Spring 5-10-2014

Exercise and Diet Program for the College Student

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EXERCISE AND DIET PROGRAM FOR THE COLLEGE STUDENT

By

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Submitted in Partial Fulfillment
of the Requirements for
Graduation with Honors from the
South Carolina Honors College

April 2014

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Summary

Oftentimes college students can be seen going to the gym with simply no direction in exercise or nutrition. They go through the motions of exercising, but have no real understanding of what they are doing. These students may see some progress, but plateau early and find it discouraging to continue to workout. The goal of this project was to create a personal diet and exercise program that could be used by the average college student to improve their physical fitness levels. The exercise program attempts to improve body composition, cardiovascular fitness, muscular strength and endurance, and flexibility. This is done using a combination of aerobic training, resistance training, flexibility training and a specific diet program. The dietary program followed the recommended proportions of carbohydrates, proteins, and fats. Baseline testing was performed to determine current levels of fitness. A daily food diary, exercise logs and a daily journal were meticulously recorded throughout the 10-week program. Post-program testing will provide the effectiveness of the program. The following paper provides background information, the overall methods, results, and interpretation of the results.

Foreword

At the time of the final repetition, the idea of being finished with exercising never crossed my mind. I had just completed my ten-week exercise and dieting program, but it stood as nothing but another workout for me. Being physically fit is not something one can achieve in ten weeks and just altogether quit. Physical fitness should never have some terminal end to it. The prospect of being physically fit is something that needs to occur over a lifetime.

I first began working out in the seventh grade. My goals were rather subjective; I just wanted to get stronger for playing sports. I had no distinct approach, doing entirely resistance training and having no approach as to what muscle groups I was working. I had always been on the small side, standing barely five feet tall and breaching 90 pounds soaking wet upon entering high school. My success working out was fairly infinitesimal, which caused me to quickly lose motivation. I would stay committed for a few weeks at a time, but the lack of progress would further stunt my motivation to continue.

This trend continued throughout high school. My skillfulness and experience carried me through sports, but I consistently lagged behind my peers in terms of strength. I continued to quit and restart working out until midway through my sophomore year of college. Besides the occasional recreational game, I was completely out of competitive sports. Finally I decided to do some research and create a program. I started seeing some gains in strength and better yet stayed motivated to continue with the program until the summer following my junior year. Despite moving in a positive direction in terms of

muscular strength, I still had poor flexibility, cardiovascular endurance, and poor dieting.

I spent my entire life being a picky eater. Vegetables were a sworn enemy and I stubbornly refused to stray from my diet of macaroni and cheese, hot dogs, pizza, and other unhealthy sweets.

I was not getting fat eating this poorly and I had the mentality that if I stayed somewhat active, then I would remain skinny. One day my father said something to me following my freshman year of college that I would never forget. My father was very overweight despite playing baseball into his mid-forties. He told me that I would one day get fat too. He explained how he was once skinny and that it was in my genetics to start getting fat. Based on the paternal side of my family, he appeared to have a solid argument. All five of his brothers are well overweight. His statement was the ultimate motivation for me to start eating healthy and striving for great physical fitness.

I began making an attempt at eating healthier as I continued through college, incorporating more vegetables into my diet and cutting some sweets out of my diet. In the first semester of my senior year, I decided to log my food intake for a week. I was astonished when I realized that I was still eating fairly poorly. My saturated fat and sugar intakes were both fairly high in relation to the total calories I had been eating.

Between my varied success in physical training and little knowledge in nutrition, I decided to undertake the challenge of creating my own exercise and diet program. I researched different training programs and diets and eventually

customized a program for myself. The program was not overly strict in terms of following a specific diet and doing explicit exercise progressions, but rather stood as overarching guidelines to how I was going to spend the final semester of my college career. I was motivated not just to have a successful 10-week program, but also spend the next 10 weeks working towards creating better lifestyle habits for my well-being.

Beyond my seemingly self-centered goals, I had further ambitions for my program. I also created this program to see not only if it was successful for me, but then to investigate whether or not my program could be replicated the average college student. I look back at myself and see how little direction I had in my attempts to be physically fit and eat well. If I was once naïve, and I am sure that other students enter college having little background knowledge as well. I hope that the paper that follows can serve as instructions and what to expect for any student interested in trying to improve their fitness.

Introduction

When planning an exercise program, it is important to understand the different forms of exercise and their benefits. There are five main health components of physical fitness. They are body composition, cardiovascular endurance, muscular strength, muscular endurance, and muscular flexibility. These five components can be improved through different forms of training.

Body composition refers to the make-up of mass in the body [1].Often times the body is separated into two components, fat free mass and fat mass. Fat mass is typically located surrounding the organs and just below the skin. The fat

located below the skin is called subcutaneous fat. This fat tissue is distributed throughout the body. The distribution of this fat is dependent on both genetic and environmental factors [2].

There are multiple ways to predict body composition. The most accurate measurement of body composition is cadaver analysis, while in vivo methods are more indirect and not as accurate [1]. Body Mass Index (BMI) is used to categorize populations by their weight relative to their height. BMI is typically used to place people in overweight and obese categories. However, BMI is not measuring or predicting fat free mass or fat mass, but the index number is correlated with fat mass [1].

Obesity can also be predicted by measuring waist circumference. Waist circumference assesses abdominal fat, and can be very predictive of obesity related health risk [3]. Like BMI, waist circumference does not estimate fat mass and fat free mass.

Skinfold testing consists of a set of measurements that can predict the amount of fat mass in the body. Skinfolds are taken at multiple sites of the body to assess the amount subcutaneous fat [1].The sum of the thicknesses of the different sits can be used to calculate body density. Body density can then be used calculate the amount of fat mass in the body. Indirectly, skinfold testing predicts the fat mass and fat free mass with a standard error of 3-5%. According to the *National Council on Strength and Fitness,* the accuracy of skinfold testing relies on the assumption that most fat is stored subcutaneously [4].

Cardiovascular endurance is defined as the ability for the circulatory and respiratory systems to supply oxygen to the muscular system for a sustained period of time [5]. Improvements in cardiovascular endurance are associated with a reduced risk in mortality from all causes and from cardiovascular disease [5].

Cardiovascular endurance for an individual can be quantified by calculating the maximal oxygen uptake (VO_2max). VO_2max has been highly associated with the limits of cardiovascular endurance [6]. One way that VO_2max can be predicted is through the participation in a maximal treadmill test. The duration of the test is highly correlated with VO_2max [5]. Therefore, a total time running during a maximal treadmill test should be indicative of a specific level of cardiovascular endurance.

One of the main forms of maximal treadmill tests is known as the Bruce Protocol. The Bruce Protocol consists of seven three-minute stages, with each stage becoming increasingly difficult. The total time a participant can last in the Bruce protocol can be used to calculate VO_2max.

The term muscular strength denotes the capacity for a muscle or group of muscles to produce force or torque [7]. Some evidence suggests that muscular strength independently can reduce risk of cardiovascular disease [7]. Muscular strength can be estimated by measuring the one-repetition maximum (1-RM) for exercises involving particular muscle groups.

A 1-RM refers to the maximal amount of weight that can be lifted in one repetition of the exercise. When testing muscular strength, 1-RM testing is typically done for both the upper and lower body. The upper body exercise used

is normally the bench press and the lower body exercise used is typically the leg press. The 1-RM is indicative the absolute muscular strength of the individual's upper and lower body.

1-RM may sometimes be difficult to measure due to the need to muscle fatigue associated with repetitions at a lighter weight. Repetitions to fatigue at a weight lower than 1-RM can be used to accurately predict 1-RM [8]. However, the weight below 1-RM should be relatively close because the equations lose accuracy as more repetitions to fatigue are completed.

Muscular endurance refers to the capability for muscles to contract repeatedly or hold contraction for prolonged periods of time [7]. The resistance is submaximal when performing muscular endurance exercises. Increases in muscular endurance allows for more work to be completed over a longer period of time.

One way that muscular endurance can be measured is by doing a minute sit-up test. The goal of the test is to do as many sit-ups in one minute. According to the *Amercian College of Sports Medicine* (ACSM), training used to improved muscular strength and endurance can lead to increases in lean tissue mass and bone density [9].

Flexibility is the absolute range of motion of a joint or group of joints. Different joints and sets of joints located throughout the body have different levels of flexibility. The ability for joints to have a good range of motion is important for the movements of daily life.

Testing of flexibility can be done using the Sit and Reach Test. The Sit and Reach test assesses the participant's flexibility in their lower back and hamstrings [10]. The test assumes that the further participants reach, the greater flexibility that the participant has. The test has been found to be highly related to hamstring flexibility, but limitations can occur [10]. Those with lower back issues may test at a level that is not indicative of actual flexibility [10].

There are multiple forms of training that can help improve the five health components of physical fitness. Aerobic training, resistance training, and flexibility training can all lead the development of specific health related components.

According to the *ACSM*, aerobic training can be defined as any activity that it continuous, rhythmic, and involves large muscle groups [9]. Examples of aerobic training include cycling, running, and swimming.

A study by Song *et al.* found that aerobic training could reduce percentage of body fat [11]. This study's results may be limited by the fact that the study involved obese adolescent boys. The study did not review whether or not body fat percentage could be significantly reduced in normal BMI subjects.

Aerobic training also can lead to improvements in cardiovascular endurance. Duscha *et al.* found that aerobic exercise at moderate intensity throughout the week can increase VO_2max [12]. Cardiovascular adaptations occur over time with aerobic training, including a decrease in resting heart rate and increases in stroke volume and cardiac output [13]. The increase in cardiac output contributes to the increase in maximal oxygen consumption.

The intensity of aerobic exercise can be characterized by either percent of max heart rate or metabolic equivalents (METs). One MET is equal to 3.5ml/kg/min, which is the approximate value of a body at rest.

The *ACSM* considers activities between 3-6 METs to be moderate intensity and activities greater than 6 METs to be vigorous intensity [9]. Higher intensity training has been shown to improve VO_2max more significantly than moderate intensity training [14].

The *ACSM* suggests that individuals get 30-60 minutes of moderate activity 5 times per week or 20-60 minutes of vigorous activity 3 days per week for health benefits [9]. It is also suggested that the activity sessions should be at least 10 minutes of continuous sessions at a time.

The *ACSM* defines resistance training as physical activity that exercises muscles or muscle groups against an external resistance [9]. This form of training is used to lead to increases in both muscular strength and muscular endurance [15]. Resistance training also leads to increases in muscle mass, thus having an effect body composition. Aerobic training can decrease body weight by burning calories, but resistance training leads to an increase in lean mass. The increase in lean mass raises the body's metabolic rate, allowing for more calories to be used throughout the day [15].

The *ACSM* also has guidelines for resistance training. It is suggested that adults train each muscle group 2-3 days per week, allowing 48 hours to pass between sessions. For increases in muscular strength, the *ACSM* suggests 2-4 sets be completed for each exercise, with somewhere between 8-12 repetitions [9].

Flexibility training also is needed to supplement aerobic training and resistance training. This form of training helps improve the range of motion in joints and increases the flexibility of tendons [15]. The *ACSM* recommends that flexibility exercises be performed 2-3 days per week, stretching all parts of the body [9].

The construction of the diet program tends to have a target calorie range per day. In addition to total calories, it is important to understand the significance of consuming the proper types of calories. It is essential to eat carbohydrates, fats, and proteins at suitable levels in relation to the total calories.

Carbohydrates serve as the primary energy source for the body. Carbohydrates can be broken down into simple carbohydrates and complex carbohydrates. Simple carbohydrates include sugars found in fruit and milk products. Simple carbohydrates also come from sugars added in processed foods. The U.S. Department of Health and Human services suggests avoiding added sugars from processed food [16]. Complex carbohydrates can be split into starch and dietary fiber. Starch consists of chains of glucose that must be broken down for energy. Dietary fiber is indigestible food matter that helps with the digestion process. The CDC recommends 14 grams of dietary fiber per 1000 calories [17]. The Dietary Guidelines for Americans recommends that carbohydrates account for 45-65% of daily caloric intake [18]. Because carbohydrates are a primary energy source, consumption prior to a workout is beneficial in that it provides the energy needed by the body.

Fats are used for a variety of functions in the body in addition to being a secondary energy source. Fats can be split into saturated and unsaturated fats. Saturated fats mostly stem from animal fat and should be kept to a low dietary intake. Sources of saturated fat include meats, milk, and milk products such as cheese and butter. The CDC recommends that only 10% of daily calories comes from saturated fats [17]. Unsaturated fats are typically oils and should be where most fat intake comes from. Sources include nuts, vegetable oils, and fish. The Dietary Guidelines for Americans recommends that 20-35% of calories should come from fats [18].

Proteins are essential for the structure of the body. Proteins are broken down into amino acids, which are used to reconstruct proteins used throughout the body's cells. Sources of protein include meats, legumes, eggs, and milk products. Lean meats are often preferred sources of protein due to having less saturated fat than other meats. The *Dietary Guidelines for Americans* recommends that 10-35% of daily calories should come from proteins [18].

It can be hypothesized that through the combination of aerobic training, resistance training, flexibility training, and a suitable diet plan, all five components health related components of physical fitness can significantly improved. This program is also believed to be capable of being replicated by the average college student.

Methods

Pre/Post Testing

The order of each test was kept consistent for the pre-test and post-test. A graduate assistant served as the administrator of each test. Prior to the pre-test, the subject filled out a PAR-Q survey and AHA screening questionnaire to determine that the subject was healthy enough to participate in the testing and further exercise programs.

Height and weight were first taken. The subject removed his shoes prior to height and weight being recorded. Height was measured in meters and weight was measured in kilograms. Body mass index was then calculated using the following equation:

BMI= Weight (kg)/Height(m)^2

Body mass index was then classified based on World Health Organization classifications.

Resting heart rate was then taken. The subject was asked to sit and relax for 5 minutes. The administrator then felt for a radial pulse on the subject's right wrist. A stopwatch was used to keep track of the time elapsed. The administrator then recorded the number of pulses felt over a ten second period. This number was then multiplied by six in order to convert the number into beats per minute.

The subject remained seated for testing of resting blood pressure. A sphygmometer was utilized for the testing of blood pressure. The subject was asked to rest their right arm on the administrator's shoulder while the blood pressure cuff was applied and blood pressure was taken. The administrator increased pressure in the cuff and then let pressure out, listening to Korotkuff

sounds to determine the systolic and diastolic blood pressures. The blood pressure was then classified by American Heart Association Standards.

Testing of body composition followed the testing of blood pressure. Body composition testing followed a male seven-site form of testing. The subject was asked to remove his shirt for skinfold reading. The administrator took skinfold readings at the chest, abdomen, thigh, subscapular, triceps, suprailiac, and midaxillary areas. The readings were then repeated for a second time. If any of the readings were not as precise as 2mm, then skinfolds were taken again for a third time. The trials were then averaged and added for a sum of the seven skinfolds. Using the sum of the skinfolds, body density (D_b) was calculated using the following calculation:

Jackson-Pollock 7 site equation-males

$D_b = 1.112 - (0.00043499*X) + (0.00000055*X^2) - (0.00028826*Age)$

X= sum of seven sites

Body density was then used to calculate percentage of body fat using the following equation:

$\%BF_{est} = [(4.95/D_b) - 4.5]*100$

Body fat percentage was then compared to the norms for men and classified into a percentile.

Waist circumference was taken following body composition. A tape measure was used to measure around the waist. Using BMI and waist circumference, disease risk was assessed.

Cardiovascular endurance was then tested by using the Bruce Maximal Exercise Treadmill Protocol. A heart rate monitor was used to determine the subject's heart rate for each stage. Time was recorded using a stopwatch. The subject was instructed to go through the stages for as long as possible. Heart rate was recorded for each minute of every three-minute stage. The subject was asked for their rate of perceived exertion before the end of each stage. When the subject had gone through for the protocol for as long as possible, the total time elapsed was recorded. This time was then used to estimate VO_2max using the following equation:

VO_2max prediction equation for Bruce Protocol (Males)

VO_2 (mL/kg/min) = (0.056 x time*) + 3.88

***Time is in seconds**

A three-minute cool-down on the treadmill followed the Bruce Protocol.

One rep maximum tests took place afterwards. The administrator served as a spotter and timekeeper for each rest period. A bench press test occurred first. The subject began by warming up with the weight of the bar, performing 8 repetitions. The subject rested for one minute and then moved up to a higher weight, performing fewer repetitions. The rest time between lifts were made progressively longer. The subject continued multiple lifts progressing in weight until the subject finally reached a point in which not even one repetition could be done. If the subject had done multiple repetitions in the lift preceding not being able to do any at a higher weight, then the 1-RM was calculated using the following equation:

1-RM= Weight Lifted/(1-(repetitions * 2)/100)

The same steps were repeated for testing the 1-RM for the leg press.

The subject moved onto performing a vertical jump test. This test was used to test muscular power. The subject step onto a vertical jump mat and was told to jump as high as possible. The subject was told not to bend knees while in the air. 3 total jumps were assessed and the top jump was recorded.

Muscular endurance testing was then assessed. This was done using a bent knee sit-up test. The subject was asked to complete as many sit-ups as possible in one minute. The administrator kept track of time and held the ankles of the subject. For each sit-up, the subject kept his hands on the floor and moved them up to his heels for each sit-up. When coming back down to the ground, the subject's shoulder blades had to touch the ground for the sit up to count. The total number of sit-ups was recorded at the end of one minute.

Finally, muscular flexibility wrapped up the testing. A sit and reach test was used to test flexibility. The subject removed his shoes and placed his feet at the base of the sit and reach box. The subject sat with straight legs and asked to reach as far as possible on the sit and reach box. The middle finger of the right hand was placed on top of the middle finger of the left hand. The total length (in centimeters) that the subject reached on the box was recorded. The process was repeated two times and the best of three trials was ultimately recorded.

Exercise Program

An exercise program was created containing elements of aerobic training, resistance training, and flexibility training. The goal of this program was to

ultimately improve all five health components of physical fitness in ten weeks. The program began the day immediately after the pre-test and continued until the post-test concluded the program ten weeks later.

Aerobic training consisted of the choice for the subject between running and swimming. The subject followed *ACSM* recommendations of participating in vigorous activity three days per week. Aerobic training occurred typically on Tuesdays, Thursdays, and Saturdays. Towards the end of the program, the subject began doing aerobic training on Sundays rather than Saturdays. Swimming accounted for much of the earlier aerobic exercise due to the subject having greater difficulty for running for long periods of time initially. Eventually the effects of training allowed for the subject to start running for longer periods of time. Running accounted for much of the later aerobic workouts. Swimming was performed in intervals with specific length rest periods, whereas running was either continuous or had one rest period halfway between the workout. Progression for the swimming exercises included lengthening the intervals and the total distance of the workout. Progression for the swimming workouts included increasing the speed of the treadmill and the total time and distance of the run.

In accordance with *ACSM* recommendations, resistance training took place three days of the week. The subject participated in resistance training on Mondays, Wednesdays, and Fridays. The subject split up the muscle groups for each day of the week. Large muscle groups were worked before smaller muscle

groups. The sets tended to go in a pyramid fashion, increasing weight with every set. The repetitions, sets, and total resistance was recorded for each exercise.

Mondays served as chest, triceps, and abdominal muscles days. 2 chest exercises were performed for 4-5 sets. Typical exercises included bench press, incline bench press, and decline bench press. These presses were performed using a barbell. 2 triceps exercises were performed for 3-4 sets. Typical exercises included triceps pull downs with rope attachment, lying triceps extensions, and dips. For the abdominal portion of the workout, the goal was to exercise all of the abdominal muscles. The main exercises utilized included front planks, side planks, sit-ups, and oblique twists.

Wednesdays served as upper back, biceps, and shoulder muscles days. 3-4 upper back exercises were performed for 3-5 sets. Some of the exercises implemented included pull-ups, seated rows, and lat pull downs. 2 biceps exercises were performed for 3-4 sets. Some of the exercises utilized included standing biceps curls, preacher curls, and concentration curls. 2 shoulder exercises were executed for 2-4 sets. Some of the shoulder exercises used included front raises, shoulder flys, and military press.

Fridays were used as legs and lower back days. Squats and deadlifts were both utilized for 4-5 sets, exercising many different muscles in both the legs and lower back. Other exercises used to further supplement the workout of these muscles included calf raises, leg curls and extensions, and back extensions. These exercises were usually done for 3-4 sets.

Flexibility training in the form of yoga was performed 3 times per week, in accordance with *ACSM* recommendations. Flexibility training occurred on Mondays, Wednesdays, and Fridays. This training took place an hour and a half prior to resistance training for the day. The yoga workout was thirty minutes long and incorporated stretching for just about the entire body. The yoga performed followed a 30-minute yoga video. Minor stretching was also done before each exercise during resistance training.

Diet Program

The idea of the diet program was to eat 2,700 to 3200 calories each day with a specific ratio of calories for each macromolecule. The goal ratio for each day was 50-55 percent carbohydrates, 25-30 percent fats, and 20-25 percent proteins.

Carbohydrates were most typically eaten earlier in the day. They were eaten during breakfast through cereal and fruit. Lunches consisted of pasta or rice with vegetables quite often. The lunch was eaten about an hour prior to the workout for each day. The goal was to eat mostly complex carbohydrates as opposed to sugar. Sugar was consumed mostly through fruit and milk. Typical sources of complex carbohydrates came via cereals and pasta.

Fats tended to be consumed in fairly balanced portions throughout the day. The goal with fats was to keep saturated fats to a minimum and to completely avoid trans fats. The fats eaten were usually in the form of oils, animal fat from meat, and nuts.

Protein tended to be consumed towards the end of the day. Most of the protein consumption occurred following the workouts for each day. The primary sources of protein for each day were eggs, chicken, and protein from post-workout supplementation. Due to the lack of access to meat immediately following workouts, supplementation was utilized so protein could be consumed.

In addition to fulfilling the specific ratios of calories each day, consuming the proper level of vitamins and minerals was also stressed. Sodium was attempted to be kept within the daily value range, and most vitamin requirements were accomplished daily.

The diet was recorded using the application *MyNetDiary*. Each food consumed was added to the program after each meal. A food scale and measuring cups were used to measure exact portion sizes. Analyses for each day and week were made to analyze the calorie ratio. In addition to logging food consumption, the cost of all food bought for the ten weeks was also recorded.

Results

Category	Pre-test Results	Pre-test Classification/percentile	Post-test Results	Post-test Classification/percentile
Height (m)	1.78	N/A	1.78	N/A
Weight (kg)	72.6	N/A	74.6	N/A
BMI (kg/m^2)	22.91	Normal	23.5	Normal
Resting Heart Rate (BPM)	78	N/A	60	N/A
Resting Blood Pressure (mmHg)	SBP: 128 DBP: 52	Pre-Hypertension	SBP: 152 DBP: 58	Stage 1 Hypertension
Body Fat %	15.63	50^{th} Percentile	11.60	70^{th} Percentile

Waist Circumference (cm)	78	Low Disease Risk	78.5	Low Disease Risk
Bruce Time (s)	693	N/A	815	N/A
VO_2max (ml/kg/min)	42.576	40th Percentile	49.52	75th percentile
Bench Press 1-RM (lbs)	175	50th Percentile	200	70th Percentile
Leg Press 1-RM (lbs)	535	90th Percentile	611	90th Percentile
Vertical Jump (inches)	23.5	Above Average	27.1	Very Good
Total Sit-ups	29	N/A	37	N/A
Sit and Reach (cm)	23	Average	28	Above Average

Figure 1. Pre and Post Test Results

Figure 1 shows the results of the fitness testing before and after the 10-week program. The classifications for each test are shown if applicable.

Week	Average Calories	Average % Carbohydrates	Average % Fats	Average % Proteins
1	3036	48.6	31.1	20.3
2	3228	48.3	29.2	22.5
3	3485	52.5	26.5	21.0
4	3467	54.0	23.5	22.5
5	3536	53.8	23.2	23.0
6	3206	53.8	21.2	25.0
7	2814	45.0	29.1	25.9
8	2708	54.8	22.2	23.0
9	2782	52.1	23.4	24.5
10	2648	49.4	24.8	25.8
Average	3091	51.2	25.4	23.4

Figure 2. Diet Plan Calorie Ratios

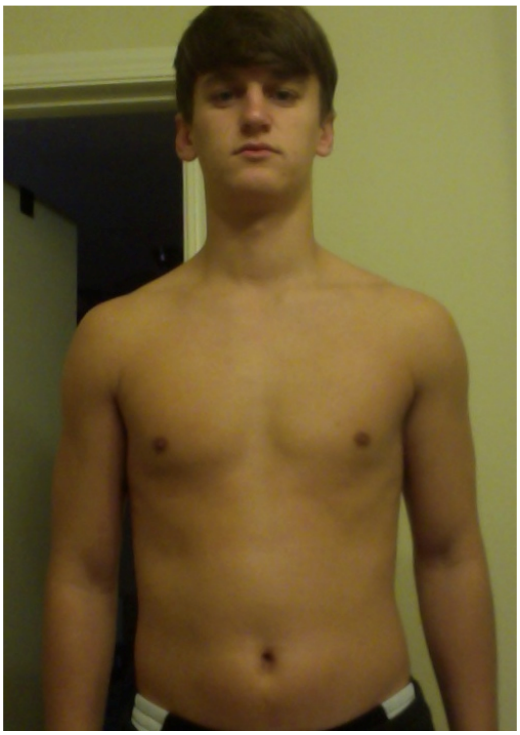
Figure 2 shows the average daily calorie total for each week of the program. The average percentage of carbohydrates, fats and proteins for each week are also shown.

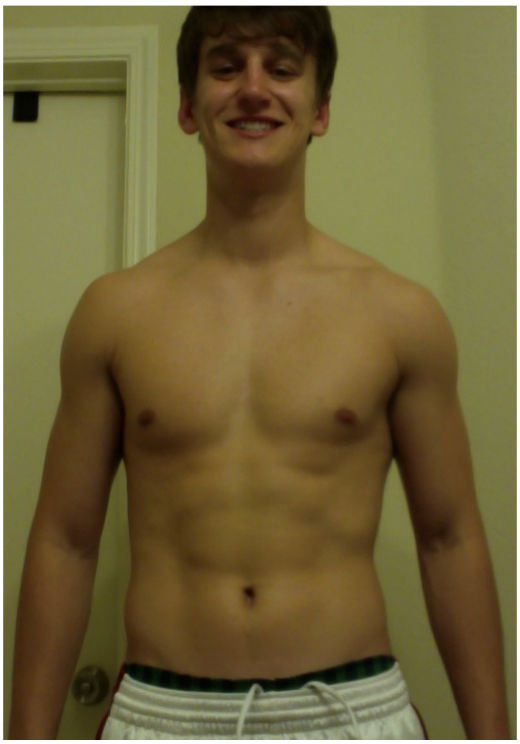
Average Food Costs per Week ($)	Additional Costs ($)

64.44	21.81

Figure 3. Costs of program

Figure 3 shows the average costs of food each week. The main additional cost was for the purchase of a food scale.





The photos above represent pictures before (left) and after (right) the program.

Discussion

Overall the ten-week program went fairly smooth. Based on the results of the pre-test and post-test, the hypothesis that this ten-week program would improve all five health related components is supported. The first figure shows an increased ability in body composition, cardiovascular endurance, muscular strength, muscular endurance, and flexibility. These increases appeared to be rather significant changes.

Body composition went from being 15.63% to 11.60%. In terms of normative values, body composition for the subject went from being in the top 50^{th} percentile to the top 70^{th} percentile. The combination of aerobic training, resistance training, and the diet plan was likely the most logical reasoning to the change. The amount of lean mass must have increased, as the weight of the subject increased by two kilograms but the percentage of fat did decrease. Due to this increase in weight, BMI did in fact slightly increase. However, the increase in BMI was not significant enough for the subject to move to the "Overweight" classification. Waist circumference also slightly increased, but the increase did not raise disease risk. The results of the decrease in body fat could be limited by the standard error of calculating body composition using the skinfold technique, which could be off by as much as 3-5%.

Cardiovascular endurance also had fairly significant improvement. VO_2max predicted using the Bruce Protocol increased by nearly 7ml/kg/min from the pre to post testing, nearly a 15% increase. The subject managed to continue with the protocol for more than two minutes longer than during the pre-test. This improvement can be most credited to the high intensity aerobic training the subject partook in 3 days per week over the ten weeks. The aerobic training programmed progressed fairly well over the course of the program. At the beginning of the program, the subject could only manage to run for 15 minutes with a break halfway through the run. By the program's end, the subject was able to run 20 to 25 minutes at a time without any break. The later runs were also at a slightly higher speed than the early parts of aerobic training. The idea that

cardiovascular endurance increased was further reinforced by the fact that resting heart rate decreased by 18bpm over the course of the program. A decrease in resting heart rate is one the main adaptations to aerobic training. The one statistic of interest was the high increase in blood pressure. The high systolic pressure in the post-test was quite interesting because of the aerobic training and diet program. Sodium tended to be kept in the daily value range so the reasoning behind the increase is somewhat vexing. One possibility could have been the subject's overall stress to perform well in the post-tests. The subject will continue to monitor his blood pressure in the upcoming months.

Muscular strength had a moderate increase. Both the bench press and leg press had improvements following the program. The bench press 1-RM increased by 12.5%. Based on norms comparing the bench press to body weight, the subject moved from the 50^{th} to 70^{th} percentile. The leg press had an increase of more than 75 pounds, an increase of also nearly 12.5%. The improvements can mostly be attributed to the resistance training program. The program mainly targeted muscular strength as most sets consisted of 6-10 repetitions. There were significant increases in weight in nearly every exercise performed. Some of the increase in strength can be credited to the diet and flexibility aspect of the program. Before each day of training, complex carbohydrates were consumed to provide energy for the workout. Following the workout, there was always a high intake of protein immediately afterwards. The combination of disciplined eating strategies and hard work in the weight room contributed heavily to the increase in muscular strength. The flexibility portion of

the program may have also helped further supplement increases in strength by providing greater range of motion for the joints. The subject found flexibility to have a profound effect on the weight used for both deadlifts and back squats. Also of note, muscular power had a moderate increase as well as shown by the subject's improvement in the vertical jump.

Muscular endurance had a moderate increase as well. The amount of sit-ups increased by 8 total from the pre to post test. This increase can also be attributed to the resistance-training program. Most abdominal exercises had 10-20 repetitions or were held for a prolonged period of time. The amount of abdominal sets completed also increased over the duration of the program.

Flexibility had a noticeable increase through the program. The sit and reach results had an increase of 5cm from pre to post testing. This moved the subject from being categorized as having average flexibility to above average flexibility based on normative values. The use of yoga 3 days per week appeared to be most important for improving flexibility. However, the overall flexibility of the subject could be questioned due to the fact that the sit and reach measures lower back and hamstring flexibility. The use of yoga targeted just about every joint, so flexibility likely had some improvement throughout the body.

Due to the vast number of variables in the study, it is difficult to attribute the improvements of the five health related components to any parts of the workout and diet program. However, it can be noted that the use of a training program that incorporated aerobic training, resistance training, flexibility training,

and a diet using specific calorie guidelines did in fact improve all five health related components of physical fitness.

Another limitation may have been due to the fact that the subject had participated in previous resistance training but had been detrained for over 5 months. This could have slightly skewed the muscular strength gains because it may have been easier to regain strength rather than acquire it. However, the subject noted multiple personal bests in terms of weights lifted still occurred during the program.

The other question this program was to address was whether or not other college students would be able to repeat this program. Between preparing food and workouts, an average of 18 hours per week were spent working on this program. Food preparation took about an hour and a half per day. Aerobic workouts took a half hour per day. The combination of resistance training and flexibility training took about two hours per day. However, most college students either prepare their own meals or take time to order food or use their meal plan. The time spent in the workout program comes out to be about 7.5 hours per week. Students would only need to take a maximum of two hours out of their day to spend on working out. The spacing between the days would need to about the same between workouts, but the actual days of workouts could be changed to help students with busier schedules.

In general, the diet plan would appear to be more suitable for people not on a meal plan. It would be difficult to accurately measure portions and be able to identify exactly what in meals if one is on the meal plan. People who cook for

themselves would have a much easier time being able to track the food they ate. The cost of food was relatively cheap for a diet that averaged over 3000 calories and had suitable ratios of calories for each macromolecule. The $64.44 average cost per week would come out to slightly under 1,000 dollars for a 15-week semester. Additional costs for the program could include transportation to a gym and workout apparel. Although the diet aspect of the program could be difficult for students with a meal plan, the exercise program appears to be one that could work for most students.

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