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Research Article

The Effects of Mental Interventions on Cardiovascular Activity and Sport Performance of College Athletes

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Abstract

This experimental study examined the effects of an eight-week mental training program on athletes' cardiovascular regulation and learning ability of visualization skills for soccer related contests. A total of 56 college soccer players (NCAA Division III) were randomly assigned to either the experimental or control group. The athletes completed measurements of cardiovascular activity (HR and BP) in four stations, which included baseline analyses, measurements prior to the juggling and shooting contests, and measurements in the recovery-resting phase after the contests. The results suggested that the mental training program generated positive effects on athletes in optimizing cardiovascular activity prior to and after contests (lowering the Heart Rate values) and improving juggling skills (59% improvement in touches and 45% enhancement in time). The execution of the exhale phase (6 seconds long exhale) through the mouth in order to initiate the Heart Rate Deceleration trends with positive self-talks before the sports specific executions was the crucial psycho-physiological factor for successful performance. This study offers valuable information about the Heart Rate Deceleration trends and Baroreceptor Reflex Mechanism during cardiovascular changes between HR and BP in sport performance.

Introduction

Sport psychologists, athletes, college and professional coaches have been interested in knowing whether breathing techniques with guided imagery would reduce stress and thus, improve sport performance in various competitions (Lovell & Collins, 2001; Mamassis & Doganis, 2004; Murphy, 2005; Watanabe et al., 2006). The significant problem was that many college or professional athletes, as well as coaches, were only slightly familiar with the positive applications of effective mental training. It appeared that many coaches and athletes concentrated just on the physical aspects in athletic preparation and underestimated the mental quality of a training. It was important to investigate whether mental training interventions should regularly be integrated into training processes in pre-game and pre-competition preparations or in post-game and post-competition recovery phases. Mental interventions might support the complete psycho-physiological approach to athletic training preparation that underscores the importance of the body-mind conscious inter-play as well as the unconscious interactions in training processes. This study examined whether an eight-week mental training with relaxation techniques and guided imagery would have a positive impact on cardiovascular regulation of college athletes when they were dealing with stress before and after soccer related juggling and shooting contests.

Previously, Brent (2004) and Morgan (2006) conducted research studies which investigated implementations of relaxation techniques, including breathing and imagery that generated positive effects on college athletes. In other research studies, Altman (2000) and Mcquown (2001) examined the effects of mental interventions by measuring heart rate variability and systolic and diastolic blood pressures, indicating positive cardiovascular changes in participants. Sosovec (2004) found there was a positive impact of imagery techniques on soccer college players who executed soccer penalty kicks in various contests. This mental intervention program combined breathings and imagery techniques that were utilized to reduce stress, optimize cardiovascular activity and improve soccer skills.

Considering the previous research, it was essential to examine, analyze, and evaluate how the mental interventions impacted the physiological functions of athletes regarding their cardiovascular activity which has been considered as the indicator of stress and anxiety reactivity (De Geus, Van Doornen, & Orlebeke, 1993). The measurements of heart rate, systolic and diastolic blood pressures before and after soccer related competitions indicated changes in the athletes' psychobiological reactions within the autonomic nervous system in the parasympathetic and sympathetic activity (Charney, 2004; Du et al., 2005; Rossy & Thayer, 1998; Wolf et al., 2006).

This study presents a contribution to athletes who had to deal with daily sport-related anxiety and various stressors in demanding situations in the modern sport environment. Measurement of the athletes' susceptibility to stress is a very individual matter, and it often requires not only self-reported questionnaires but also data from cardiovascular activities as the feasible indicator of general psycho-physiological responses in the athletes' autonomic nervous system (De Geus et al., 1993; Iellamo et al., 2003). Contemporary college and professional athletes have often been exposed to acute or chronic stressors that have often caused a failure to adapt and cope with the critical moments in sport competitions (Pensgaard & Ursin, 1998; Tenenbaum, Jones, Kitsantas, Sacks, & Berwick, 2003).

Understanding the above mentioned assertions, athletes need to learn how to cope with emotions and symptoms of stress before and during various competitions as well as how to quickly relax and recover after the competitions in order to regain the psycho-physiological well-being. It has been important to examine how athletes may implement breathing techniques in practice, and thus, gain control over the stress, increased competitive anxiety, muscular tensions, and psycho-physiological burnouts (Anshel & Delany, 2001; Anshel, Jamieson, & Raviv, 2001; Anshel, Porter, & Quek, 1998).

To test these psychosomatic adaptations, special breathing techniques with guided imagery were applied to investigate the application of the holistic modalities in the practical setting of the sport environment. Modern mental modalities for athletes integrate cognitive- behavioral interventions along with holistic procedures such as autogenic training, concentration-meditative methods, breathing exercises, self-talks, as well as self-hypnotic and imagery techniques (Ford-Martin, 2001a; La Torre, 2001; Murphy, 2005). It has been known that relaxation interventions that combine the aspects of psychosomatic exercises generate a positive impact on the whole endocrine system, glands, cardio-vascular system, and metabolic functions of the physical body, which positively influence the whole autonomic nervous system (Baldwin, 1999; Heilbronn, 1992; Maheshwarananda, 2000; Perez-De-Albeniz & Holmes 2000; Tacon, Mc. Comb, Caldera, & Randolph, 2003). Thus, progressive relaxation methods should integrate effective combinations of the psycho-physiological and holistic aspects in order to balance the mind-body interaction with proper breath control, concentration, self-talk, and guided imagery (Gruzelier, 2002; Haney, 2004; Perez-De- Albeniz & Holmes 2000; Ray & Wiese-Bjornstal, 1999).

Mental imagery and visualization have integrated effective mental skills interventions that might positively shape the athlete’s cognitive as well as physical functions and abilities. Ford-Martin (2001b) explained that guided imagery generated a specific interaction between the mind and physical body which involved mental processes with deep slow breathing and visualization images for specific purposes such as healing, learning, pain control, or rehearsing. In particular, guided imagery became a flexible cognitive-somatic intervention and an effective therapeutic tool to enhance immune functions and reduce competitive anxiety and stress-recovery functions (Gruzelier, Levy, Williams, & Henderson, 2001; Murphy, 2005; Utay & Miller, 2006). Sport researchers found that guided imagery, in connection with exercise imagery and motor imagery, intensively sustained the athlete’s cognitive and motivational functions for trainings, improved memorization of movements and learning perceptions, as well as increased self-determination, skill execution, and game performance (Giacobbi, Hausenblas, Fallon, & Hall, 2003; Hausenblas, Hall, Rodgers, & Munroe, 1999; Holmes & Collins, 2001; Wilson, Rodgers, Hall, & Gammage, 2003).

The main focus of this study was the examination of psycho-physiological parameters in terms of cardiovascular activity and its relationship to stress before and after soccer related competitions. This area of the study might enhance our understanding of psycho- physiological methodologies in sport research, the impact of stress on the cardiovascular system, and the alterations in cardiovascular activity, including peripheral resistance before and after manipulated sport-related settings. Physiological research indicated that cardiovascular responses to mental stress included increases in heart rate and changes in blood pressure (Flaa, Mundal, Eide, Kjeldsen, & Rostrup, 2006; Herd et al., 2003; Iellamo et al., 2003; Ring et al., 2005).

The aim of these cardiovascular measures was to investigate whether physiological indicators such as heart rate and blood pressure might detect athletes' psycho-physiological reactivity to competitions and their individual stress-related differences in dispositional competitiveness regarding anxiety arousal and stress recovery. On a theoretical level, the mechanism of the cardiovascular measurements explains that the lowered heart rate values measured before and after sport competitions should indicate the equilibrium of athletes' autonomic nervous system, generating senso-motoric balance and mental resistance towards stress related symptoms (Achten & Jeukendrup, 2003; Mcquown, 2001; Väänänen, 2004). Thus, the monitoring of the cardiovascular activity and heart rate deceleration trends (HRD) should have indicated the effects of mental interventions on the soccer players in the experimental group regarding their adaptation to the stress and changes in autonomic responses within the peripheral reactivity and the baroreceptor reflex mechanism (Du et al., 2005; Rossy & Thayer, 1998; Carlstedt, 2007).

This study advocates the eight-week mental training program as an easily applicable preparation to the college training for athletes and contributes with some new findings to the area of the sport-science including sport psychology, psycho-physiology, and soccer training.

Methodology

Research Design

This study employed an eight-week pretest-posttest design that engaged 56 participants (NCAA Division III College Soccer Players) who were randomly assigned to either the experimental group or the control group (each consisting of 28 athletes). The participants in the experimental group went through the eight-week mental training program that synthesized eight (one-hour) mental training sessions utilizing breathing techniques and guided imagery. The participants in the control group did not receive any mental training.

Participants

The participants were 56 Virginia Wesleyan College soccer players who volunteered and completed pretest as well as posttest measurements. The experimental group consisted of 28 participants [15 women and 13 men with a mean age of 19.10 (SD = 1.13)]. The control group consisted of 28 participants (15 women and 13 men) with a mean of age 19.60 (SD = 1.10). The mean age of the men's experimental group was 19.07 (SD = 1.03) and the mean age of the men's control group was 19.61 (SD = 1.12). The mean age of the women's experimental group was 19.13 (SD = 1.24) and the mean age of the women's control group was 19.60 (SD = 1.12). The experimental group and the control group were not statistically significantly different in terms of age, t(54) = -1.57, p = .122. The participants in the experimental group were 39.3% freshmen, 28.6% sophomores, 21.4% juniors, and 10.7% seniors. The participants in the control group were 21.4% freshmen, 39.3% sophomores, 17.9% juniors, and 21.4% seniors.

A diagrammatic chart of the research design (see Figure 1) is presented below:

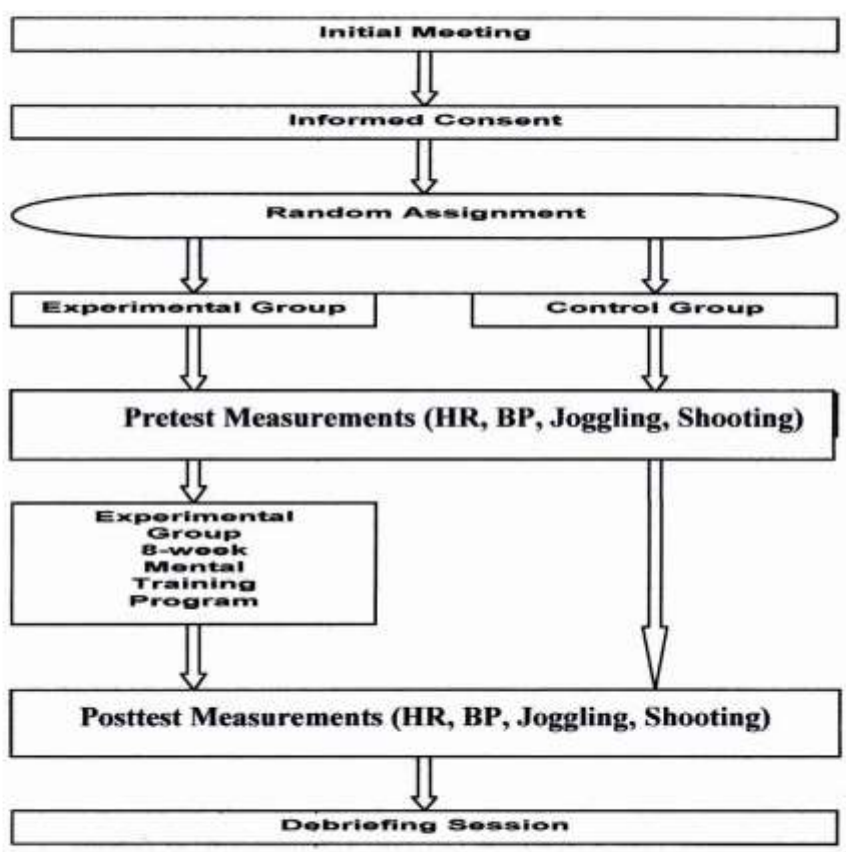

Figure 1. Research Design.

Materials

The physiological measurements of heart rate and systolic and diastolic blood pressures were measured by Omron HEN-790IT and 712C monitors. The results of the juggling (touches) with the soccer ball and soccer shooting accuracy on a specific target (goals) were written down in prepared tables. The meeting room, soccer fields, balls, and nets were available for the research at Virginia Wesleyan College.

Mental Training Interventions

The instrumentation for the independent variable was a mental training program that integrated eight (one-hour) mental training interventions spread in an eight week timeline. The first goal of these mental interventions was to teach the participants in the experimental group to enhance their awareness of their body-mind connection by executing breathing with concentration on the exhale phase which lowers the heart rate values before and after sport- related competitions. The second goal of the mental training was to help athletes improve their sport performance and develop their learning, perceptual, and motivational skills by utilizing the sport-guided imagery and visualization techniques.

Two licensed yoga teachers were hired as consultants to help conduct these mental interventions. The curriculum of the mental training sessions was systematically organized and each session was sensitively associated to the previous topic, synthesizing the aspects of the holistic modalities. The athletes in the experimental group learned how to visualize soccer related skills to improve performance and how to properly breathe with concentration on the exhale phase and self-talks in the critical moments before shooting and juggling contests to activate the heart rate deceleration trend. Specifically, for 10 minutes per day, they visualized how they were juggling the ball in the air and how they were accurately shooting (scoring the goals) to the right or left corner of the goal. In addition to the actual implementation of the mental program, daily diaries monitored the guided imagery and breathing exercises. These daily diaries were developed and handed out at the beginning of the experiment and served as proof that the participants were active during the program and did all the required homework.

Procedures

At the initial meeting with participants and coaches, the informed consent forms were signed and collected, and the participants were randomly divided into two groups.

In station one, the participant was measured twice, first in standing and immediately after that in sitting position for heart rate and blood pressure. The readings were taken in an air- conditioned room in order to gain the baseline-initial measurements of cardiovascular activity. Right after the initial measurements, the participant went on to the soccer field to station two where he or she was measured (in standing) for heart rate and blood pressure right before the juggling contest. Right after the measurements (a two-second limit allowed for removing the cuff), the participant performed the juggling contest (at most a two-minute interval). Right after the juggling contest, the participant went to station three, where he or she was measured (in standing) for heart rate and blood pressure right before the execution of the shooting contest (at most a one-minute interval). Right after the participant performed the shooting contest, he or she went back to another air-conditioned room (station four) and was measured (in sitting) for heart rate and blood pressure for the recovery-stress response. A diagrammatic chart of the pretest-posttest measurement stations is presented below (see Figure 2).

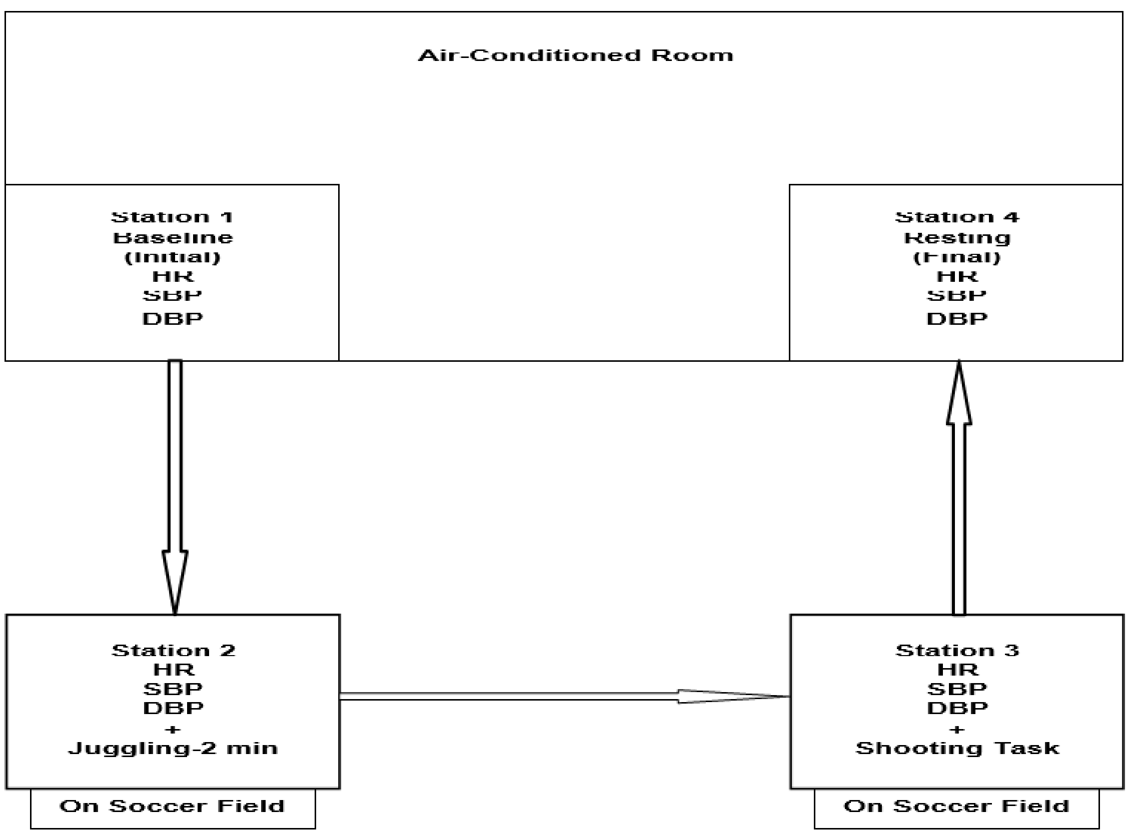

Figure 2. The Pretest-Posttest Measurements in Four Different Stations.

The soccer related tasks including the juggling test and the shooting accuracy test represented one of the measurable stressors related to sports performance in this experiment.

Soccer coaches assisted the players in two working places, in station two for the juggling contest and in station three for the shooting accuracy contest. The juggling contest (station two) required just a soccer ball and a timing device (a stop watch). A soccer coach timed a two-minute interval for the execution of juggling during which the player must kept the ball in the air using only feet (insteps), thighs, or head. The player would stop juggling if the ball was dropped on the ground within the two-minute interval, and the completed number of touches and time (in seconds) was recorded. The fear of dropping the ball on the ground represented the measurable stressor from the beginning of the starting moment of the actual juggling.

The shooting accuracy contest (station three) required a full size soccer net and targets close to each goal post into which the participants were aiming ten soccer shots within a one- minute interval from a distance point of 11 meters. In the posttest measurements the shooting distance was lengthened to 12 meters, and the targets were narrowed down closer to the posts. Each player was required to execute this drill at high speed in order to make a run to another designated spot on the field and shoot again (this was repeated ten times) in one-minute intervals. The running time, concentration, and accuracy of shooting/execution techniques represented the stressors measured from the beginning of the starting moment of the actual shooting. Immediately following the shooting contest, the participant proceeded (walking distance 30 seconds) to station four for the last cardiovascular measurements of heart rate and blood pressure. These measurements detected the stress-recovery abilities in the participant through cardiovascular activity measured after the soccer performances. A debriefing session was held at Virginia Wesleyan College where eight winners of the juggling and shooting contests received $20 Starbucks gift cards.

Results

Analyses utilized parametric inferential procedures including independent, one-sample t-tests and Cohen's d- effect size. There were no statistically significant differences in the pre- tests for all the variables among participants in the experimental group and control group (see Table 1). This indicates that both the experimental and control groups were equal in all measurements at the beginning of the experimental study.

Measurements	EX-Mean	EX-SD	CO-Mean	CO-SD	*p*	*d*
Station 1-Heart Rate	65.18	10.98	63.85	8.09	.614	-0.13
Station 1-Systolic BP	124.25	13.19	126.22	11.08	.557	0.16
Station 1-Diastolic BP	70.81	8.53	70.55	11.34	.925	-0.02
Station 2-Heart Rate	69.66	11.80	70.33	9.87	.823	0.06
Station 2-Systolic BP	130.22	11.05	130.92	11.95	.823	-0.06
Station 2-Diastolic BP	76.29	8.57	75.96	11.18	.903	-0.03
Station 2-Juggling seconds	23.29	27.77	25.14	32.21	.822	0.06
Station 2-Juggling touches	35.55	48.44	40.70	57.78	.724	0.09
Station 3-Heart Rate	74.00	15.03	77.07	12.69	.421	0.22
Station 3-Systolic BP	131.96	13.74	131.40	13.00	.871	-0.04
Station 3-Diastolic BP	73.69	8.35	72.81	9.38	.737	-0.09
Station 3-Shooting goals	6.07	2.20	6.22	2.20	.806	0.06
Station 4-Heart Rate	76.77	19.58	77.25	16.94	.923	0.02
Station 4-Systolic BP	160.44	17.81	157.70	14.71	.540	-0.16
Station 4-Diastolic BP	82.85	9.93	81.70	11.39	.695	-0.10

Note. EX-experimental group, CO-control group, SD-standard deviation, Heart Rate (bpm), Systolic and Diastolic (mmHg), BP-blood pressure. *$p < .05$, **$p < .01$, Cohen's d- effect size.

Table 1. Pretest Measurements-Cardiovascular Activity-Juggling and Shooting Contests.

Analysis and Evaluation of Findings

Station One Post-Test Baseline Measurements of the Cardiovascular Activity

In the measurements of the cardiovascular activities at station one, the baseline heart rate (bpm), systolic blood pressure (mmHg), and diastolic blood pressure (mmHg) of the participants were measured twice, while sitting and while standing. The standing baseline values (see Table 2) were compared with the cardiovascular measurements at station two (before juggling) and at station three (before shooting), which were performed in standing position. The baseline measurements of the sitting values (see Table 3) were compared with the scores in station four of the measurements of stress recovery, which was performed in the sitting position.

In the standing baseline measurements, the cardiovascular assessments revealed significant differences in diastolic blood pressure (mmHg) for women in the experimental group (M = 70.71, SD = 7.89) and the control group (M = 63.73, SD = 9.22), t(26.81) = 2.19, p = .037, d= -0.81 (see Table 2).

Measurements	EX-Mean	EX-SD	CO-Mean	CO-SD	*p*	*d*
Heart Rate	70.33	9.91	68.40	8.81	.454	-0.20
Heart Rate-men	69.38	8.45	73.16	8.75	.284	0.43
Heart Rate-women	71.21	11.34	64.60	6.99	.075	-0.70
Systolic BP	125.33	12.72	123.25	11.19	.528	-0.17
Systolic BP-men	130.46	14.92	130.58	9.31	.981	0.009
Systolic BP-women	120.57	8.20	117.40	9.03	.331	-0.36
Diastolic BP	71.44	8.48	64.81	9.37	.009**	-0.74
Diastolic BP-men	72.23	9.32	66.16	9.79	.128	-0.63
Diastolic BP-women	70.71	7.89	63.73	9.22	.037*	-0.81

Note. EX-experimental group, CO-control group, SD-standard deviation, Heart Rate (bpm), Systolic and Diastolic (mmHg), BP-blood pressure. *p < .05, **p < .01, Cohen's d- effect size.

Table 2. Station One-Baseline Measurements of Cardiovascular Activity in Standing Position.

The baseline cardiovascular assessments in station one in the sitting position displayed no significant differences between the groups nor between sexes (see Table 3).

Measurements	EX-Mean	EX-SD	CO-Mean	CO-SD	*p*	*d*
Heart Rate	60.74	9.01	60.48	8.87	.916	-0.02
Heart Rate-men	60.15	7.44	64.91	8.18	.143	0.60
Heart Rate-women	61.28	10.52	56.93	7.95	.223	-0.46
Systolic BP	125.85	10.31	123.03	9.71	.307	-0.28
Systolic BP-men	130.69	7.68	127.75	8.11	.363	-0.37
Systolic BP-women	121.35	10.63	119.26	9.44	.581	-0.20
Diastolic BP	68.96	9.58	66.96	8.23	.415	-0.22
Diastolic BP-men	66.84	10.71	68.08	7.30	.738	0.13
Diastolic BP-women	70.92	8.30	66.06	9.05	.143	-0.55

Note. EX-experimental group, CO-control group, SD-standard deviation, Heart Rate (bpm), Systolic and Diastolic (mmHg), BP-blood pressure. *p < .05, **p < .01, Cohen's d- effect size.

Table 3. Station One-Baseline Measurements of the Cardiovascular Activity in Sitting Position.

Station Two Posttest Cardiovascular Activity before Juggling Contest

The heart rate (bpm) analyses showed that there was a positive relationship between the participation of the men in the experimental group in the eight-week mental training program and the moderation of cardiovascular activity, t (19.86) = -2.38, p = .027, Cohen's d of 0.96. The systolic and diastolic blood pressure (mmHg) values before the juggling contest in the experimental group and in the control group were not significantly different (see Table 4).

Measurements	EX-Mean	EX-SD	CO-Mean	CO-SD	*p*	*d*
Heart Rate	67.51	10.24	69.77	13.04	.482	0.19
Heart Rate-men	67.15	9.68	78.41	13.46	.027*	0.96
Heart Rate-women	67.85	11.08	62.86	7.65	.175	-0.52
Systolic BP	141.55	11.96	136.14	12.28	.107	-0.44
Systolic BP-men	145.15	12.92	141.83	13.97	.545	-0.24
Systolic BP-women	138.21	10.34	131.60	8.77	.076	-0.69
Diastolic BP	81.44	10.77	82.59	14.38	.741	0.08
Diastolic BP-men	80.76	12.37	91.91	15.10	.057	0.80
Diastolic BP-women	82.07	9.49	75.13	8.41	.048*	-0.77

Note. EX-experimental group, CO-control group, SD-standard deviation, Heart Rate (bpm), Systolic and Diastolic (mmHg), BP-blood pressure. *p < .05, **p < .01, Cohen's d- effect size.

Table 4. Final-Posttest Measurements-Station Two-Cardiovascular Activity right before the Juggling Contest.

Measurements	M-BASTEX	M-JEX	EX-*d*	M-BASTCO	M-JCO	CO-*d*
Heart Rate	70.33	67.51	0.27	68.40	69.77	-0.12
Heart Rate-men	69.38	67.15	0.24	73.16	78.41	-0.46
Heart Rate-women	71.21	67.85	0.29	64.60	62.86	0.23
Systolic BP	125.33	141.55	-1.31	123.25	136.14	-1.09
Systolic BP-men	130.46	145.15	-1.05	130.58	141.83	-0.95
Systolic BP-women	120.57	138.21	-1.89	117.40	131.60	-1.59
Diastolic BP	71.44	81.44	-1.03	64.81	82.59	-1.46
Diastolic BP-men	72.23	80.76	-0.77	66.16	91.91	-2.02
Diastolic BP-women	70.71	82.07	-1.30	63.73	75.13	-1.29

Note. Heart Rate (bpm), BP-Blood Pressure, Systolic and Diastolic (mmHg), M-BASTEX-Mean Baseline Standing Experimental Group (Station 1), M-JEX- Mean Prior the Juggling Experimental Group (Station 2), EX-d- Experimental Group- d- effect size, M-BASTCO- Mean Baseline Standing Control Group (Station 1),M-J CO-Mean Prior the Juggling Control Group (Station 2), CO-d- Control Group- Cohen's d- effect size.

Table 5. Comparisons of the Means Between the Baseline Standing Measurements at Station One and Right Before the Juggling at Station Two.

Station Three-Posttest-Cardiovascular Activity before the Shooting Contest

The heart rate (bpm) in the experimental group (M = 69.69, SD = 13.36) and in the control group (M = 81.75, SD = 12.82) showed that there was a positive relationship between the participation of the men in the experimental group in the eight-week mental training program and the moderation of cardiovascular activity, t(22.95) = -2.30, p = .031. The findings indicated that the men in the experimental group showed lower heart rate (bpm) values before the shooting contest and thus, optimized their cardiovascular activity (see Table 6).

The systolic and diastolic pressure (mmHg) mean values in sex comparison found significant changes in women. The diastolic blood pressure (mmHg) mean values in the experimental group (M = 82.14, SD = 7.18) and in the control group (M = 75.80, SD = 8.14) were significantly different, t(26.92) = 2.22, p = .035 (see Table 6).

Measurements	EX-Mean	EX-SD	CO-Mean	CO-SD	*p*	*d*
Heart Rate	72.33	13.10	76.22	13.64	.291	0.29
Heart Rate-men	69.69	13.36	81.75	12.82	.031*	0.92
Heart Rate-women	74.78	12.86	71.80	13.01	.540	-0.23
Systolic BP	144.66	13.33	138.77	15.28	.138	-0.41
Systolic BP-men	146.92	14.09	140.33	18.37	.329	-0.40
Systolic BP-women	142.57	12.75	137.53	12.84	.229	-0.39
Diastolic BP	79.81	7.73	79.29	10.27	.835	-0.05
Diastolic BP-men	77.30	7.78	83.66	11.29	.120	0.65
Diastolic BP-women	82.14	7.18	75.80	8.14	.035*	-0.82

Note. EX-experimental group, CO-control group, SD-standard deviation, Heart Rate (bpm), Systolic and Diastolic (mmHg), BP-blood pressure. *p < .05, **p < .01, Cohen's d- effect size.

Table 6. Final-Posttest Measurements-Station Three-Cardiovascular Activity right before the Shooting Contest at Station Three.

Measurements	M-BASTEX	M-SHEX	EX-*d*	M-BASTCO	M-SHCO	CO-*d*
Heart Rate	70.33	72.33	-0.17	68.40	76.22	-0.68
Heart Rate-men	69.38	69.69	-0.02	73.16	81.75	-0.78
Heart Rate-women	71.21	74.78	-0.27	64.60	71.80	-0.69
Systolic BP	125.33	144.66	-1.48	123.25	138.77	-1.15
Systolic BP-men	130.46	146.92	-1.13	130.58	140.33	-0.66
Systolic BP-women	120.57	142.57	-2.05	117.40	137.53	-1.81
Diastolic BP	71.44	79.81	-1.03	64.81	79.29	-1.47
Diastolic BP-men	72.23	77.30	-0.59	66.16	83.66	-1.65
Diastolic BP-women	70.71	82.14	-1.51	63.73	75.80	-1.38

Note. Heart Rate (bpm), BP-Blood Pressure , Systolic and Diastolic (mmHg), M-BASTEX-Mean Baseline Standing Experimental Group (Station 1), M-SHEX- Mean Prior Shooting Experimental Group (Station 3), EX- d- Experimental Group- d- effect size, M-BASTCO- Mean Baseline Standing Control Group (Station 1), M- SHCO- Mean Prior Shooting Control Group (Station 3), CO-d- Control Group- Cohen's d- effect size.

Table 7. Comparisons of the Means between the Baseline Standing Measurements at Station One and Right before the Shooting at Station Three.

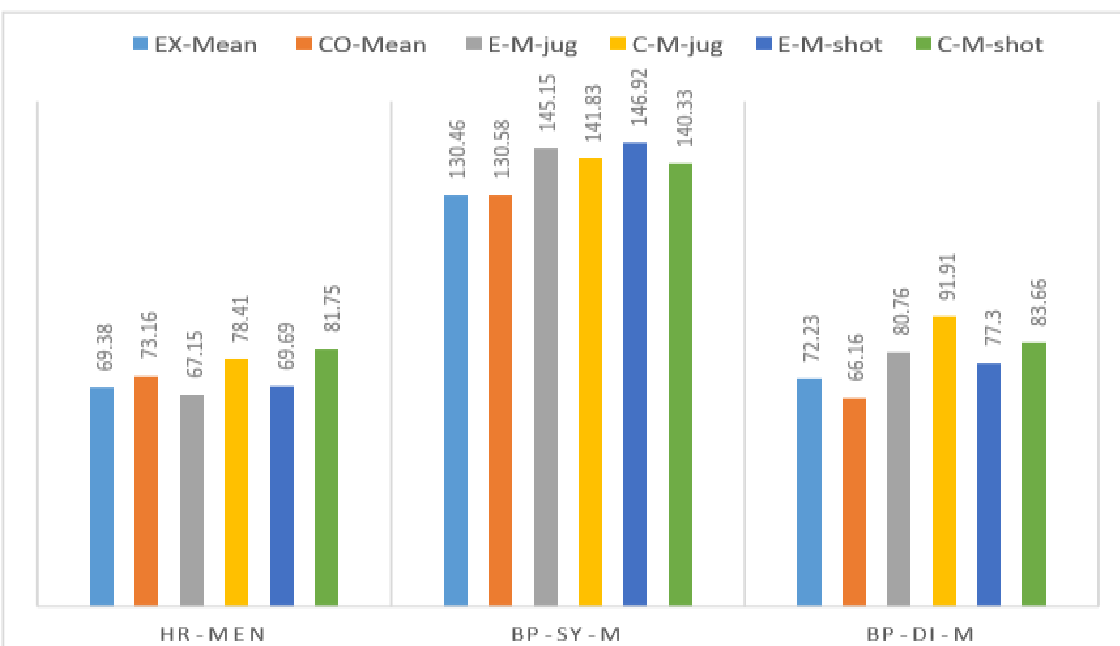

Figure 3. The oscillation of the men's HR Means and Systolic and Diastolic Blood Pressure means between the Baseline Standing Measurements at Station One and immediately before the Juggling and Shooting contests at Station Three.

Station Four-Cardiovascular Activity-Resting-Stress Recovery

The heart rate (bpm) mean values in the experimental group (M = 70.38, SD = 12.10) and the control group (M = 80.50, SD = 11.94) showed that there was a positive relationship between the participation of the men in the experimental group in the eight-week mental training program and the moderation of cardiovascular activity, t(22.88) = -2.10, p = .047.

The systolic and the diastolic blood pressure (mmHg) mean values after the contests in the experimental group and the control group were not significantly different (see Table 8).

Measurements	EX-Mean	EX-SD	CO-Mean	CO-SD	*p*	*d*
Heart Rate	72.81	13.05	75.14	12.57	.507	0.18
Heart Rate-men	70.38	12.10	80.50	11.94	.047*	0.84
Heart Rate-women	75.07	13.93	70.86	11.71	.389	-0.32
Systolic BP	145.70	12.11	140.74	12.92	.152	-0.39
Systolic BP-men	146.92	11.05	146.00	12.67	.848	-0.07
Systolic BP-women	144.57	13.34	136.53	11.88	.099	-0.63
Diastolic BP	78.11	5.30	75.66	6.76	.146	-0.40
Diastolic BP-men	77.30	6.08	76.08	5.10	.590	-0.21
Diastolic BP-women	78.85	4.57	75.33	8.01	.156	-0.53

Note. EX-experimental group, CO-control group, SD-standard deviation, Heart Rate (bpm), Systolic and Diastolic (mmHg), BP-blood pressure. *p < .05, **p < .01, Cohen's d- effect size.

Table 8. Final-Posttest Measurements-Station Four-Cardiovascular Activity-Resting-Stress Recovery at Station Four.

Measurements	M-BASIEX	M-REX	EX-*d*	M-BASICO	M-RCO	CO-*d*
Heart Rate	60.74	72.81	-1.07	60.48	75.14	-1.35
Heart Rate-men	60.15	70.38	-1.01	64.91	80.50	-1.52
Heart Rate-women	61.28	75.07	-1.11	56.93	70.86	-1.39
Systolic BP	125.85	145.70	-1.76	123.03	140.74	-1.54
Systolic BP-men	130.69	146.92	-1.70	127.75	146.00	-1.71
Systolic BP-women	121.35	144.57	-1.92	119.26	136.53	-1.60
Diastolic BP	68.96	78.11	-1.18	66.96	75.66	-1.15
Diastolic BP-men	66.84	77.30	-1.20	68.08	76.08	-1.27
Diastolic BP-women	70.92	78.85	-1.18	66.06	75.33	-1.08

Note. Heart Rate (bpm), BP-Blood Pressure, Systolic and Diastolic (mmHg), M-BASIEX-Mean Baseline Sitting Experimental Group (Station 1), M-REX- Mean Recovery Experimental Group (Station 4), EX-d- Experimental Group- d- effect size, M-RESICO- Mean Recovery Sitting Control Group (Station 1), M-RCO- Mean Recovery Control Group (Station 4), CO-d- Control Group- Cohen's d- effect size.

Table 9. Comparisons of the Means between the Baseline Sitting Measurements at Station One and the Recovery-Sitting Phase at Station Four.

Juggling Contest and Shooting Contest

The juggling and shooting contests revealed no significant differences between the experimental and the control group or between the sexes. However, in comparison with pretest-posttest measurements the experimental group increased the juggling time (seconds) by about 45% and improved the juggling touches by about 59%. In the shooting contest by elimination of the outliers (fewer than 1 and 2 goals), the contest revealed significant improvement with women in the experimental group.

Measurements	EX-Mean	EX-SD	CO-Mean	CO-SD	*p*	*d*
Juggling (seconds)	33.81	36.80	24.88	25.88	.308	0.28
Juggling-(sec.)-men	37.30	39.72	25.91	15.65	.353	0.37
Juggling-(sec.)-women	30.57	35.05	24.06	32.40	.609	0.19
Juggling touches	56.59	64.72	40.07	44.36	.280	0.29
Juggling (touch)-men	65.38	69.61	42.58	29.81	.296	0.42
Juggling (touch)women	48.42	61.29	38.06	54.28	.635	0.17
Shooting-goals	4.96	1.89	4.81	1.75	.767	0.08
Shooting-goals-men	4.46	1.80	5.66	1.70	.101	-0.68
Shooting-goals-women	5.42	1.91	4.13	1.50	.054	0.75
Shooting-women-(out.)	6.00	1.34	4.46	1.33	.009**	1.15

Note. EX-experimental group, CO-control group, SD-standard deviation, Heart Rate (bpm), Systolic and Diastolic (mmHg), BP-blood pressure. *p < .05, **p < .01, Cohen's d- effect size.

Table 10. Final-Posttest Measurements-The Juggling and Shooting Contests.

Measurements	M-PREX	M-POEX	EX-*d*	M-PRCO	M-POCO	CO-*d*
Juggling (seconds)	23.29	33.81	0.32	25.14	24.88	-0.008
Juggling (touches)	35.55	56.59	0.36	40.70	40.07	-0.012
Shot goals	6.07	4.96	-0.50	6.22	4.81	-0.70

Juggling (seconds)-time in seconds during juggling, Juggling (touches)- touches made by juggling, Shot goals- scored goals, M-PREX- Mean Pretest Experimental Group, M-POEX- Mean Posttest Experimental group, EX-d- Experimental Group- d- effect size M-PRCO- Mean Pretest Control Group, M-POCO- Mean Posttest Control group, CO-d- Control Group- d-effect size.

Table 11. Comparisons of the Means between Pretest and Posttest Soccer Contests (Juggling and Shooting).

Discussion

This study indicates that the mental modalities in the eight-week training program can be applied for college soccer training curricula in order to effectively engage the athletes' body-mind interaction into better autonomic equilibrium and training preparation.

The participants in the experimental group learned to execute a special breathing pattern before the juggling and shooting contest in the pre-action phase at stations two and three as well as before the final resting cardiovascular measurements at station four. The breathing pattern had two phases: to inhale through the nose for 3 seconds and then to exhale through the mouth for 6 seconds while inwardly repeating positive self-talks for better self-confidence. The ratio of breathing between the inhale-exhale was 1:2. The extended exhale phase for 6 seconds activated the Heart Rate Deceleration (HRD) trends which balanced the cardiovascular activity and stabilized the sensomotoric equilibrium for better performance.

These heart rate deceleration (HRD) trends in pre-action phases were investigated in a variety of sports validated measurements including tennis, baseball and golf (Carlstedt, 2004).

Station Two- HR before juggling contest

In the juggling contest the findings showed HRD trends in the pre action phases. In the sex comparison there were significant differences in men showing a positive relationship between the participation of the men in the experimental group in the eight-week mental training program and the moderation of cardiovascular activity, $t(19.86) = -2.38$, $p = .027$.

The dependent measures in the heart rate (bpm) in the men's control group showed elevated heart rate (bpm) values suggesting a higher stress level and unbalanced anxiety arousal, which was also confirmed in poorer juggling contest results. The experimental group showed lower heart rate (bpm) values before the juggling contest and thus, optimized their cardiovascular activity. In comparison with the baseline standing measurements in station one, the changes confirmed a decrease in the heart rate (bpm) mean values in the experimental group (67.51 final < 70.33 baseline, Cohen's d of 0.27) over the control group, which showed a slight increase in the heart rate (69.77 final > 68.40 baseline, Cohen's d of -0.12) before the juggling contest. In sex comparisons the differences showed a slight decrease in the men's heart rate (bpm) in the experimental group (67.15 final < 69.38 baseline, Cohen's d of 0.24) over the control group, which displayed a major increase in the heart rate (78.41 final > 73.16 baseline, d of -0.46) before the juggling contest. In the women's heart rate (bpm) values, the measurements showed a greater decrease in the heart rate values in the experimental group (67.85 final < 71.21 baseline, Cohen's d of 0.29) than in the control group (62.86 final < 64.60 baseline, Cohen's d of 0.23) before the juggling contest (see Table 5).

Station Three- HR before shooting contest

In the shooting contest the findings also indicated the HRD trends in the pre-action phase. In the sex comparison there were significant differences in men displaying that there was a positive relationship between the participation of the men in the experimental group in the eight-week mental training program and the moderation of the cardiovascular activity, $t(22.95) = -2.30$, $p = .031$. The findings indicated that the men in the experimental group showed lower heart rate (bpm) values before the shooting contest and thus, optimized their cardiovascular activity. In comparison to the baseline standing measurements in station one, the changes confirmed a lower increase in the heart rate (bpm) mean values in the experimental group (72.23 final > 70.33 baseline, Cohen's d of -0.17) before the shooting contest over the control group (76.22 final > 68.40 baseline, Cohen's d of -0.68). In sex comparisons to the baseline standing measurements in station one, the differences showed less of an increase in the men's heart rate (bpm) in the experimental group (69.69 final > 69.38 baseline, Cohen's d of -0.02) over the control group, which displayed a major increase of the heart rate (81.75 final > 73.16 baseline, Cohen's d of -0.78) before the shooting contest. In the women's heart rate (bpm) values, the measurements showed less of an increase in the heart rate values in the experimental group (74.78 final > 71.21 baseline, Cohen's d of -0.27) over the control group, which showed a greater increase in the heart rate (bpm) values (71.80 final > 64.60 baseline, Cohen's d of -0.69) before the shooting contest (see Table 7).

Station Four- HR in the recovery resting phase

In the recovery phase in station four, the HRD trends were detected during the relaxation stage. The sex comparison yielded significant changes in men indicating that there was a positive relationship between the participation of the men in the experimental group in the eight-week mental training program and the moderation of cardiovascular activity, $t(22.88) = -2.10$, $p = .047$. The baseline measurements in the heart rate (bpm) mean values were compared to the heart rate (bpm) mean values while sitting in station one. In comparison to the baseline sitting measurements, the changes confirmed less of an increase in the heart rate (bpm) mean values in the experimental group (72.81final > 60.74 baseline, Cohen's d of - 1.07) over the control group (75.14 final > 60.48 baseline, -1.35). In sex comparisons with the baseline sitting measurements, the differences showed less of an increase in the men's heart rate (bpm) in the experimental group (70.38 final > 60.15 baseline, Cohen's d of -1.01) over the control group, which displayed a greater increase in the heart rate (80.50 final > 64.91 baseline, Cohen's d of -1.52). In comparison to the baseline sitting measurements in station one in the women's heart rate (bpm) values, the measurements showed less of an increase in the heart rate values in the experimental group (75.07 final > 61.28 baseline, Cohen's d of - 1.11) than in the control group (70.86 final > 56.93 baseline, Cohen's d of -1.39) in stress- resting recovery (see Table 9).

This study also demonstrated that the diaphragmatic breathing with concentration on the exhale phase performed by participants in the experimental group before the juggling and shooting contests as well as in the recovery phases effectively activated the functions of the parasympathetic nervous system which consequently lowered the heart rate (bpm) values (Costanzo, 2006; Forcier et al., 2006; Prakash et al., 2005).

Blood Pressure

The findings revealed that in comparisons to the baseline measurements in station one, the participants in the experimental group experienced (in most cases) a higher increase in the systolic blood pressure (mmHg), but less of an increase in the diastolic blood pressure before the juggling and shooting contests. The lowered HR mean values for the experimental group (67.51 < 70.33 baseline, Cohen's d of 0.27) caused a higher increase in systolic blood pressure (mmHg) mean values in the experimental group (141.55 final > 125.33 baseline, Cohen's d of -1.31) over the control group (136.14 final > 123.25 baseline, Cohen's d of - 1.09) before the juggling contest. Yet, the same lowered HR mean values before juggling in the experimental group caused less of an increase in the diastolic blood pressure (81.44 final > 71.44 baseline, Cohen's d of -1.03) than in the control group (82.59 final > 64.81 baseline, Cohen's d of -1.46). In the same way, the significantly lowered HR mean values in the mean experimental group (p = .027) before the juggling contest reached a higher increase in systolic blood pressure (mmHg) mean values (145.15 final > 130.46 baseline, Cohen's d of -1.05) than the control group (141.83 final > 130.58 baseline, Cohen's d of -0.95). This again caused a less of an increase in the diastolic blood pressure mean values in the experimental group (80.76 final > 72.23 baseline, Cohen's d of -0.77) than in the control group (91.91 final > 66.16 baseline, Cohen's d of -1.29) (see Table 5 and Figure 3).

The same pattern repeated before the shooting contest. The significantly lowered HR mean values in the mean experimental group (p = .031) before the shooting contest showed a higher increase in the men's systolic blood pressure (mmHg) in the experimental group (146.92 final > 130.46 baseline, Cohen's d of -1.13) over the control group, which displayed a lower increase in systolic blood pressure (mmHg) (140.33 final > 130.58 baseline, Cohen's d of -0.66) before the shooting contest. The elevation of the systolic blood pressure (mmHg) again caused a less of an increase in the diastolic blood pressure mean values in the experimental group (77.30 final > 72.23 baseline, Cohen's d of -0.59) than in the control group (83.66 final > 66.16 baseline, Cohen's d of -1.65) (see Table 7 and Figure 3).

Based on these conclusions, this study was consistent with the findings of the current psycho-physiological research regarding the so-called baroreceptor reflex mechanism which explains that when the parasympathetic activation lowers the heart rate (bpm) values, it naturally activates oscillating and balancing effects among the cardiac output, stroke volume, and arterial pressures leading to the systolic and diastolic blood pressure fluctuation (Carroll, Harris, & Cross, 1991; Costanzo, 2006; Forcier et al., 2006; Lehrer et al., 2003; Prakash et al., 2005). As a consequence, these findings endorsed the applications of the breathing techniques, especially the concentration on the exhale phase through the mouth that lowered the heart rate (bpm) values during the pre-action phases of the soccer skill executions in this research study.

Juggling Contest

In station three, the assessment of the juggling contest was measured by the time (seconds) in which the soccer ball was kept in the air by the player who was juggling and by the number of touches made within a two-minute interval. In comparison with the pretest measurements, the data confirmed an increase in time (seconds) mean values in the experimental group (23.29 pretest < 33.81 posttest, Cohen's d of 0.32) over the control group, which showed a slight decrease of time (seconds) mean values (25.14 pretest > 24.88 posttest, Cohen's d of -0.008). The posttest experimental group total time was 912 seconds in contrast to the pretest experimental group time of 629 seconds. This suggests that the total juggling time (seconds) in the experimental group which, was increased by about 45%, shows a positive relationship between the athletes' participation in the eight-week mental training program and improvement in juggling skills. The performance in the juggling time of the control group did not increase as recorded in the posttest value of 672 seconds and was less than the pretest value of 678 seconds (see Table 1 and Table 11).

In comparing the pretest-posttest measurements in the juggling contest by the number of touches, the data confirmed an increase of mean values in the experimental group (35.55 pretest < 56.59 posttest, Cohen's d of 0.36) over the control group, which showed a slight decrease in mean values (40.70 pretest > 40.07 posttest, Cohen's d of -0.012). In the posttest, the total number of touches in the experimental group was 1528 in contrast to the pretest number of 960 touches. This suggests that the experimental group increased the number of touches by about 59%, showing a positive relationship between the athletes' participation in the eight-week mental training program and improvement in juggling skills. On the contrary, the performance in juggling (touches) in the control group did not improve (Posttest 1082 touches < Pretest 1099 touches) (see Table 1 and Table 11).

Shooting Contest

In station four, the posttest measurements of the shooting distance was lengthened to 12 meters, and the targets were narrowed down closer to the posts to increase the difficulty of scoring. In the comparison to the pretest-posttest measurements in the shooting contest, the data confirmed an increase in the mean values of touches in the experimental group (35.55 pretest < 56.59 posttest, Cohen's d of 0.36) over the control group, which showed a slight decrease in the mean values (40.70 pretest > 40.07 posttest, Cohen's d of -0.012). This comparison discovered a hidden effect and a slight improvement because the experimental group scored four fewer goals than the control group in the pretest measurements. In the posttest measurements the experimental group scored four more goals than the control group (see Table 1 and Table 11).

The evaluation revealed significant differences in women. The posttest shooting mean values in the experimental group (M = 5.42, SD = 1.91) and the control group (M = 4.13, SD= 1.50) showed that there was no positive relationship between the athletes' participation in the eight-week mental training program and improvement in shooting skills, t(24.72) = 2.01, p= .054. In additional analyses by eliminating outliers (fewer than 1 and 2 goals), the mean values in the experimental group (M = 6.00, SD = 1.34) and the control group (M = 4.46, SD= 1.33) showed that there was a positive relationship between the women's participation in the eight-week mental training program and improvement in shooting skills, t(22.78) = 2.87, p = .009. These results revealed significant improvement in shooting in the women in the experimental group (see Table 10).

The findings regarding the soccer related contests mentioned above are consistent with previous research studies that examined the effectiveness of imagery techniques, cardiovascular responses and mental toughness in soccer players (Jordet, 2005; Tessitore et al., 2005; Thelwell, Weston, & Greenlees, 2005). The results in study are similar to studies conducted by Kruer (2002) and Sosovec (2004) in which the effects of guided imagery on gender, scored goals, and technical soccer skills were tested in soccer athletes. This experimental research promotes the effective implications of the guided and exercise imagery and visualization techniques into the practical soccer training in college or professional environment. Finally, these mental techniques should be followed by additional physical training for even more effective executions.

Recommendations

Future research should concentrate on investigation of stress and competitive anxiety which impact the performance of the athletes in various sport environments. Measurement of cardiovascular activity through the heart rate variability biofeedback (HRV) has been one of the well-sought psycho-physiological detectors of competitive anxiety in sport. However, only few studies explained how diaphragmatic breathing and mental interventions optimized the heart rate and blood pressure during and after the sport performance in order to effectively activate the functions of the baroreceptor reflex mechanism and autonomic balance (Carroll, Harris, & Cross, 1991; Costanzo, 2006; Forcier et al., 2006; Lehrer et al., 2003; Prakash et al., 2005).

The athletes in the experimental group learned how to lower their HR values before the soccer skill executions and performed better overall than the athletes in the control group. The major question of how much lowered HR values or HRD trends are needed or are ideal to increase the concentration and improve the performance remains. The research showed that this was a very individual matter for each player due to various psycho-physiological predispositions, including but not limited to gender, weight, height, stress resistance, motivational factors and belief system. Finally, more studies should be conducted regarding applications of breathing and guided imagery. Coaches and sport psychologists would like to know if, for example, the guided imagery should be performed in the sitting or lying position, in the morning or evening, before games or before or immediately after training sessions.

Clinical Practice Recommendations

The first recommendation is that athletes in any sports should be executing breathing with the extended exhale phase through the mouth (for approximately 4 to 6 seconds) before the sport performance or in pre-action phase in a particular drill-execution in order to moderate cardiovascular activity (lowering the heart rate values) and thus, adjust competitive anxiety to the optimal performance level. The prolonged exhale phase should be accompanied by inner self-talk to increase self-confidence and embed the positive affirmations to the players conscious and subconscious level. In the same way, it is recommended that athletes should be executing deep and slow diaphragmatic breathing pattern after their sport performances in order to moderate the cardiovascular activity, and thus, release various post- stress performance symptoms for optimal psycho-physiological regeneration.

The second recommendation for future research concerns mental training and its applications to the actual physical soccer preparations. It is recommended that the visualization practice of juggling and shooting techniques would be subsequently (within a few minutes) followed by physical training with real soccer balls. That would help the players effectively generate and successfully absorb the connection of the subliminal, mental, and physical aspects of the body-mind functions, which should lead to smoother and quicker improvement in desired soccer skills.

Future Research Recommendations

Hiring of sports psychologist is recommended because it is important to demonstrate all mental training exercises with impeccable accuracy, precision, flexibility, and self- confidence. Mental applications showed effectiveness in athletic practices when the theoretical explanations regarding the relaxation techniques, with a variety of breathing exercises and guided imagery procedures, were followed by practical demonstrations and practice.

It is advisable to create a mental training program longer than eight weeks. Based on the experience in this study, a 12-16 week time line (meeting twice a week) would be an ideal period in order to generate more occasions for effective learning as well as absorption of the mental practices into the daily routine and regimes of college students.

The major recommendation for the future research concerns the measurements of the cardiovascular activity called the heart rate variability (HRV). It would be ideal if each player could wear wireless heart rate monitoring equipment (Polar H10) equipped with R-R interval analyses to measure heart rate acceleration (HRA) or heart rate deceleration (HRD) trends as the player goes throughout the stations. This cardiovascular assessment with HRV analyses would require a special computer-monitoring program and separate videotaping cameras which would accurately detect the exact heart rate value (bpm) in the pre-action phases just 10 seconds prior to juggling and shooting executions to accurately analyze the HRA or HRD trends and later correlate them with the achieved goals and touches. The application of the above-mentioned mechanism by the Polar H10 and Kubios system would be monitoring just the heart rate values. The measurements of blood pressure with the assembly of cuffs, which required professional physician assistants, would be executed only at the beginning and at the end of the designed contest. Finally, the apparatus of the Polar H10 and Kubios system would integrate more efficient autonomic assessment of the athletes including the R-R intervals, SDNN index, as well as the sympathetic and parasympathetic moderation in comparisons of the baseline measurements at the beginning of the contest and recovery phases after the contest (Carlstedt, 2001, 2004, 2007).

Conclusion

This study presented a design for a mental preparation of the college soccer players with the actual psycho-physiological interventions to monitor and analyze the pre-action phases which are considered as critical moments in sport performance. This research deals with relatively low heart rate (bpm) values concentrating mostly on the psycho-physiological changes in athletes immediately before the executions of the soccer drills with no preceding high physical activity. The monitoring of the HRD trends by Polar H10 and Kubios system would give new perspective to the evaluation of the complete psycho-physiological processes occurring in soccer players within lower as well as higher heart rate zones during the entire soccer testing games. The abovementioned recommendations may be followed up by additional neurofeedback (EEG Biofeedback) evaluations to assess the athletes' subliminal brain responses, hemispheric activations, and neurocognitive functions before the performance in the laboratory test-battery (Carlstedt, 2004, 2007). Based on the findings of this study, it is highly recommended to continue to conduct rigorous research studies regarding the functions of the baroreceptor reflex mechanism during the breathing in connection with the changes occurring in heart rate variability (HRV), especially within the activation of the sympathetic and parasympathetic nervous system during sport competitions. Finally, this study confirmed that future research in a variety of sport competitions should apply valid and reliable measurements of cardiovascular activity as the ideal psycho- physiological assessment for college or professional athletes.

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