.496	-0.61882	.541	.293
		2	30	0.4725		0.61882		
Triglyceride (mmol/L	0.7542	1	30	-0.1832	1.220	-0.06535	.904	.817
		2	30	0.1831		0.06537		
High Density Lipoprotein (mmol/L	1.7108	1	30	0.2925	.881	0.26625	.568	.312
		2	30	-0.2925		-0.2663		
Low Density Lipoprotein (mmol/L	2.5525	1	30	-0.5108	1.020	-0.42957	.816	.665
		2	30	0.5108		0.4295		

1- Resistance Training group, 2- Control group

Table 2b showed the pre-test, mid- test and post-test of the lipid profile of both the resistance training and the control groups. The positive effects of resistance exercise on the lipid profile of the young adults was further asserted by the results of Analysis of covariance (ANCOVA) in table 3 which presented a calculated F. ratio of 452.013 for total cholesterol, 88.687 for triglycerides, 59.900 for High Density Lipoprotein (HDL) and 104.056 for Low Density Lipoprotein (LDL) which are greater than the critical value of 4.03 required for significance at 0.05 levels. The hypothesis which stated that there would be no significant effect on the lipid profile of young adults when exposed to a 12-week resistance training programmed was therefore rejected.

A further analysis using the Multiple Classification Analysis (MCA) on table 4 showed that the exercise training program accounted for 29.27% of the observed decrease in the total cholesterol, 81.72% of the decrease in Triglyceride, 32.26% of the observed increase in the High Density Lipoprotein and 66.59% of the observed decrease in Low Density Lipoprotein (LDL).

A further illustration of the graph showed the declining rates of Total cholesterol, Triglyceride and Low Density Lipoprotein in the resistance training group in figures 1, 2, 3 and 4. Figure 1 indicated a higher decrease between the 1st and the 6th week than between the 6th and the 12th week. Meanwhile, the control group showed an increasing rate that is higher between the 1st and the 6th week. Figures 2 and 4 also showed declining tendencies that are higher between the 1st and 6th week, while the control group showed increases that are higher between the 6th and 12th week in both Triglyceride and Low density lipoprotein (HDL).

Figure 3 exhibited a sharp increase and decrease in the High Density Lipoprotein in both the resistance training and the control groups respectively between the 6th and the 12th week, but both showed gradual slow increases between the 1st and the 6th week.

Discussion

The resistance training employed in this study had demonstrated a positive effect on lipid profile of the resistance training group. This is evident in the mean decrease of Total cholesterol in the resistance training group that amounted to 1.1mmol/L compared with an increase of 0.43 mmol/L in the control group. Likewise a mean decrease of 0.07 mmol/L in the Triglyceride of the training group compared with a mean increase of 0.1 mmol/L in the control group. A mean decrease was also observed in the training group for Low density lipoprotein (LDL) while an increase was found in the control group:

However, a mean increase (0.37mmol/L) was found in the training group in High density Lipoprotein (HLD). This increase might be due to the positive exercise effect, marked by the significant reduction (29.27%) of Total cholesterol, 81.72% reduction in Triglyceride, 32.63% increase in the High Density Lipoprotein and 66.59% decrease in Low density lipoprotein.

We observed significant decreases in the total cholesterol; triglycerides and low density protein (LDL) concentrations in the resistance training group but the changes in the control group were slightly on the increase. These changes were very evident right from the 6th week of the training regimen and were further confirmed at the completion of the training regimen with higher intensity and duration. The increase of these variables in the control group might not be unconnected with their normal lifestyle that did not change in any way during the intervention period. However, our observations in this study are consistent with some already published works on the relationship between exercise training and blood lipids. Huttunen et al. (1979) found both total and LDL cholesterol decrease in the training group but an unexpected decrease in LDL among the control group they attributed to the seasonal trends typical of a particular population of the study in the spring months.

The findings of this study further give credence to earlier findings on lipid profile (Goldberg et al. 1984; Hurley et al. 1988 and Boyden et al. 1993) who reported improved lipid profile in men and women after high intensity resistance training. Goldberg et al. (1984) reported decreased total cholesterol, low density lipoprotein cholesterol, triglycerides and decreased the ratio of LDL/HDL cholesterol and total/HDL cholesterol after 16-week resistance training in a study of a single group of men and women. Boyden et al. (1993) also reported a reduction in the total and LDL cholesterol in pre-menopausal women after a resistance training regimen at 70% of 1 repetition maximum. A significant decrease in total cholesterol and LDL cholesterol was observed by Prabhakaran et al. (1999) who studied the effects of a 14 –week resistance training on the lipid profile in premenopausal women and the sedentary control group. The findings of this study are at variance with the claim of Fletcher et al. (2005) that only exercise regimen and diet intervention of long duration can have any meaningful effect on the total cholesterol and LDL cholesterol.

Meanwhile, a progressive increase in HDL cholesterol was observed in the resistance training group after the 6th week of the training regimen till the end of the intervention program. In contrast, the control group had inconsistencies in the alteration. The group recorded a slight increase in the mid- test and a sharp decrease in the post- test values. This observation might be accounted for by other factors that could affect the HDL cholesterol concentration such as alcohol consumption, weight loss etc. which were not considered in this study.

The findings of this study are in agreement with the findings of Drygass (2000), who reported an association between exercise training and increased concentration of HDL cholesterol and Bemben (2000), who recorded an improvement in HDL cholesterol and total cholesterol after a-16 week resistance exercise program. Hurley et al. (1998) reported a 13% increase in HDL cholesterol following a 16-week of heavy resistance training. Also the observations of Fletcher et al. (2005) agreed favorably with the findings of this study in the Multiple Classification Analysis. They claimed that a single exercise session could elicit between 7% and 69% decrease in triglycerides and between 4% to 18% increase in HDL cholesterol in both single and regular exercise participation.

Evidence from previous studies (Stone et al. 1991, Goldberg et al. 1984, Mougios et al. 1998 and Dustine et al. 2001) have suggested that only during the highest volume of exercise training can greater positive changes be expected in serum lipid profile especially the HDL cholesterol.

Conversely, Kokkinos et al. (1991), Kohl et al. (1992), Smutok et al. (1993) and Halbert et al. (1999) reported that strength training did not significantly alter the serum lipid profile from their investigations. The results of this present study have clearly indicated that well designed and supervised strength training can influence the levels of blood lipids profile most especially the HDL cholesterol**.**

Conclusion

The fact that a reduction in total cholesterol, triglycerides, low density lipoprotein (LDL) and increase in high density lipoprotein (HDL) cholesterol resulted from this training regimen indicates that a training program of this nature is capable of lowering low density lipoprotein (LDL) and raising high density lipoprotein (HDL) cholesterol levels in healthy young adults. From the results of this study, it can also be concluded that resistance exercise training can be a useful adjunct to therapeutic measures for prevention of coronary heart diseases (CHD).

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References:

Bemben, D.A & Bemben, M.G (2000). Effects of resistance exercise and body mass index on Lipoprotein – lipid patterns of post-menopausal women. Journal of Strength Cond. Research. 140, 80-86.

Boyden, T.W, Pamenter, R.W & Going, S.B. (1993). Resistance exercise training is associated with decreases in serum low density lipoprotein cholesterol levels in pre-menopausal women. Achieves of internal medicine. 153: 97-100.

Drygass, W (2000). Long term effects of different physical activity levels on coronary heart disease risk factors in middle aged men. International journal of Sports Medicine. 21(4) 235-41.

Durstine, J.L, Grand jean, P.W, Davis, P.G, Ferguson, M.A, Alderson, N.L & Dubose, K.D (2001). Blood lipid and lipoprotein adaptations to exercise: A quantitative analysis. Journal of Sport Medicine. 31. (15) pp 1033-1062.

Durstine, J.L & Haskell, W.L (1994). Effects of exercise training on plasma lipids and lipoproteins. Exercise and Sport Science Reviews. 22: 477-522.

Fletcher, B, Berra, K, Brain, L.T, Dustine, J.L, Fletcher, G.F, Hiatt, W.R & Kris-Ether ton, P. (2005). Managing abnormal blood lipids. American Heart Association Journal Incorporation Circulation. 23; 655-667.

Goldberg, L, Elliot, D.L & Schultz, R.W. (1984). Changes in Lipid and Lipoprotein levels after weight training. Journal of the American Medical Association 252: 504-506.

Halbert, J.A, Silagy, C.A, Finucane, P, Withers, R.T. & Handorf, P.A (1999). Exercise training and blood lipids in hyperlipidemic and nomolipidemic adults; a meta- analysis of randomized controlled trials. European Journal of Clinical Nutrition. 53(7); 514-522.

Hurley, B.F & Hagberg, J.M (1998). Optimizing health in older persons; J.O. Holloszy. Baltimore; Williams and Wilkins pp, 61-89.

Hurley, B.F, Hagberg, J.M & Goldberg, A.P (1988). Resistive training can reduce coronary risk factors without altering VO_2 max or percent body fats. Medicine and Science in Sports and Exercise. 20(2): 150-154.

Huttunen, K.J, Esko ~~Lansmies~~, Voutilainen, e, Ehnholm, C., Hietanen, E, Penttila, I, Siitonen, O, & Rauramaa, R. (1976). Effect of moderate physical exercise on serum lipoproteins; a controlled clinical trial with special reference to serum High-density Lipoproteins. Circulation. 60, No 6. Pp. 1220-1229.

Kohl, H.W, Gordon, N.F, & Scott, C.B. (1992). Musculoskeletal strength and serum lipid levels in men and women. Medicine and Science in Sports and Exercise, 24, 1080-1087.

Kokkinos, P.F, Hurley, B.F & Smutok, M.A (1991). Strength training does not improve Lipoprotein - lipid profile in men at risk for coronary heart disease. Medicine and Science and Sports and Exercise, 23, 1134-1139.

Maughan, R, Gleeson, M & Greenhalf, P.L. (1997). Biochemistry of Exercise and Training. New York, Oxford University Press.

Mougios, V, Kouidi, E, Kyparos A & Deligiannis, A. (1998). Effect of exercise on the proportion of unsaturated fatty acids in serum of untrained middle aged individuals. British Journal of Sports Medicine; 32; 58-62.

Prabhakaran, B, Dowling, E.A, Branch, J.D, Swain, D.P & Lentholtz, B.C, (1999). Effects of 14 weeks of resistance training on lipids profile and Body fat percentage in premenopausal women. British Journal of Sports Medicine. 33: 190-195.

Robbins, G, Powers, D & Burgess, S. (2002). A wellness way of life. New York. McGraw – Hill.Inc.

Sale, D.G (1989). Strength training in children. In C.V Gisdfi and D.R Lamb (Eds) Perspectives on Exercise Science and Sports medicine, (2) Youth Exercise and Sport. Indianapolis. Benchmark Press. Pp 165-216.

Smutok, M.A, Reece, C & Kokkinos, P.F (1993). Aerobic versus strength training for risk factor intervention in middle aged men at high risk of coronary heart disease. Metabolism 42; 177-184.

Stones. Matt, Fleck, S.J, Triplett, N.T & Kramer, W.J. (1991). Health and performance related potential of resistance training. Journal of Sports Medicine, 11, 210-231.

William, J.B, Maher, M.A, Thompson, W.G, Bassett, D.R. Wayne, M, Mohammed, A Daniel, J.K & Michael, B.Z (2003). Effects of resistance versus aerobic training on coronary artery disease risk factors. Journal of Experimental Biology and Medicine, 228; 434-440.