

THE PROGRAM

Pilot Test Results

Abstract

Two pilot programs were conducted to determine the short-term effects of a comprehensive, integrated approach to physical and mental conditioning and proactive health management.

The programs consisted of two groups of teen-age athletes participating in intense fitness and cognitive training, lectures, readings, chiropractic adjustments, and taking nutritional supplements for at least one month. The physical training included endurance, strength, agility, and balance exercises; the cognitive training included exercises using a computer controlled, interactive metronome.

Quantitative physical, physiological, and cognitive measures, and athlete ratings, were collected before, and at the end of, each program. These measures included height, weight, arm and leg circumference, heart rate, blood pressure, lean body and fat mass, cognitive functioning, and rating surveys by the athletes, their parents and the Program Doctor. Measures collected during the program included metronome response time and tri weekly self-assessments. Daily diet habits were also recorded.

Although the two programs differed slightly in measures taken, physical exercises, and duration, both programs resulted in significant improvements in fitness, timing, cognition, and subjective impressions.

The following report is an overview of the two pilot programs and their results.

Background

Although many studies have been conducted on the positive effects of physical conditioning, health education, and cognitive training, there does not appear to be any quantitative research of these effects combined with an intense workout environment with athletes. In order to investigate these effects, two pilot programs were conducted to determine the effects of a comprehensive, integrated approach of intense physical and mental training on cognition, physical fitness, behavior, and vitality of teenage athletes. Both the programs were exploratory with the goal of identifying exercises, protocols, measures, lectures, and assignments that could be used to produce statistically significant results.

The programs were designed to produce high levels of intermittent exertion during two sets of physical workouts followed by an intense cognitive workout. The intent was to allow for physical recovery during the cognitive exercise and mental recovery during the physical workouts. The purpose of this method was to simulate the physical and mental stresses that occur in a competitive sports situation (game) and to observe the effects of combined highly intense training on physical and mental performance.

The first program (Pilot 1) was conducted in the Summer of 2007; the second program (Pilot 2) was conducted in the Fall of 2007.

The ultimate objective of our research is to create and provide a unique program of training and tools for young athletes that will not only produce dramatic changes in physical (including sports) and mental performance, but also provide knowledge to be used throughout life to stay healthy and maintain peak performance.

Protocol

For the Pilot 1 program, participants were recruited from student athletes who were patients of the Program's supervising doctor. The Pilot 2 program participants were recruited from a sports program at a local health club.

The athletes participated in tri-weekly sessions composed of physical and cognitive training, chiropractic adjustments, intake of nutritional supplements, lectures, readings, and assignments on topics related to the program objectives. The physical training included intense endurance, strength, agility, and balance exercises; the cognitive training required athletes to respond to a computer generated tone by clapping or foot tapping a response unit of the Interactive Metronome (IM).

During the exercise sessions, rock music was played to create high energy. In addition, a videographer continually recorded exercise sessions. These distractions forced athletes to increase their focus and attention during the workouts and Interactive Metronome tasks.

The Pilot 1 program included 3 male and 6 female athletes and was 5 weeks in duration; the Pilot 2 program included 10 male athletes and was 4 weeks long. There were three 90 minute sessions held each week. Each session began with a 10-15 minute health and personal development talk by the supervising doctor followed by at least 60 minutes of workouts. Athletes worked out at three separate stations (1: Agility/Endurance, 2: Strength/Balance, and 3: Interactive Metronome) and rotated from each station every 4 minutes. Each athlete thus participated in 4 or 5 workout sets depending on available time.



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Quantitative physical, physiological, and athlete assessment measures were collected before and at the end of each program. These measures included height, weight, leg and arm circumference, lean body and fat mass, heart rate, blood pressure, cognitive functioning, and ratings by the athlete, their parents and the Program Doctor. Interactive Metronome and self-assessment measures were collected throughout each program. Daily diet habits were also recorded.

The primary differences between the Pilot 1 and Pilot 2 programs were:

- Duration & number of sessions
The Pilot 2 session was one week shorter (4 weeks) in duration than Pilot 1 (5 weeks) because of limitations of athlete availability due to conflicting sports schedules.
- Participant source
The athletes participating in both programs were from Santa Rosa area schools (Middle School, High School, and Junior College). The athletes in the Pilot 1 program were current patients of the Chiropractic Neurology Center and were thus well known by the Doctor.
- Participant gender and sports
The participants in the Pilot 1 program included males and females who played a variety of sports. The Pilot 2 participants were all males and mainly basketball players.
- Participant body condition
Although all participants were athletes, their fitness level was moderate.
- Supplement intake
Nutritional supplements were provided to the Pilot 2 participants since several of the Pilot 1 participants got tired and some became ill during the first part of the Pilot 1 program.
- Exercises
The Pilot 2 program included more side-to-side shuffles, fewer ladder exercises, and less weight machine exercises than the Pilot 1 program.
- Fitness
The Pilot 2 program included pre and post fitness measures: squat jump ups, side-to-side shuffles, push ups, and push up holds; Pilot 1 did not include pre and post fitness measures.

The following tables summarize differences between the two programs:

Time & Duration

	Pilot 1	Pilot 2
Season	Summer	Fall
Activities	Non school	School
Number of weeks	5	4
Number of sessions	16	12

Participants

	Pilot 1	Pilot 2
Number of participants	9	10
Source	Doctor's patients	Health Club sports group
Gender	Males (3) & females (6)	Males
Age range	14-18	14-19
Fat and Leanness	Mesomorphic	Ectomorphic
Beginning strength & endurance level	Moderate	Moderate
Main sport	3 football; 1 basketball 2 soccer; 2 volleyball	7 basketball; 2 track 1 baseball



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Protocol

	Pilot 1	Pilot 2
Exercises	Agility (mainly ladder) Endurance Strength & Balance (weight lifting & weight machines)	Agility (mainly side-to-side shuffles) Endurance Strength & Balance (weight lifting)
Metronome	Hand clapping Toes & heels tapping	Hand clapping Toes tapping
Supplements provided	None	Daily vitamin pack
Lectures & readings	X	X
Chiropractic adjustments	X	X

Measures

	Pilot 1	Pilot 2
Pre and Post		
▪ Height & weight	X	X
▪ Circumferential	X	X
▪ Fitness		X
▪ Heart rate & blood pressure	X	X
▪ Lean body mass and fat mass	X	X
▪ Timing (Metronome Long Form Assessment)		X
▪ Timing (Metronome) throughout program	X	X
▪ Cognitive online test (Visual response to color change and Basic math calculations)	X	
▪ Woodcock Johnson paper and pencil test (Decision Speed & Visual Numeric Matching)		X
▪ Doctor ratings (pre & post)	X	
▪ Parent ratings (pre & post)	11 criteria	9 criteria
Tri weekly Self assessment ratings	X	X
Daily diet log	X	X
Post program athlete Anonymous Survey	X	X

RESULTS

Lean Body Mass and Fat Mass

There was a significant increase in percent of lean body mass and decrease in percent of fat mass from the beginning to the end of the Pilot 1 program ($p < .01$), but not for the shorter Pilot 2 program ($p > .05$) (see Figure 1). Of the 8 athletes measured, 50% gained at least 5% lean body mass and 75% lost at least 10% fat mass (see Figure 2)

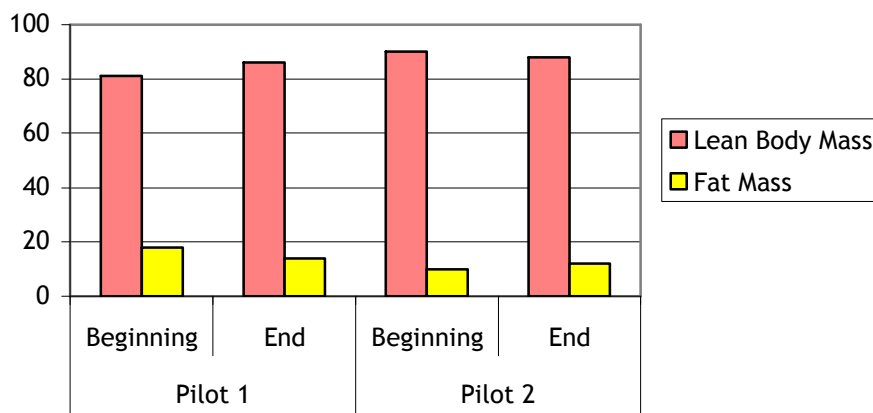


Figure 1: Average of Lean Body Mass and Fat Mass Average Measures for both programs

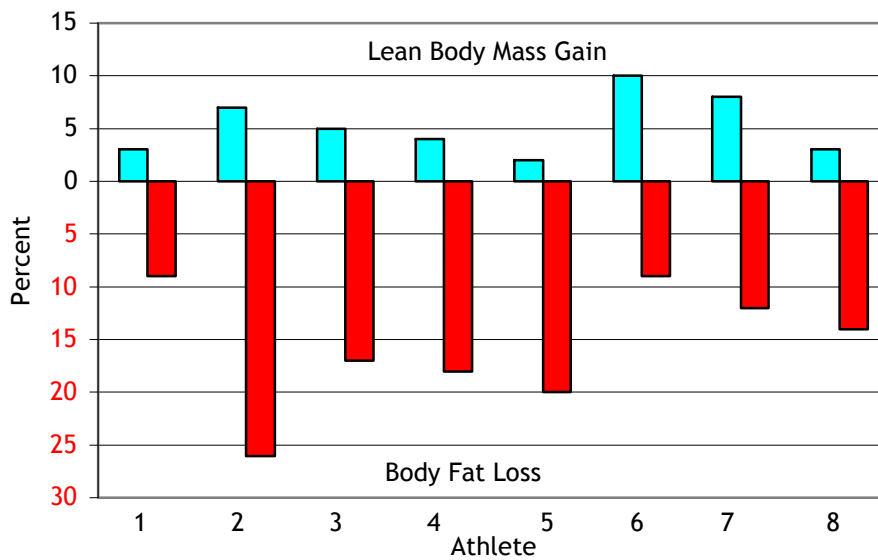


Figure 2: Pilot 1 Post Program Lean Body Mass and Fat Mass Measures by Athlete

Arm and Leg Circumference

There were no significant changes in the circumferential measures of athlete's forearms, biceps, calves, and quadriceps by the end of either program.

Response Time (Metronome) Performance

By the end of both programs, best metronome response time improved significantly ($p < .05$). There was a greater improvement in response speed of the Pilot 2 group and response speed was faster than of the Pilot 1 group (see Figure 3).

- In Pilot 1, the best response time improved by almost 30%: average response speed decreased from 51 milliseconds (ms) to 36 ms (see Figure 3).
- In the Pilot 2 program, response time improved by 42%: average response speed decreased from 59 ms to 34 ms.

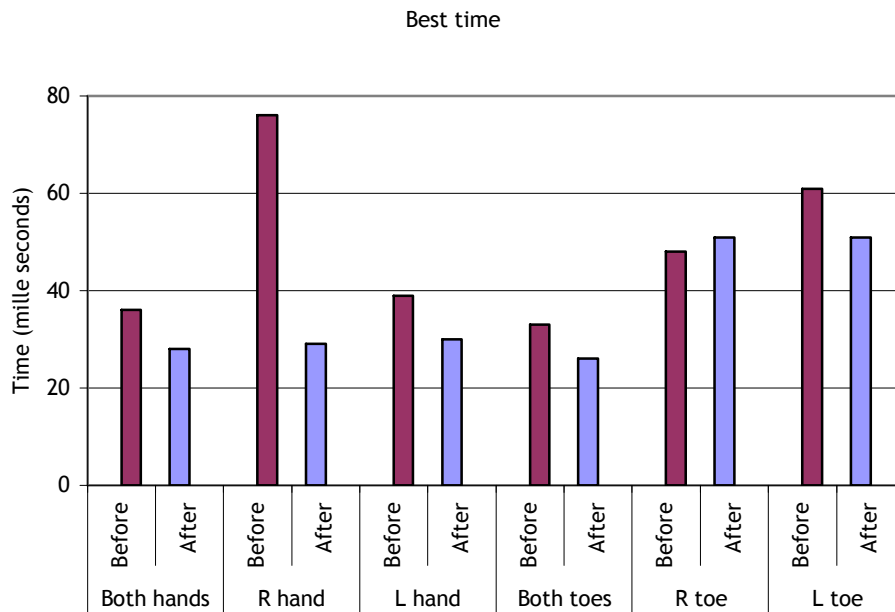


Figure 3: Pilot 1 Average best time at beginning and end of the program

In the Pilot 2 program, metronome response data was collected using a Long Form Assessment (LFA) during the first and last sessions. The LFA assessed timing and rhythm, motor planning and sequencing, and attention and focus. The assessment consisted of 14 tasks requiring response from either the upper body, lower body, or both. The 14 tasks included tapping the metronome response unit with: 1) both hands, 2) right hand, 3) left hand, 4) both toes, 5) right toe, 6) left toe, 7) both heels, 8) right heel, 9) left heel, 10) right hand and left toes, 11) left hand and right toes, 12) right foot, 13) left foot, and 14) both hands with a guide tone. The LFA calculations are average scores. The LFA scores were significantly better ($p < .01$) at the end of the Pilot 2 program (see Figure 4).



Metronome Performance

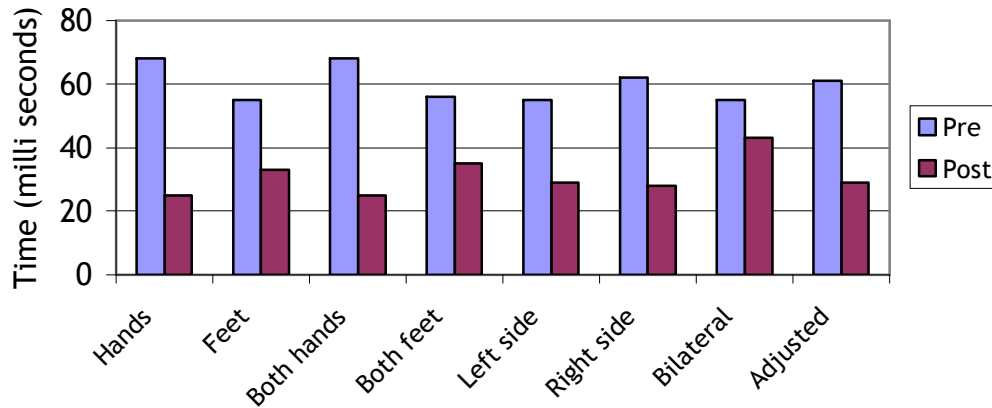


Figure 4: Pilot 2 Long Form Assessment time averages at the beginning (pre) and end (post) of program “Adjusted” are overall averages of all scores

Cognitive Performance

In the Pilot 1 program, athletes initially completed three online cognitive tests: greater, same, and less than number comparisons, flashcards, and stoplight reaction time. However, insufficient responses did not yield sufficient data for statistical analysis.

In the Pilot 2 program, athletes completed two Woodcock Johnson cognitive tests (Decision Making and Matching Numbers) during the first and last sessions:

- The Decision Making test required identifying two objects in a row of 7 objects that were of the same type or had a similar function. There were 40 rows of problems in this test. It required participants to utilize high cognitive (associative) processes.
- The Matching Numbers test required finding the two number that were the same in a row of 7 numbers. There were 60 rows of single, double, and triple digits in this test. It required participants to utilize high visual (matching) processes.

The average time for the participants to correctly complete the Decision Matching test was 4.11 seconds prior to the Program and 3 seconds after the Program. The participants thus improved their test time by an average of 1.11 seconds - 27% faster.

The average time for the participants to complete the Matching Numbers test was 4.22 seconds prior to the Program and 3.78 seconds after the Program (see Figure 5). The participants thus improved by an average of 0.22 seconds - 10% faster although the difference was not statistically sufficient.

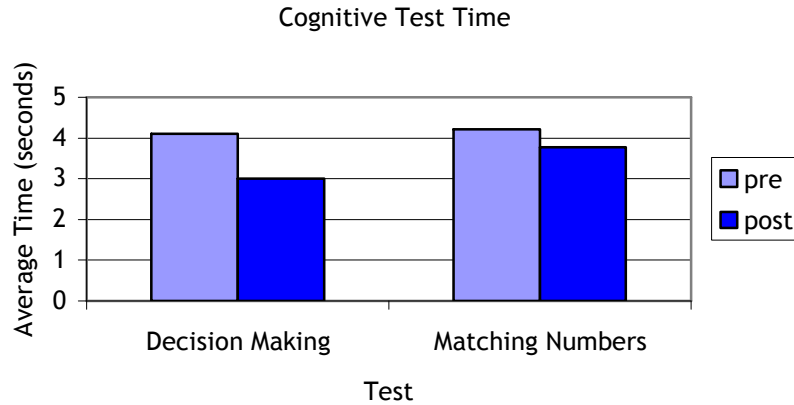


Figure 5: Time to complete the cognitive test decreased from the start (pre test) to the end (post) of the program

Impressions

In both programs, survey ratings were completed by participants and their parents. Participants also completed a tri-weekly rating survey before each session. All surveys were 7 point rating scales with 1-3 representing negative values, 4 representing neutral values, and 5-7 representing positive values. A rating of 1 was thus the lowest rating and a rating of 7 was the highest rating.

Athlete Ratings

Rating differences between the first and last rating were significant ($p < .05$). There was a significant increase in the total number of positive ratings (and decrease in both neutral and negative ratings) by the end of each program (see Figure 6).

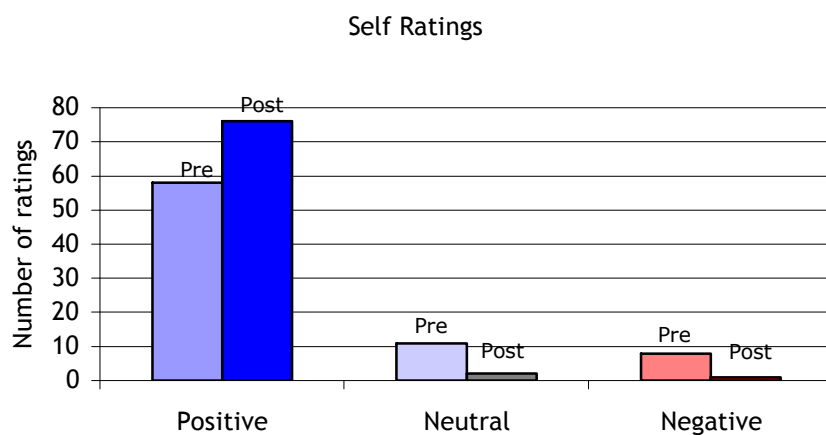


Figure 6: Number of ratings from beginning (left color) to end (right darker color) of both programs

Parent Ratings

In the Pilot 1 program, 7 out of 10 participant's parents completed both the Pre and Post Program Surveys containing 9 criteria:

1. Ability to stay focused
2. Confidence level
3. Moodiness
4. Follow through
5. Punctuality
6. Body language
7. Cooperativeness
8. Getting along with others
9. Enthusiasm

Since parents did not have access to their original survey results at the end of the Program, they completed the final survey without knowledge of their original ratings.

By the end of Pilot 1, parent ratings increased: all (except one) rating increased by at least one rating level (see Figure 7).

Average Number of Parent Ratings

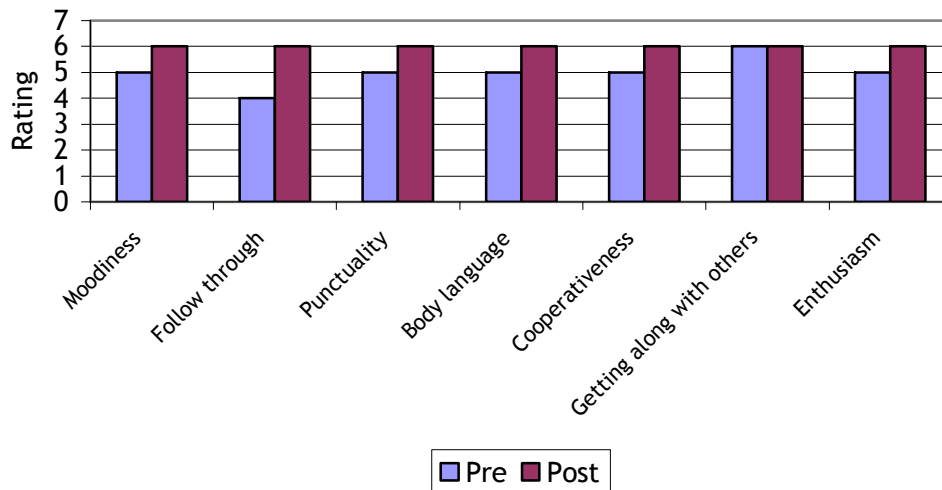


Figure 7: Pilot 1 parent average pre and post ratings



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By the end of Pilot 2, parent ratings increased on all except two criteria: three of the criteria (Confidence level, Follow through, and Body language) increased by an average of 2 ratings; four criteria (Ability to stay focused, Moodiness, Punctuality, Enthusiasm) increased by an average of 1 rating. There was no increase for Cooperativeness and Getting along with others (see Figure 8).

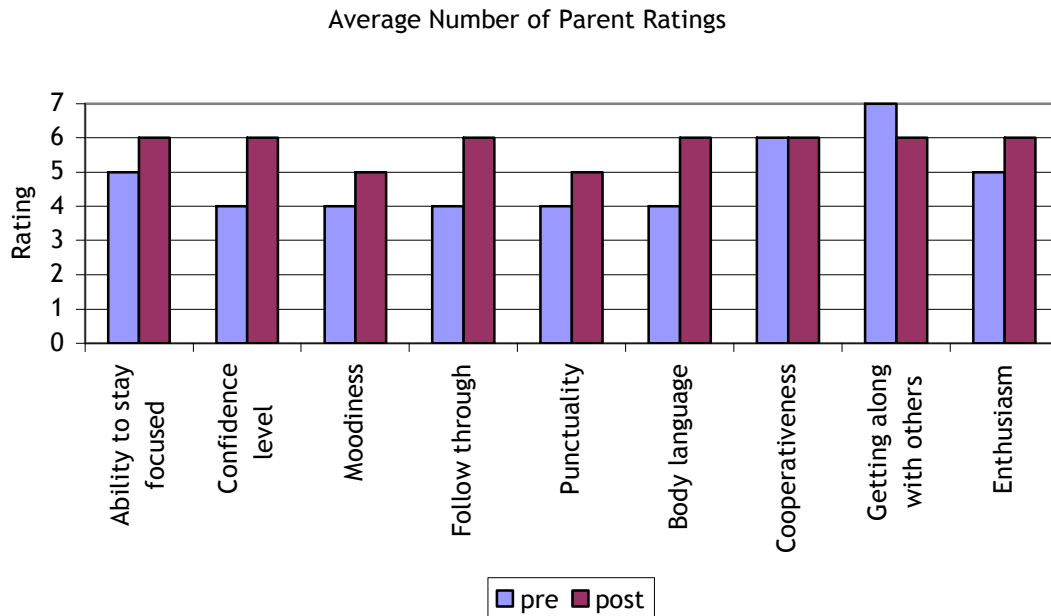


Figure 8: Pilot 2 average parent pre and post ratings

Doctor Ratings

In the Pilot 1 Program, the Program Director (Clinic Doctor) rated each athlete on the following 13 criteria:

- | | |
|----------------------------|-----------------------|
| 1. Current fitness level | 8. Leadership ability |
| 2. Ability to stay focused | 9. Follow through |
| 3. Confidence level | 10. Punctuality |
| 4. Endurance | 11. Body language |
| 5. Strength | 12. Cooperativeness |
| 6. Moodiness | 13. Enthusiasm |
| 7. Team player | |

Average ratings increased by at least one point; almost half (46%) the ratings increased by 2 levels (see Figure 9). The greatest increases (2 point level change) were for:

- Current fitness level
- Endurance
- Strength
- Moodiness
- Team player
- Follow through

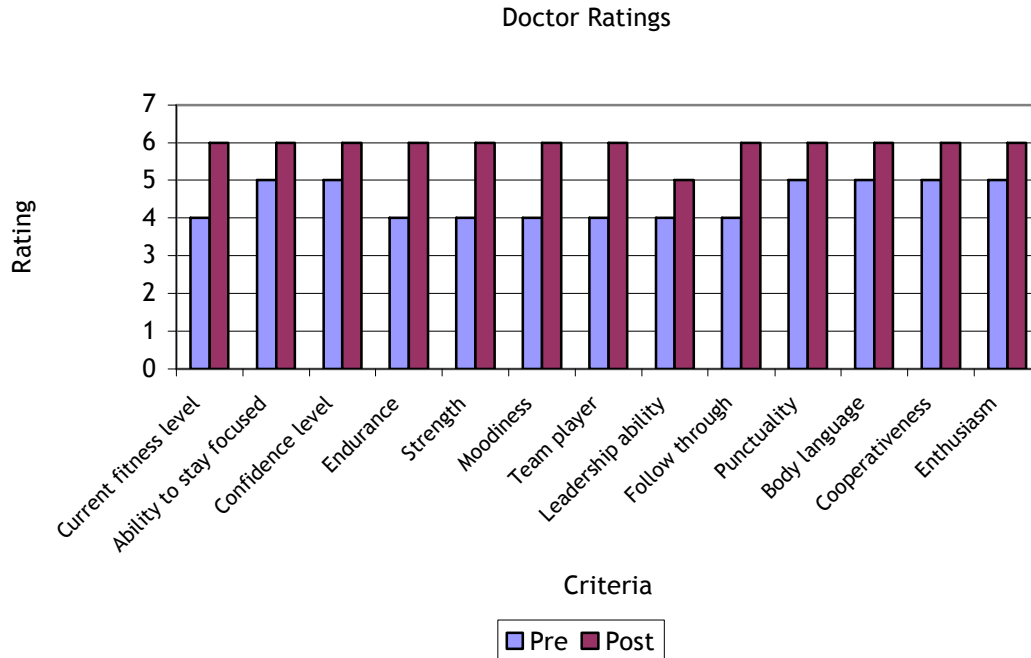


Figure 9: Doctor ratings at the start (pre) and end (post) of Program

Anonymous Post Program Survey Results

Athletes were asked to complete an anonymous survey when the Program ended. The Pilot 1 group completed the anonymous survey before leaving the last session. In the Pilot 2 program, athletes were asked to return the anonymous survey after they left. There were more surveys returned from Pilot 1 participants than Pilot 2 participants: eight of the Pilot 1 surveys were returned; only 3 of the Pilot 2 surveys were returned. Additionally, the answers in the Pilot 1 surveys were substantially more detailed and extensive.

Features of the program reported most liked were: workouts and pre-workout lectures on diet and personal responsibility.

Suggested additions were increased: weight and speed conditioning, cardio exercises, emphasis on the diet, and personal goal discussions. The only suggested eliminations were the ball tug of war, repetitive ladder exercises, Funky music, and bear crawl.

All participants stated that as a result of program participation, they changed their daily routine and most of all changed their diet. Other changes were increase in rest, water consumption, and motivation.

The changes that athletes anticipated would occur as a result of the program included improved: fitness, weight training, goal fulfillment, intensity, determination, ease of sports workouts, task completion (finishing), and diet.

The greatest gains reported to be attained were: knowledge, motivation, focus, strength and endurance. Least perceived gains were: Overall Health, Leadership and Confidence.

All participants rated that the program met their expectations; most reported that it exceeded their expectations. All the participants asked, said they would participate in the program again and that the program met their goals.

Summary

Both Pilot Programs resulted in a significant increase in positive changes in fitness, cognitive performance, response time, and self-image. These results demonstrate that several physical, mental, and self-image changes can be accomplished in a relatively short time period of 4 to 5 weeks. However, the programs also demonstrated that significant body changes in lean body and fat mass might require more than 4 weeks and that circumferential changes require more than 5 weeks. Because the duration and the exercises of the two programs were slightly different, it is difficult to determine if the changes observed body mass in the Pilot 1 program were due to the type of exercises, duration of program, or both.

Pre and post cognitive test data was only available from the Pilot 2 program. Results showed that the higher level cognitive processing task (Decision Making) improved more after participating in the Program than the lower level of cognitive processing task (Number Matching). Three participants increased their Decision Making speed by 40%-50%, while the largest increase in speed for the Numbers Matching task was only 20%-25%.

The effects of the Program on cognitive functioning were not only evaluated with the cognitive tests but also by the Interactive Metronome. While the cognitive tests assessed decision-making and visual matching, the metronome assessed response time and accuracy resulting from timing and rhythm, motor planning and sequencing, and attention and focus. Both programs resulted in significant improvements in metronome response time.

In the Pilot 1 program, pre and post ratings were collected from the Doctor. Since the Pilot 1 Program participants were patients, the Doctor was sufficiently familiar with them to be able to rate them at the beginning of the Program. In the Pilot 2 program, participants were not known to the Doctor, and he was thus not sufficiently familiar with them to be able to rate them.

These exploratory studies resulted in the following conclusions:

- A short-term, comprehensive, intensive program can improve physical and mental performance and positively affect health, fitness, and behavior of teenage athletes.
- Simultaneously conditioning the body and brain may produce more immediate, extensive, and lasting success than conditioning each separately.
- Lectures on fitness, diet, behavior, and proactive health management can result in changing daily habits, behaviors, and attitudes.
- Pre and post fitness measures should be collected.
- Pre and post Metronome response data should be collected using the Long Form Assessment .
- Two days (one before and one after program sessions) should be reserved to collect pre and post measures.
- Exercise conditioning should start in the second session.
- Nutritional supplements should be provided to participants at least one week prior to the start of the program.
- All testing should be conducted at the Center rather than relying on participants to complete tests on their own time.
- The BIA equipment should be frequently calibrated to ensure accurate readings.
- Circumferential measures of the arms and legs will not change in the short term.



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- As anticipated, the distracting activities around the workout stations (i.e., music, video recording, visiting observers, and activities and noise from other exercise stations) forced athletes to intensify their concentration and focus at the Metronome.
- Teenage athletes have poor diet and eating habits and do not understand the importance of diet and consumption frequency.
- Providing nutritional information is important to participants.
- The Program produced more positive results than originally anticipated including:
 - body shape (in Pilot 1)
 - strength
 - motivation and enthusiasm
 - attitude
 - commitment (be part of)
 - team building
 - leadership
 - impressions of athletes by parents, doctor, coaches
- One-on-one discussions between the Doctor and participants early in, and during, the program is important to program success for each individual
- Providing specific instructions and examples of responses in using ratings scales is important to ensure good data.
- Pre program meetings with participants (and parents) to describe program is important to program efficiency.

The interaction of the physical and mental exercises is unclear and is interesting content for future studies. For example, it would be interesting to test performance of test groups against control groups: compare test scores (for timing and cognitive performance) of three groups - one participating in the full program, a second participating in only the endurance and strength training, and a third participating only in the metronome training.

In conclusion, we believe that the intensity level and combination of the physical workouts, metronome exercise, nutritional supplements, and chiropractic adjustments resulted in the extent of the positive results and absence of injuries.