

# The Impact of Serum Lipid Profile on Muscle Size in Male Jamaican Track and Field Athletes

Aldeam Facey<sup>1,\*</sup>, Lowell Dilworth<sup>2</sup>, Rachael Irving<sup>1</sup>

<sup>1</sup>Department of Basic Medical Sciences, Biochemistry Section

<sup>2</sup>Department of Pathology, University of the West Indies, Mona, Kingston 7, Jamaica

\*Corresponding author: [Aldeamfacey@yahoo.com](mailto:Aldeamfacey@yahoo.com)

**Abstract Background:** Exercise causes a reduction of serum cholesterol, prevents cardiovascular disease and is a contributor to the muscle thickness. **Objectives:** The research examined the impact of Total Cholesterol (TC), High Density Lipoprotein Cholesterol (HDL-C), Low Density Lipoprotein Cholesterol (LDL-C) and triglyceride (TG) levels on muscle thickness at three muscle sites in well trained young adult male athletes. **Methods:** Nineteen (19) athletes and twenty seven (27) non-athletes who served as controls were selected for the study. Fasting serum lipid concentrations (HDL-C, LDL-C, TC and TG) and muscle thickness at three sites: the chest, abdomen and thigh were determined using ultrasound technology. **Results:** Results showed that TC and LDL-C levels are significantly higher in the non-athletic group. The HDL-C and TG levels however, were not significantly different between the groups. There was a significant negative correlation ( $P=0.01$ ) between thickness of the thigh muscle and HDL-C concentration. The TC, LDL-C and TG concentrations had no significant association with the thickness of the muscles at any of the three sites assessed. **Conclusions:** The thickness of the muscles of the thigh in young non-athletic Jamaican males is associated with HDL-C concentration.

**Keywords:** total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol, triglyceride

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## 1. Introduction

Exercise reduces TC, LDL-C and TG but increases HDL-C concentration [1]. Rats subjected to treadmill exercise had a reduction in the concentration of total cholesterol and plasma triglyceride with increased lipoprotein lipase activity in the heart muscles [2]. HDL-C levels in humans are higher in physically active individuals and are associated with the increased HDL protein survival [3]. Endurance training in men does not affect the total triacylglycerol fatty acid or muscle triacylglycerol content [4]. However, moderate exercise is associated with an increase in HDL-C concentration and a decrease in TG and LDL-C concentrations [1,5,6].

It is known that serum lipids can accumulate in smooth muscle cells [7]. There are however no published studies which define the effect of serum lipids on muscle thickness in the three sites: the chest, abdomen and thigh of individuals of varying levels of fitness.

In order to favorably alter the blood lipid concentration, training quantities of 24km to 32km per week of brisk walking or jogging must be established as a threshold [1]. Research has proven that between 1200 kcal/week and 2200 kcal/week of energy expenditure during training can reduce TG concentration by up to 0.23 mmol/L and increase HDL-C concentration by 0.08 mmol/L [1].

A study on Jamaican middle-aged males revealed that HDL-C was inversely correlated with serum TG and LDL-C [8]. It was also found that Jamaican hill farmers had a significantly higher HDL-C concentration in comparison to Jamaican business men [8], conveying the benefits of physical activity on HDL-C levels.

Individuals of African descent tend to have higher HDL-C concentrations and lower TG concentrations when compared with other ethnicities [9]. Skeletal muscle adiposity of men of African descent is associated with serum lipid level and this association is independent of central and total adiposity [9].

Intra-myocellular TG levels are associated with muscles in both endurance runners and obese humans [10]. These TG accumulate in the skeletal muscles due to varying metabolic conditions. There is a link between the accumulation of TG and insulin resistance [10]. In the obese group it is proposed that the accumulation is due to a decreased muscle fatty acid beta-oxidation activity. In endurance trained individuals there is increased oxidative capacity nevertheless the accumulation of TG also occurs [10]. A clinical study found that skeletal muscle lipoprotein lipase activity was significantly elevated in the physically active [11]. The study also found that physical training increases the HDL-C concentration of previously sedentary middle-aged men [11]. To the best of my knowledge, there is a dearth of information on the direct impact of serum lipid profile on muscular thickness.

Reference ranges for serum lipids are: LDL-C <2.586 mmol/l, HDL-C >1.293 mmol/l and TG <1.694 mmol/l [12].

The present study sought to confirm the relationship between serum lipids and muscle thickness at three sites: the chest, abdomen and thigh in physically active and inactive young Jamaican males.

## 2. Method

Ethical approval was granted by the University Hospital/ University of the West Indies Ethics Committee for conduct of the research. Athletes were selected from the University of the West Indies Mona track and field team as well as a track club whose members train on the University of the West Indies Campus. Signed informed consent was obtained from each participant. All samples were collected between August and November 2013.

Two defined groups were selected for this study. One group consisted of 19 well-trained track and field athletes between the ages of 18 and 30 years while the other group consisted of relatively inactive non-athletes of the same age and BMI (18.1-29.9 kg/m<sup>2</sup>) ranges as the athletes. Exclusion criteria were females, male > 30 years and males with a chronic disease or injuries. The resting blood pressure and pulse rate measurements were taken in three sequential measurements with an electronic sphygmomanometer and the average of these readings were recorded. Anthropometric measurements inclusive of waist circumference, hip circumference, height and weight were taken. A modified American Council on Exercise physical fitness questionnaire [13] was used as a tool to distinguish between the athletic and non-athletic groups. Each athlete trained for 3 hours per day for 5 days each week with a certified coach while

the non-athletes exercised for 0-20 minutes per week. All participants were non-smoker and did not consume alcoholic beverages.

Body fat percentages were measured using the BodyMetrix Analyzer. This method utilized the three site technique which employed a modified version of the Jackson-Pollock three site skinfold equation [14]. The Machine measures the thickness of the fat at the specific site by use of ultrasound technology [15]. Three points on the right side of the body were used. The ultrasound machine was placed at the chest mid-way between the nipple and the shoulder joint. A read out was displayed on a computer which recorded the thickness of each tissue that is fat, muscle and the interfaces in millimeters. This was done 2 to 3 times and an average for improved accuracy was determined. This was repeated at the two other areas, one an inch right of the umbilicus and the other on the thigh mid-way between the knee and hip joints. From the readings obtained the percentage body fat was calculated.

Fasting blood TC, HDL-C and TG were measured. The Cobas 6000 autoanalyzer was used for analysis of the serum samples using spectrophotometry with reagents supplied by Roche Diagnostics (Roche Diagnostics, Indianapolis, USA). The LDL- C concentration was calculated using the Friedewald equation (LDL-C = non-HDL-C) – (triglycerides / 5) in mg/dL.) [16].

### Statistics

Data were analyzed using the Pearson's bivariate correlation, a two-tailed t-test and the level of significance was noted at the P≤0.05 level. Data is generally reported as mean ±SD.

## 3. Results

**Table 1. Anthropometric comparisons between the athletic and non-athletic groups**

Parameters	Athletes	Non-athletes
Age (Years)	21.47 ± 0.95	21.93 ± 2.09
Body Fat (%)	8.29 ± 5.42	10.83 ± 4.94
BMI (kg/m <sup>2</sup> )	23.31 ± 3.33	22.34 ± 3.11
WHR	0.79 ± 0.03	0.79 ± 0.03
Systolic Blood Pressure (mmHg)	120.78 ± 20.32	120.38 ± 11.84
Weight (kg)	69.40 ± 12.00	87.58 ± 40.16
Diastolic Blood Pressure (mmHg)	68.00 ± 8.95	74.56 ± 9.84
Heart Rate (Beats per minute)	63.44 ± 14.23	69.18 ± 11.10
Muscle Thickness		
Chest Muscle (mm)	35.01 ± 6.12	33.41 ± 6.39
Abdominal Muscle (mm)	21.45 ± 7.08	22.03 ± 9.64
Thigh Muscle (mm)	36.62 ± 8.25	33.51 ± 9.67

Data are presented as mean ±SD. P<0.05 is significant. There were no significant anthropometric difference between the two groups.

**Table 2. The athletic group: correlations between muscle thickness and serum lipid profile**

Muscle	Total cholesterol	HDL	LDL	Triglycerides
Chest	R=0.134, P=0.59	R=-0.016, P=0.95	R=0.127 P=0.60	R=0.228 P=0.35
Abdomen	R=-0.316, P=0.19	R=0.042, P=0.87	R=0.345, P=0.15	R=-0.256 P=0.29
Thigh	R=-0.132, P=0.59	R=0.017, P=0.95	R=-0.125 P=0.61	R=-0.213 P=0.38

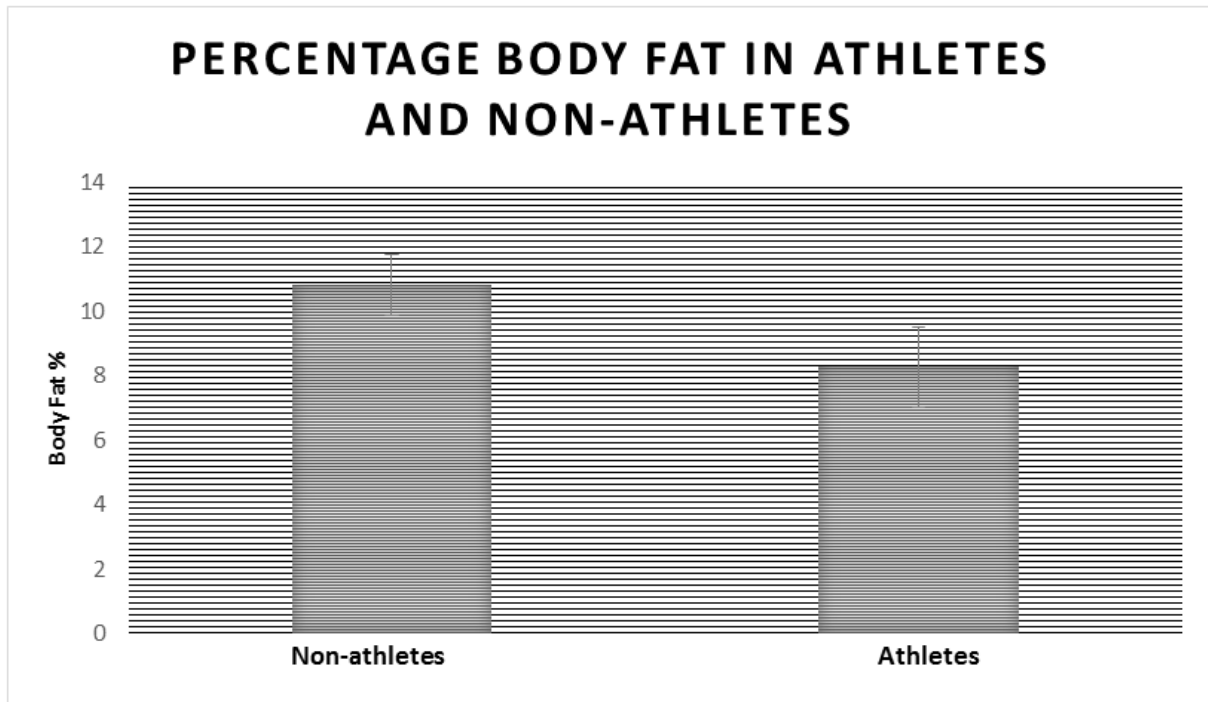
The levels of significance (P) and the Pearson's Correlation (R) for the relationship between serum lipids and muscle thickness at three sites. No significant

correlation was found between muscle thickness and serum lipids at any of the three sites in the athletic group.

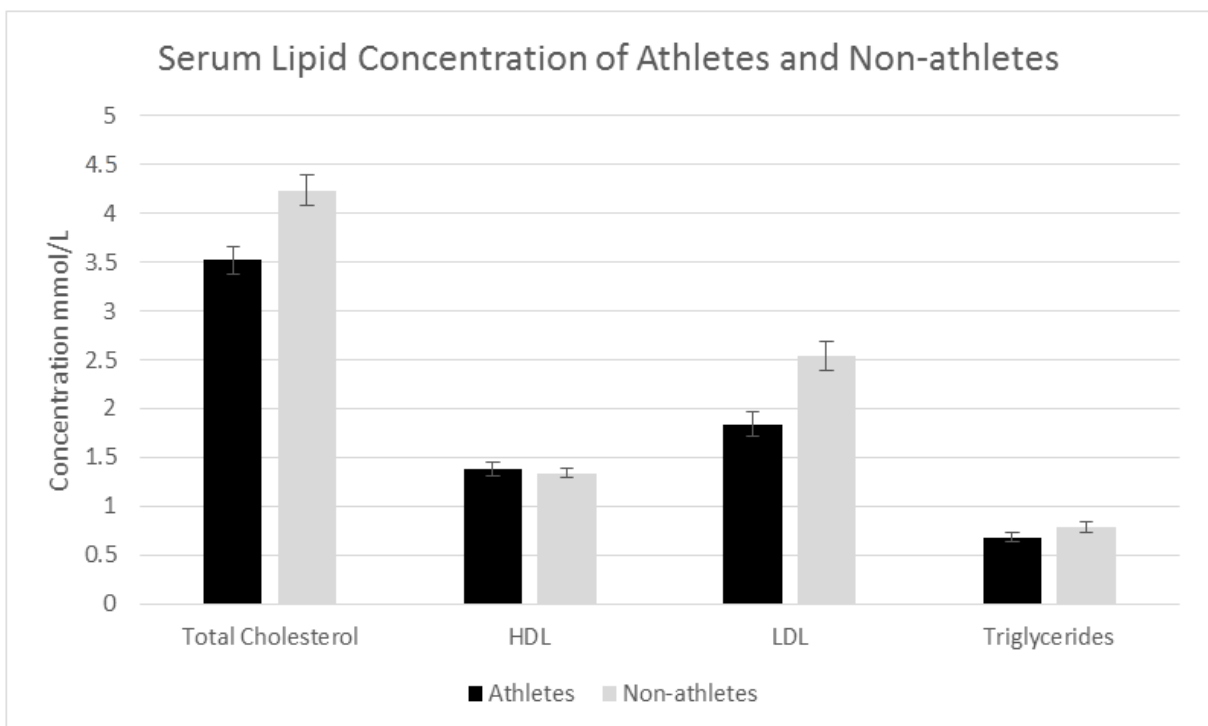
**Table 3. The Non-athletes group: Correlations between muscle thickness and serum lipid profile**

Muscle	Total cholesterol	HDL	LDL	Triglycerides
Chest	R=0.187, P=0.37	R=0.133, P=0.53	R=0.151, P=0.47	R=0.040 P=0.85
Abdomen	R=-0.053, P=0.81	R=0.127, P=0.56	R=-0.092, P=0.67	R=-0.047, P=0.83
Thigh	R=-0.228, P=0.27	R=-0.530, P=0.01	R=-0.024, P=0.91	R=-0.118, P=0.57

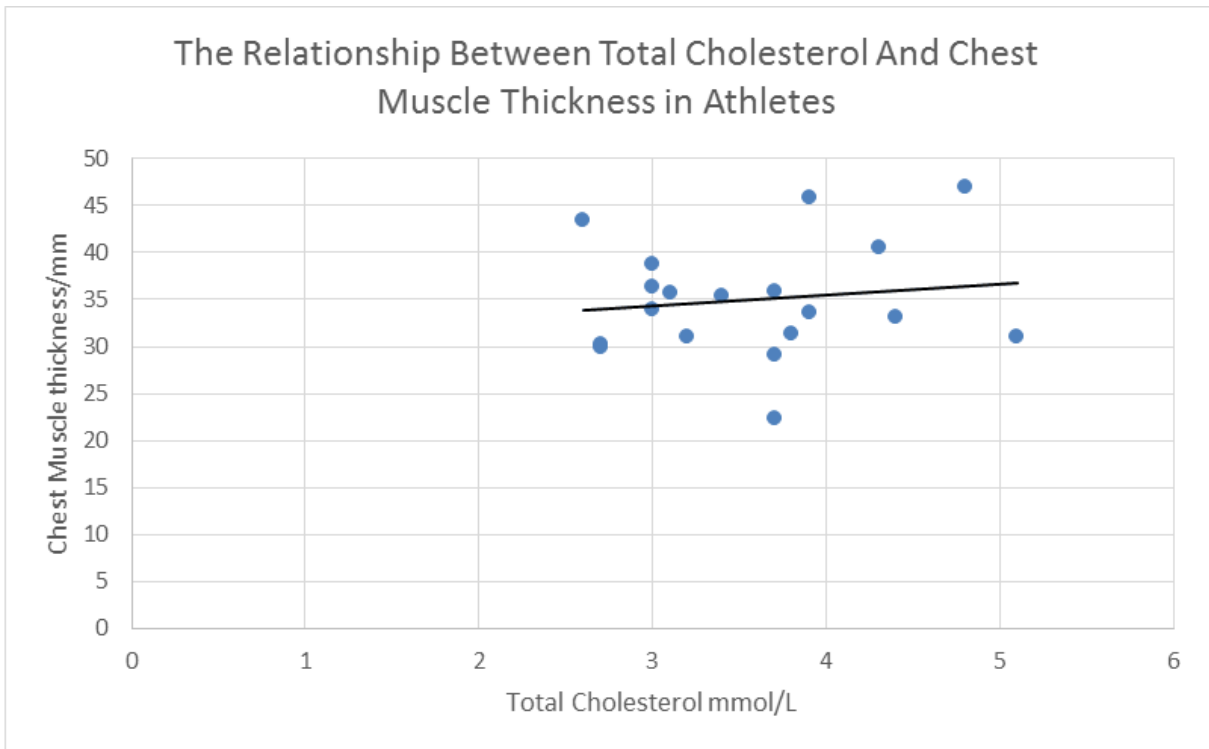
The levels of significance (P) and the Pearson's Correlation (R) for the relationship between serum lipids and muscle thickness. There is a significant negative correlation between thickness of the muscle in the thigh and HDL-C concentration (P=0.01, R=-0.530).

**Figure 1.** Comparison of the mean body fat percentages of the athletes and non-athletes as measured using the BodyMetric Analyzer

Although the body fat was higher in the non-athletes, there were no significant difference in body fat percentage between the groups (P=0.11).

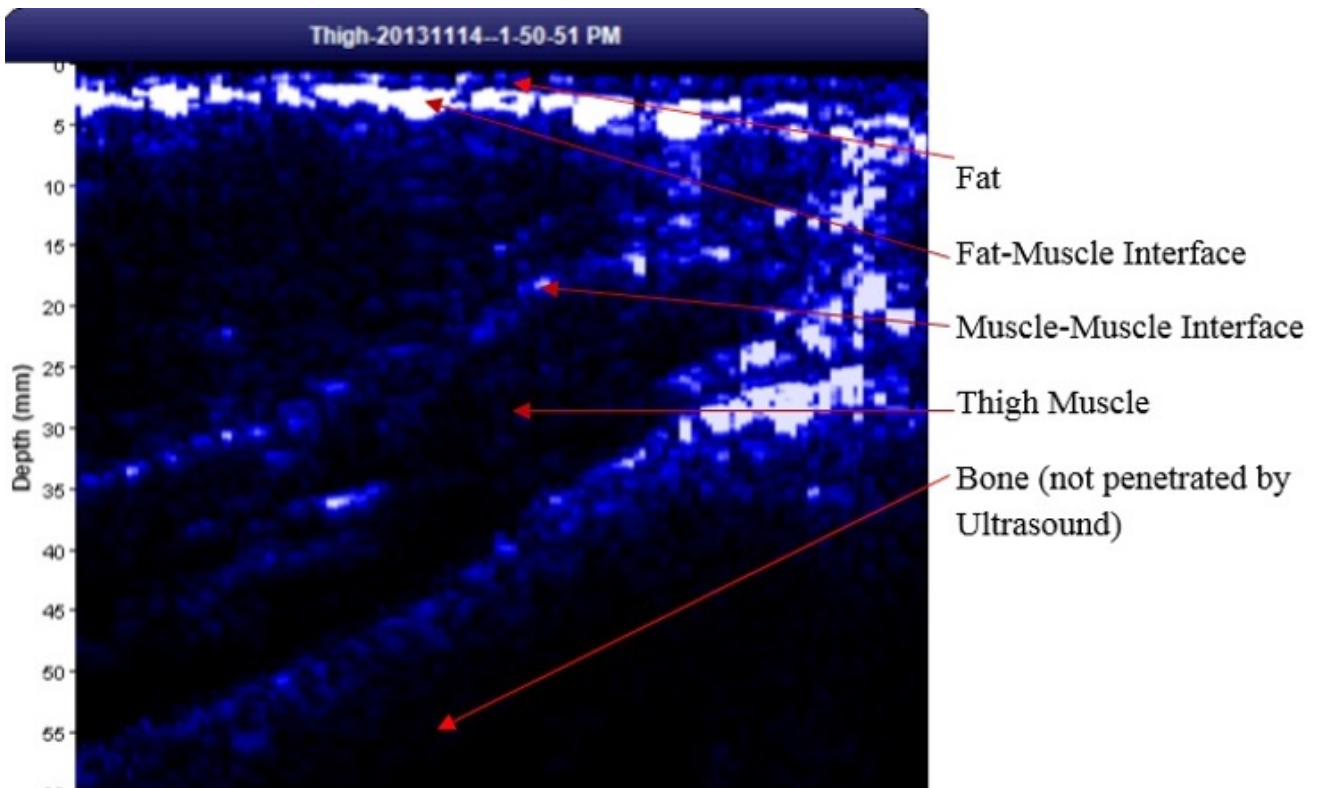
**Figure 2.** Mean Serum Lipid concentrations in Athletes and Non-athletes

TC and LDL-C concentrations were significantly higher in the non-athletes when compared to athletes. No significant differences in HDL-C and TG concentrations were noted between the groups.



**Figure 3.** The relationship between total cholesterol and chest muscle thickness in the athletes

There was no significant relationship observed between TC and muscle thickness in the chest of the athletes ( $P>0.05$ ).



**Figure 4.** Representative ultrasound scan of the athlete's thigh muscle

Image displays a thin layer of fat and a thick thigh muscle.



**Figure 5.** Respective ultrasound scan of the non-athlete's thigh muscle

Image displays a comparatively thicker layer of fat and a least thick thigh muscle than seen in scan [Figure 4](#).

#### 4. Discussion

No significant anthropometric differences between the two groups studied were noted. This was an important requirement as relatively young and healthy individuals should have similar serum lipid profiles. The variable is the level of physical activity and this was the only significant difference between the two groups. While the thickness of the fat in the thigh of the athletes was less than the non-athletes ([Figure 4](#) & [Figure 5](#)), the athletes' overall body fat percentage was not significantly different compared to the non-athletes. Athletes are however expected to have higher BMIs indicative of a larger muscle composition, given that muscle has a higher density when compared to fat [17]. The results showed that there were significantly lower concentrations of TC and LDL -C in athletes compared to non-athletes. This observation is not unexpected and is in line with the literature [1]. The HDL-C concentration of both the athletes and non-athletes were within the normal range. Research shows that exercise does increase HDL-C level 1 but this usually happens when the HDL-C concentration is initially low [18] providing a possible reason for the insignificant difference in HDL-C concentration observed. Triglyceride concentration was expected to be lower in the athletic group. The TG level was lower in the athletic group however not significantly so ( $P>0.05$ ). Both groups had TG levels within the normal range. The hypocholesterolemic effects of physical activity observed may be possibly due to the reduction in LDL-C concentration. Bearing in mind that both groups were young and relatively healthy. The thigh thickness of the

non-athletes negatively correlated with the HDL-C concentration ( $P<0.05$ ). This was however not found in the athletic group. HDL-C in the athletic group may be more functional. Functional HDL-C and not concentration is associated with greater level of fitness [19]. Both groups consisted of young, relatively healthy males and this may account for why the serum lipid profiles of both groups were generally similar. Exercise impacts muscle thickness and reduce serum lipids such as TC, TG and LDL-C [1,5,6].

#### 5. Conclusion

There seems to be some correlation between HDL-C and the degree of the thickness of muscle in the thigh.

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