Invincible Athletics Program: Exercise without Stress

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Abstract

Physiologic functioning was compared during conventional athletics and Invincible Athletics—a new exercise program designed to remove stress, rejuvenate the body, and so enliven ones physical and mental potential. Results from three studies are reported: one case study, and two within studies with three and five subjects respectively. The same pattern of results were seen in each study. Heart rates were not consistently different during either workout. However, during Invincible Athletics: (1) breath rates and perceived exertion were consistently and significantly lower; (2) RSA, perceived comfort, and central-parietal EEG alpha coherence were significantly higher; (3) central-parietal EEG alpha power tended to be consistently higher; and (4) endurance was significantly longer. The findings of these three experiments suggest that Invincible Athletics leads to a discrete, repeatable physiologic pattern during exercise that is different than during conventional athletics. RSA decreases with physiologic and mental stress. The observed heightened RSA during Invincible Athletics could infer that the athlete is easily adapting to the demands made upon him. This is supported by subjective reports of greater comfort and less exertion, observed increased endurance, and objective findings of increased alpha coherence and power during the Invincible Athletics protocol.

Exercise without Stress

"No pain-no gain" is a common dictum for exercise. It is commonly believed that to build the body up you must first break it down and then allow it to recover. Breaking the body down also breaks down mind-body coordination essential for a fun, safe, and productive fitness program. Instead of forcing fitness, Invincible Athletics teaches the student how to bypass the stress/recovery cycle for ideal fitness without strain.

The Invincible Athletics program is a new exercise program that contradicts the no pain-no gain credo. It attempts to reproduce the exercise high on a regular basis. When athletes are at peak performance they report their best race was their easiest race. Roger Bannister, for example, when he broke the 4 minute mile in 1959, said that he felt he was going slow. He said that he felt no pain and no strain, just the "unity of movement and aim." He said that the world stood still or did not even exist. However, 44 years later we still subscribe to the philosophy that to enhance performance, you must strain the body and allow it to recover. Invincible Athletics contends that the exercise high experience can be replicated by anyone by reproducing the essential ingredients of the exercise high-- balance, comfort and euphoria--from the first to the last step of every exercise session.

This new program is based on the 5,000 year-old Vedic tradition of India (Shushrut Samhita), which conceptualizes mind, body, and environment as one continuum. This program attempts to revive the ancient understanding that exercise should remove stress, rejuvenate the body, and therefore ultimately access maximum physical and mental potential.[1]

A number of elements distinguish the Invincible Athletics program from conventional programs. First, the warm up and cool down exercises in Invincible Athletics, called Surya Namaskara or sun salutes, are said to integrate mind and body as well as stretch all major muscle groups, increase cardiovascular tone, and generally prepare the athlete for activity. Second, rather than increasing workloads very quickly to performance level, Invincible Athletics emphasizes gradual increasing workloads to a "performance or competitive phase" through two intermediate levels—called the "resting" and "listening phases". Third, this program recommends a deep nasal breathing technique called "ujjayi pranayam" during exercise. This is said to massage the heart and stimulate parasympathetic activity.

This paper presents preliminary findings of physiologic changes during the Invincible Athletics program. Results from three experiments are reported. The first is a case study of EEG, electrodermal activity, breath rate, and heart rate changes in a single individual. The second is a within comparison of EEG, heart rate, heart rate variability, breath rate, and self-reported exertion and comfort during a conventional and an Invincible Athletics workout. The last compares these same physiologic and self report measures along with endurance during conventional and Invincible Athletics employing a matched work load protocol. The results are discussed as a whole in the general discussion following the last experiment.

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[1]The Invincible Athletics program is a complete fitness system. Details of this program are contained in the forth coming book Body, Mind and Sport by John Douillard published by Crown-Harmony. This book contains testimonials and case studies along with a comprehensive understanding of the Vedic principles of exercise. For further details, contact John Douillard, PO Box 541, Lancaster, MA 01523.

Method

Subject

The first subject was one of the authors, John Douillard. He is a former semi-professional triathlete, age 35. He has been developing the Invincible Athletics program for five years working with Vedic scholars in India.

Procedure

John came into the lab four times. Each time, 19 electrodes in the 10-20 system were applied to measure EEG using the Electro-Cap system, axillary leads to measure heart rate from which heart rate variability was calculated, a nasal thermistor to measure breath rate, and Ag/AgCl electrodes were applied to the medial phalanges of the first two fingers on the left hand with K-Y Jelly to measure skin resistance. The EEG was recorded with a bipolar montage in an anterior/posterior line.

After all sensors were attached, John warmed up and then started the stress test on the ergonometric bike. The order of conventional or Invincible Athletics exercise was randomly selected. Twice it was Invincible Athletics, and twice conventional. During the conventional workout, he did a standard stretching warm up protocol (Anderson, 1980). Then a technician increased the weights on the bike fairly continuously to a performance weight of 200 Kg (about 4 minutes from free wheeling to performance). He performed at that weight for 10 minutes, and then cooled down. During the Invincible Athletic workout, he did sun salutes, gradually dialed up to his performance level in 25 Kg-increments every two minutes, staying for 4 minutes at each of the "resting and listening phases". He also performed for 10 minutes at the same performance level and then cooled down. The weights on the bike at the performance level were the same for both workouts.

Results and Discussion

One technical finding was the limitations on physiologic recording during exercise. Due to excessive eye movements and mechanical stress during the exercise period, EEG from the frontal electrodes was lost. However, central-parietal alpha bursts were seen when the athlete signaled that he was experiencing the exercise-high, that he felt completely integrated in mind and body. At this point there was a global, prolonged (15 sec) alpha burst. Similar bursts were not seen during the conventional athletics workout.

Respiratory sinus arrhythmia (RSA) differed markedly between the two workouts. During Invincible Athletics, RSA was initially higher, 32 bbm vs 14 bbm, and lasted longer into the exercise session, 8 minutes vs two minutes. RSA reflects the relationship between heart period and breath rate and volume, and is considered an index of parasympathetic cardiac tone (Porges & Fox, 1986; Grossman et al , 1991). This presence of RSA well into exercise suggests that, during submaximal activity, the Invincible Athletics program may stimulate parasympathetic tone. At the same time sympathetic tone, as reflected in electrodermal activity, was lower. This suggests a balance between arousal (sympathetic tone) and adaptability and restoration (parasympathetic tone). Invincible Athletics aims to foster the co-existence of opposites--composure in the midst of dynamic physical activity (the exercise high). This ideal of co-existence of opposites was seen neurological, psychologically, and subjectively in these data.

The heart rates were similar during both workouts. Comparable heart rates are noteworthy in light of the exclusive nasal breathing techniques employed during Invincible Athletics. Nose breathing is commonly thought to severely reduce the volume of oxygen intake, thereby possibly promoting hypercapnia and raising heart rates. These predicted nasal-breathing disadvantages were not seen. Rather, the observed physiologic patterns suggest possible cardiovascular and respiratory efficiency along with increased autonomic balance during the Invincible Athletics program.

Experiment 2: Method

Subjects

To follow up these pilot findings, three more subjects were run. They were male high school students, average age 17.3 yrs (sd= .47), who had been training with the Invincible Athletics program for two years. One was training for dance, another for basketball, and the third for karate. None were training for cycling.

Procedure

Each subject came in for a trial run on the ergonometric bike. No physiologic measures were taken. During this practice run, they established the pattern of increasing weights for the conventional protocol.

Each subject came in for two more recordings, counterbalanced as either conventional or Invincible Athletics program. During these sessions, EEG was recorded with the Electro-Cap system in a bipolar montage from: T3T5, C3P3, P3O1, T5O1, T6O2, P4O2, C4P4, T4T6. EKG was recorded from axillary leads, and breath rate was monitored with a nasal thermistor. These three sessions were recorded within the same week.

As in the pilot study, the athlete did a 10 minute warm up exercise, and then worked out on the ergonometric bike. During conventional exercise they quickly went up to their performance level (an average of 6 min.); during the Invincible Athlete program they gradually increased their workloads (an average of 11 min.) to their performance phase. Physiologic measures were recorded for ten one-minute windows: during a baseline period (BS1), after the warm-up exercise (POX), during free wheeling (FW1), during the resting (RST) and listening (LIS) phases of the Invincible Athletics program (and corresponding workloads during conventional athletics), twice during the performance phase (P1 and P2) with heart rate around 150 bbm; during 75% of their maximum heart rate (75%), during free wheeling afterwards (FW2), and after the cool down exercises (BS2). Whenever physiologic measures were taken, subjective ratings of exertion and comfort were also recorded. Exertion was measured using to the Borg Scale of Perceived Exertion (Borg & Linderhom, 1967); and perceived comfort was recorded according to a scale we devised (see appendix for a copy of the scales).

Results and Discussion

Figure 1 contains the results for heart rate, breath rate, and heart rate variability. The heart rates (top) are very similar for conventional athletics and Invincible Athletics. The breath rates (middle) are predictably slower for the Invincible Athletics program, since this program involves deep measured breathing. It is interesting to note that breath rate gradually increased with increasing work load during Invincible Athletics, while it increased precipitously with the beginning of exercise during conventional athletics. While the heart rates were similar, the respiratory sinus arrhythmia (bottom) is about three times as high during the Invincible Athletics program as during conventional athletics. RSA was present throughout the performance phase during IA, dropped out at

75% of their maximum work load, and quickly reappeared during the free wheeling period (FW2). In contrast, during conventional athletics, RSA quickly dropped out and took longer to reappear after exercise.

Artifact free epochs of central-parietal EEG were selected during Invincible Athletics and conventional athletics for the ten one-minute recording periods. The one-minute recordings were spectral analyzed (fast Fourier analysis) in six 10-sec epochs. The spectral means for each period are presented for theta/alpha (7-9 Hz) and alpha (10-12 Hz) frequency bands. There were no systematic differences between central-parietal theta/alpha or alpha power between the ten recording periods in the Invincible Athletics or conventional athletics programs. However, during the "resting" and "listening" phases—periods employed in the Invincible Athletics program to integrate mind and body before working out—there tended to be higher theta/alpha power (7-9 Hz) and coherence during the Invincible Athletics program, with less marked changes in the alpha range. A subject size of three is too small to do meaningful statistics. The effect size was calculated according to Cohen (1977) to estimate the subject size necessary to expect significance at the .05 level. This yielded medium effect sizes (d=.61 and d=.40) for changes in theta-alpha power during the resting and listening phases respectively. According to Cohen's (1977) tables, increasing the subject size to 26 should yield a significant result.

Subject ratings of both perceived exertion, and perceived comfort did not differ systematically between the two periods in these three subjects.

The findings of this second experiment are in the same direction as those from the case study. The Invincible Athletic program produced a different physiologic condition during exercise than did conventional athletics. While workloads and HRs were similar during both protocols, during IA, RSA was markedly different, which could indicate that the athlete was experiencing less stress during the Invincible Athletics workout.

In this protocol, the athlete exercised for an average of 5 minutes longer before reaching his performance level during Invincible Athletic than during conventional athletics, having spent more time in the "resting" and "listening" phases. The athlete, therefore may have been less fresh at his performance level, or conversely, he may have been more warmed up. The next study used the same protocol as for experiment two, but it looked at matched work loads—equal times at each weight load—to further investigate physiologic patterns during Invincible Athletics. Also, in this next experiment, endurance was monitored—how long athletes would continue to perform beyond the 75% maximum heart rate level during each protocol.

Experiment 3: Method

Subjects

Five male high school students, average age 17.5 yrs. (sd = 1.34), who had been training with Invincible Athletics for two years were tested. Two of these subjects were those tested in Experiment 2. They came in for an additional workout with matched work loads The other three subjects came in for the three testing sessions as in Experiment 2. Two of these subjects were training for tennis, the other for volleyball.

Procedure

The procedure and measurements were the same as for experiment 2, except that the athlete increased workloads slowly during the conventional athletics workload—at the same incremental steps as during the Invincible Athletic protocol. Therefore, the major

differences between the two work outs was that during the Invincible Athletics session the athlete: (1) warmed up with sun salutes predicted to integrate mind and body, vs standard stretching exercises that are only intended to stretch major muscle groups; (2) monitored form and comfort throughout the session, vs keeping the attention off the signals from his body; and (3) used nasal breathing techniques only (ujjayi pranayam), vs nasal-oral breathing.

Results and Discussion

Table 1 contains the means and standard deviations for heart rate, breathe rate, heart rate variability, perceived exertion, perceived comfort, and central-parietal theta-alpha power and coherence. Because there were too few subjects to test group differences with a repeated measures ANOVA or a MANOVA, which would be the statistical tests of choice (Jennings, 1987), each measure recorded during the ten one-minute windows was averaged for each subject to give one number for each measure per session. A dependent t-test was used to test if these session means were significantly different. The resulting two-tailed t-statistics, and p-values are also included in this table. While this analysis smeared across the differential impact of different phases of the protocol, it gives a good reflection of overall physiologic patterns during the Invincible Athletics program as compared to conventional athletics.

The results were similar to those in the previous experiments: Heart rates were not consistently different during either workout; breath rates were significantly lower during Invincible Athletics ($t(4)= -4.46$, $p = .011$); and RSA was significantly higher ($t(4)=2.93$, $p = .04$). Perceived exertion was consistently and significantly lower during Invincible Athletics in these subjects ($t(4) = -2.89$, $p=.045$) and perceived comfort tended to be higher ($t(4) = 2.40$, $p=.074$) during Invincible Athletics compared to conventional athletics.

EEG power and coherence were similar during the pre and posttest baselines (BS1, BS2), but were consistently higher during the Invincible Athletics program. This difference reached significance for coherence ($t=2.86$, $p = .049$). The effect sizes for power differences were large ($d=.77$), but due to large standard deviations it was not significant.

Endurance was also longer during the Invincible Athletics protocol. As seen in Figure 2, during Invincible Athletics , the athletes performed twice as long beyond 75% of their maximum heart rate (two tailed $t(4)=3.23$, $p = .033$).

These significant findings were seen even with the low number of subjects, and suggest discrete robust physiologic and psychologic effects of the Invincible Athletics program.

General Discussion

The findings of these three experiments suggest that Invincible Athletics leads to a discrete, repeatable physiologic pattern during exercise that was different than that seen during conventional athletics. During both Invincible Athletics and conventional athletics, the athlete seemed to be performing at similar levels, as reflected in similar heart rates. Even though breath rates were significantly lower during Invincible Athletics , the athletes were getting enough oxygen to fuel their workouts. If CO_2 built up (hypercapnia), it would have resulted in heightened HRs (Porges et al, 1988). This was not seen.

However, during IA, the athletes seemed to workout with less stress as suggested by self reports of lower exertion, higher comfort, observed higher endurance, respiratory sinus arrhythmia, and theta/alpha coherence and power. The self-report findings, and increased endurance are quite possibly confounded by subject reactivity. Subjects may have wanted to "look good" during the Invincible Athletics. However, these subjective reports were supported by significant differences in physiology.

Consideration of elevated respiratory sinus arrhythmia during the Invincible Athletics program

RSA results from a complex feedback system from peripheral and central feedback on cardiovascular functioning (Hirsch, & Bishop, 1981; Gilbey et al, 1984). As in all homeostatic mechanisms, a greater range of adaptability is a sign of greater health of the system. RSA decreases with age, and under physiologic stress (Porges & Fox, 1986; Porges, 1984). Other research reports a rapid decrease in RSA with exercise (Yamamoto et al, 1991), as was seen during conventional athletics in this study. The observed heightened RSA during Invincible Athletics could infer that the athlete is easily adapting to the demands made upon him. This is supported by subjective reports of greater comfort and less exertion during the Invincible Athletics protocol, and increased endurance.

Consideration of increased central-parietal theta/alpha coherence during the Invincible Athletics

Increased alpha activity has been reported immediately following vigorous exercise (Boutcher & Landers, 1988), but is reported to decrease during focused mental and physical activity (Niedermeyer, 1987), and be reduced during nose versus mouth breathing (Lorig et al, 1988). In these data, greater alpha activity was seen during Invincible Athletics compared to conventional athletics.

Alpha patterns characterize states of deep relaxation as seen in meditation (Banquet, 1973). This state of relaxation has been described as restful alertness (Wallace, et al. 1971), the co-existence of rested physiology with alert psychology. The production of alpha during ergonometric exercise stress testing could indicate a composed mind in the midst of dynamic activity. Alpha bursts were seen in the first experiment when the subject felt the exercise-high. This experience has been reported by elite athletes during peak experiences. Billie Jean King (King, 1992) reported on her experiences of composure in the midst of competition: "I transport myself beyond the turmoil of the court to a place of total peace and calm." The fostering of the coexistence of inner calm during physical exertion by Invincible Athletics is supported by subjective reports of reduced exertion and heightened comfort, and physiologic patterns of: lower breath rates, heightened RSA, and heightened alpha coherence with trends towards heightened alpha power.

While future studies will further clarify the physiologic effects of Invincible Athletics these preliminary findings suggest that it could be a valuable protocol for fostering integration of mind and body, and bringing the fun back into physical fitness without compromising any performance or competitive goals. The practical application of Invincible Athletics is that exercise can be fun. It affords the sedentary adult population an exercise system that conditions the body without strain and discomfort as one enjoys the exercise-high at every level of fitness.

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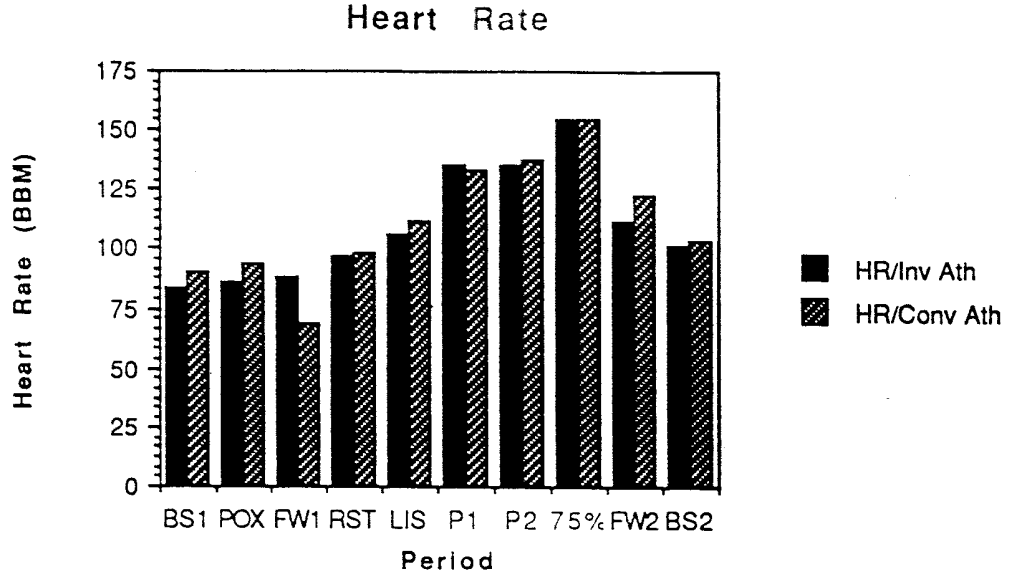
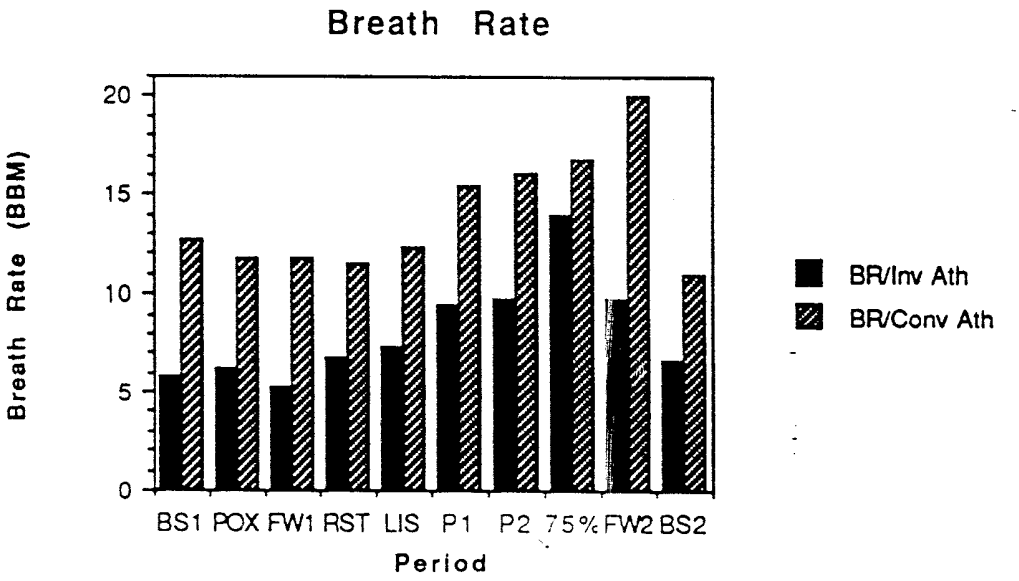
Figure Captions

Figure 1: Heart rate, breath rate, and heart rate variability during Invincible Athletics and conventional athletics . The heart rates (top) were very similar for conventional athletics (cross-hatched bar) and Invincible Athletics (solid bar). The breath rates (middle) were consistently slower. The respiratory sinus arrhythmia (bottom) was about three times as high during the Invincible Athletics program as during conventional athletics.

Figure 2. Endurance during Invincible Athletics and conventional athletics . Endurance was longer during the Invincible Athletics (solid bar) compared to conventional athletics (cross-hatched bar). During Invincible Athletics, the athletes performed twice as long beyond 75% of their maximum heart rate (two tailed $t(4)=3.23$, $p = .033$).

Fig 1


Heart Rate
Heart Rate (BBM)
175
150
125
100
75
50
25
0
BS1 POX FW1 RST LIS P1 P2 75% FW2 BS2
Period
HR/Inv Ath
HR/Conv Ath


Breath Rate
Breath Rate (BBM)
20
15
10
5
0
BS1 POX FW1 RST LIS P1 P2 75% FW2 BS2
Period
BR/Inv Ath
BR/Conv Ath

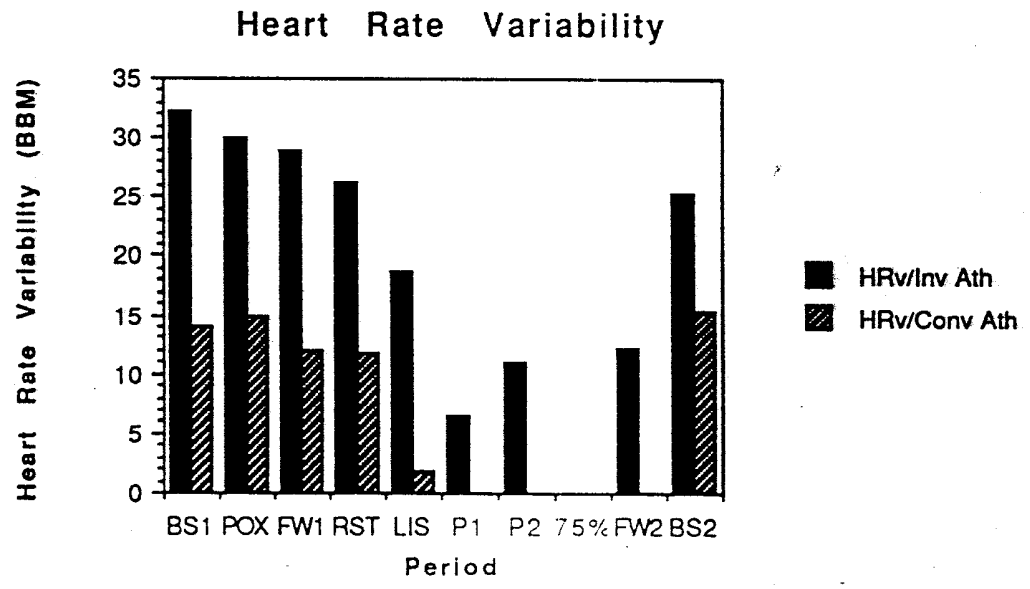

Heart Rate Variability
Heart Rate Variability (BBM)
35
30
25
20
15
10
5
0
BS1 POX FW1 RST LIS P1 P2 75% FW2 BS2
Period
HRv/Inv Ath
HRv/Conv Ath

Fig 2

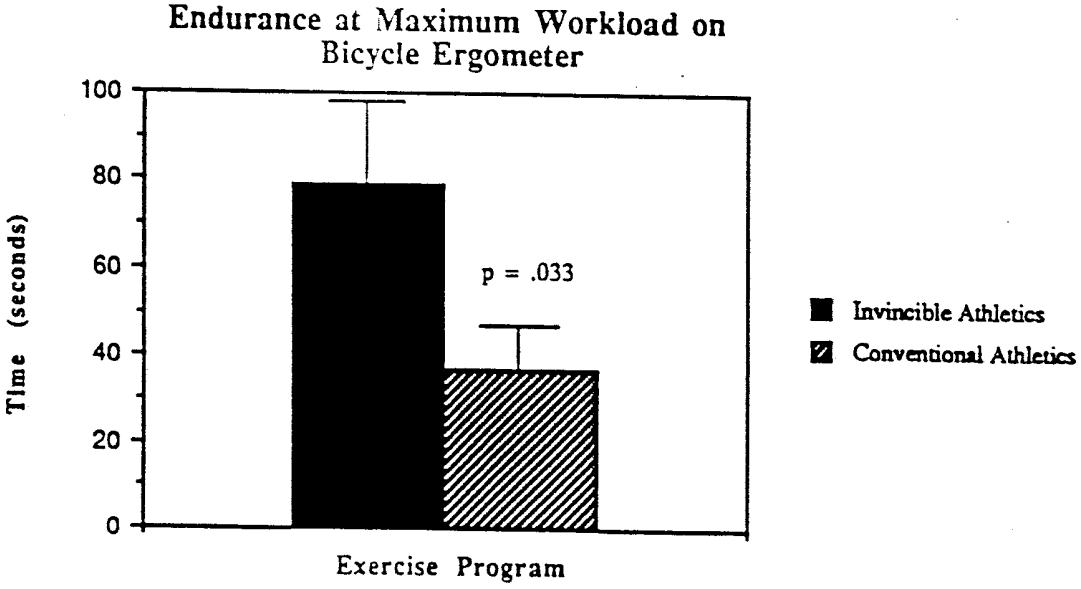

Endurance at Maximum Workload on Bicycle Ergometer
Time (seconds)
100
80
60
40
20
0
p = .033
Exercise Program
Invincible Athletics
Conventional Athletics

Table 1: Means, standard deviations, t-statistics, and p-values during conventional athletics and Invincible Athleth matched work loads.

	BS1	POX	FW1	REST	LISTEN	P1	P2	75%	FW2	BS2	t-test	p
Heart Rate												
CA	79.6±12.8	75.4±11.8	79.2±10.7	89.8±8.4	114.6±6.8	138.8±8.9	145.4±12.4	158.4±14.9	119±10.8	96±13.1		
IA	81.4±16.0	85.2±14.0	87.8±12.5	95.8±10.9	119±15.3	143.3±11.0	144.4±12.0	159.6±14.5	118.4±11.3	102.2±14.4	1.40	.236
Breath Rate												
CA	11.5±3.3	10.4±2.2	13.8±5.3	16±4.9	19.4±4.3	21.1±4.8	24±4.6	27.4±2.7	18.8±3.7	9±3.8		
IA	8.4±3.8	9.7±4.5	9.6±5.0	11.5±4.7	11.8±4.1	16±7.5	18.2±9.1	18.5±8.3	14.8±7.1	8±2.3	4.46	.011
Heart Rate Variability—respiratory sinus arryhthmia												
CA	11.4±6.7	16±7.0	8.8±5.2	6.0±9.4	2.6±4.2	1.6±3.2	0.8±1.6	0.0±0.0	2.1±0.8	12.3±5.6		
IA	22.8±12.4	20.6±9.0	16.6±7.0	14.2±6.2	10.4±11.2	1.2±1.9	3.2±6.4	0.0±0.0	2.8±5.8	18.2±17.5	2.99	.04
Perceived Exertion												
CA	6.0±0.0	7.5±1.0	7.3±1.3	8.3±1.0	11.0±1.7	12.5±1.4	14.3±2.2	13.2±2.8	7.75±1.7	7.0±1.2		
IA	6.0±0.0	6.2±0.4	6.2±0.4	6.6±0.5	7.4±1.9	10.6±1.9	12.2±2.0	14.8±2.1	8.6±1.4	6.0±0.5	2.88	.045
Perceived Comfort												
CA	12.7±0.9	11.7±0.4	12.8±1.3	12.0±1.2	10.7±1.1	10.2±1.8	14.0±2.0	9.8±1.9	11.0±1.2	13.3±1.9		
IA	13.2±1.0	14.4±2.9	15.6±3.6	14.0±2.8	14.2±2.9	12.47±3.4	14.4±2.4	9.4±2.0	13.0±3.2	13.4±1.7	2.40	.074
Central-parietal theta/alpha power												
CA	164±229	95±63	81±44	97±74	82±52	96±64	115±80	99±69	96±56	98±55		
IA	205±210	160±132	178±161	198±183	182±197	135±97	152±118	159±124	157±121	141±103	1.39	.237
Central-parietal theta/alpha coherence												
CA	.169±.11	.128±.03	.154±.07	.144±.05	.119±.01	.1354±.05	.187±.04	.105±.03	.148±.05	.168±.02		
IA	.154±.08	.169±.04	.195±.11	.192±.08	.164±.08	.149±.04	.149±.05	.134±.04	.157±.05	.168±.04	2.88	.049

Appendix A

PERCEIVED EXERTION		PERCEIVED BLISS/COMFORT
6	Nothing	Nothing
7	Very, Very Weak	Very, Very Weak
8	Very Weak	Very Weak
9	Weak	Weak
10		
11	Moderate	Moderate
12	Somewhat Strong	Somewhat Strong
13		
14	Strong	Strong
15		
16	Very Strong	Very Strong
17	Very, Very Strong	Very, Very Strong
18		
19	Maximal	Maximal