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Effectiveness of the Abbreviated Progressive Muscle Relaxation Intervention on Problems of Motor Coordination in Soccer Players

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Abstract

The present study was undertaken with an objective to study the effect of psychotherapeutic training on improvement of coordination in performance of soccer skills. Eighty one young male soccer players of the city of Kota Bharu in Kelantan province of Malaysia, in the age range of 18.6 to 20.9 years, volunteered as participants. They were assessed with transient anxiety; simple and complexreaction ability; motor coordination; psychobiological measures of tonic and phasic skin conductance activity; assessment of muscle potentiality and soccer agility and soccer juggling skill as measure of pre-intervention analyses. Thereafter, they were randomly and equally categorized into three groups; viz. Group A (N = 27), i.e. control group who didn't receive any intervention; Group B(N = 27) referred to as the Experimental Group I, who received Abbreviated Progressive Muscle Relaxation or APMR andGroup C (N = 27), hereafter the Experimental Group II, who received active relaxation training. Both of the interventions were introduced to the respective group following standardize protocol (20 minutes/day; 2 days/week for12 weeks). Mid-term analyses (on all of the parameters of pre-intervention analyses were repeated) were done six weeks after the introduction of intervention sessions. Thereafter interventions continued following the similar protocol for six more weeks. Post-intervention analyses following similar analyses protocols were done on all of the participants, and the findings revealed that both APMR and active relaxation training had beneficial impacts on enhancement in autonomic adaptation, whereas compared to active relaxation training, APMR had relatively better beneficial impacts on the level of coordination performancesof the soccer players. Furthermore, due to enhanced coordination performances, significant improvement in soccer juggling performance and in soccer agility was observed in the players who received APMR training.

Keywords: Soccer, muscle relaxation, coordination.

Introduction

Successful performance in soccer depends upon integration of significant sub-systems involved in coordinated and desired functioning of limbs and physique of the players. Kinematic analysis of kicking actions of soccer ball emphasizes the complexly related hip and lower limb movement patterns engaged in striking the ball[1]. Any disruption within this synergy would impair improvements in power and movement ability in the lower limb and ball velocity as well[2]. AsAlmåsbakk and Hoff[3] confirmed, improvement in rates of force development and improvement in coordination are precursor for improvement in the development of kicking velocity. Hence the motor control factors may determine the muscular strength in highly-skilled or professional soccer players and obscure potential relationships. We intended to identify this perplexing relationship between different limb movements with particular reference to coordinated movements during performance of basic soccer skills.

Coordination amongst limbs conceptually refers to the process of organizing and maintaining synergistic relationships between different sub-systems in the player to work together for achievement of a well timed, smooth, and efficient movement with respect to the intended goal. Hence in competitive situations motor coordination obviously would be one of the most significant aspects of performance of any sports skills, especially in soccer performance. As far as performance in soccer is concerned, it is often mistaken while putting maximum significance to lower limb movements only, while only for maintenance of balance and agility a soccer player needs to have immense coordination between the upper and lower body segments, while significance of bilateral and cross-lateral movements are absolutely essential components of agile reactions in soccer movements[4]. Fitness requirements and resulting coordination may vary with positional roles and muscle strength values, since goalkeepers and defenders were observed as having better knee extension torque compared to the midfield players and forwards[5]. But more recent researches following rigorous methodology, however clarified that the difference could be attributed to differences in body size, since the positional effects are removed when data are compared with reference to body surface area and body mass[6].

It is often reported that, if the players experiencing heightened feelings of apprehensions concerning performance outcomes

pass through immense somatic anxiety, optimal motor coordination even if accompanied by other physical and physiological advantages cannot ensure performance excellence[7].As it is proposed by Eubank and Gillmore[7], if the experience of anxiety is somatic, a somatic treatment would be required to ensure neuromuscular relaxation. This technique also has a breathing component, and involves tensing and relaxing specific muscle groups to develop the player's awareness of the difference between tension and relaxation in the muscles.

Muscle Relaxation training has a breathing component, and involves a process of tensing and voluntarily relaxing the major muscle groups of the body to develop the player's awareness of the difference between tension and relaxation in the muscles and furthermore, it is tailored to reduce neuromuscular and autonomic hypertension[8]. There are quite a few well-acknowledged advantages, such as - it can produce sustainable effect; side-effect free; cost-effective, and it can relieve mental crises as it happens with combined intervention of cognitive psychotherapy and psychotropic drugs. Alike muscle relaxation, active relaxation (is also known as autogenic training)technique is also tailored for inducing sense of relaxation, but contrary to muscle relaxation involves engagement in imagining that the limbs are warm and heavy; heart rate decelerates; and the forehead seems well-enough relaxed and cool etc. Though both muscle relaxation training and active relaxation techniques are immensely[10] popular in the field of psychiatry and in sedentary life-style), effectiveness of these techniques in the field of competitive sports seem controversial, since Saha et al.,[8] reported about beneficial impacts onto female netball players, while Barnett et al.,[11] failed to confirm any beneficial impact in reaction ability in the athletes.

With this background, the present study purports: i. To see the effect of Abbreviated Progressive Muscle Relaxation training on improvement in motor coordination in the young-adult soccer players. ii. To compare the effects of APMR and active relaxation intervention on improvement of autonomic adaptation in the soccer players. iii. To see whether the effect of APMR as could be revealed through psycho physiological measures would be corollary to that to be noted in the subjective experience of motor coordination and anxiety in the young participants.

Material and Methods

Participants: The sample size was calculated using G power 3.0.10 Test[12]. The power of the study was set at 95% with 95% confidence interval and the effect size was set at 0.5. In this study 81 consistently high performing young-adult male competitive soccer players age ranged between 18.6 to 20.9 years and residing in Kota Bharu region in Malaysia were recruited. They were mostly state selection–level soccer players and they were selected by three expert soccer coaches, while they were preparing for their forthcoming soccer season in 2014.

Inclusion Criteria: i. Participants having considerable extent of feeling of apprehension for a considerable period of time – for at least 3 to 4 months. ii. Participants who have had faced problems in motor and movement coordination. iii. Participants having inter-mediate level of soccer skills. iv. No previous exposure to any kind of Muscle Relaxation training program. iv. Participants who will be able to adapt to the training of intervention technique within the stipulated time.

Exclusion Criteria: i. Participants who did not attend at least 90% of the sessions out of a total of 24 sessions i.e. at least 21 sessions of the training programs. ii. Participants who could not learn the basic skills of intervention technique within the stipulated time, i.e. within 4 sessions. iii. Participants who experienced any major or significant change during the study.

Materials Used: i. State -Trait Anxiety Inventory (Spielberg, 1970)[13], ii. Electronic Reaction Timer (Udyog, India 2000), iii. Photo-Electric Rotary Pursuit Apparatus (Lafayette Instrument 2014), iv. Skin Conductance Biofeedback Apparatus (Udyog, India 2000), v. Electromyography Apparatus (ME6000, USA, 2008), and vi. Ball, Marker, 14 Cons, PVC Box, Stop Watch and Measuring Tape for Soccer Skill Performance Test.

Procedure: For pre-intervention or base line information all of the 81 participants were subjected to assessment of all of the afore-mentioned parameters. Thereafter they were randomly and equally categorized into 3 groups, where each group consisted of 27 participants. Gr. A consisted of participants of control group, who didn't receive any intervention. Gr. B participants received Abbreviated Progressive Muscle Relaxation or APMR and participants of Gr, C received active relaxation training. Group wise respective interventions (APMR and Active Relaxation) were imparted for 12 weeks, i.e. for 24 sessions (20 min.s /day; 2 days/ week for 12 weeks). Both the interventions continued for 6 weeks, and after six weeks, mid-term intervention assessment on all of the psychological, psychomotor and psycho physiological variables (pre-intervention assessment parameters) were carried out on all of the players following the standard methodology. Thereafter intervention training continued for sixmore weeks more following the same schedule (2 sessions per week). Thereafter at the completion of 24 intervention sessions post-intervention analyses were done on all of the participants. Data were treated with SPSS 20. Descriptive statistics and two-way repeated measure of ANOVA were done for analysis of data. Now let us pay attention to the obtained results.

Results and Discussion

Tables 1 and 2 represented the outcomes of the measures of simple and complex reaction ability respectively. Pre and mid intervention analysis revealed no differences in both simple as well as complex reaction ability outcomes, while the post intervention differences amongst the groups were evident, which revealed impacts of the interventions. Tables 3 and 4

represented the findings of upper body movement coordination and bilateral coordination respectively. Findings revealed no differences in pre-intervention phase amongst the participants of the three groups, while impact of APMR was observed both in mid and post intervention phases with respect to both upper body movement and bilateral coordination parameters. Outcomes of tables 5 and 6 showed the effects of interventions on soccer agility skills and soccer juggling performance skills respectively. Findings revealed no differences in pre-intervention phase, whereas effects of interventions in agility skill and juggling performances were observed in both mid and post intervention phases.

Table 7 depicted that in case of orienting latency no difference in pre-intervention as well as in mid intervention was evident, while post-intervention data confirmed impact of interventions. In case of orienting amplitude and recovery time, significant difference in the obtained data wasevident in the pre-intervention phase, which however continued in the mid and post intervention phases. Though pre-intervention differences were existing, butpositive impacts of both APMR and Active Relaxation on different phasic measures of autonomic skin conductance activities were obtained. Tables 8 and 9 showed the effects of interventions on fatigability, which revealed through analysis of EMG fatigue ZCR and maximal voluntary contraction (MVC) of EMG observed in the participants amongst the three groups. Here it has been observed that, findings of mid intervention and post intervention phases revealed impacts of the interventionson improvement in muscular fatigability. Outcomes of MVC of EMG however, showed no differences in both pre and mid intervention phases but the significant impact of interventions were evident in post intervention phase.

Tables 10 and 11 were conceived to explain the outcomes of repeated measure of ANOVA, and in the table 10 it is evident thatexcepting the main effect of agility with the ball,all other main effects of differences between the phasesdid not violate Mauchly's assumption of sphericity, and hence no correctionsto those main effects were done. Greenhouse-Geisser correction was applied to the main effect of agility with the ball, which along with other main effects depicted that phase differences were significant (table 11). Outcomes of table 11 thus could be reported as for the soccer performers, significant main effects of agility performance in the post-intervention phase was evident, $F(1.39,13.87) = 245.98$, $p < .000$, which implied that, if effects of other variables are ignored, autonomic conditions of the agility response in the post-intervention phase were different from each other (table 18). Similarly the outputs for juggling skills and movement coordination also revealed significant main effects {$F (2, 20.00) = 3.96$, $p < .036$, and $F (2, 20) = 297.89$, $p < .000$} also implied that, if effects of other variables are ignored, autonomic conditions of the agility response in the post-intervention phase were different from each other (table 18).

Tabular representations from Tables 1 to 9 revealed differences existent between groups across the measurements obtained in different phases of intervention. Findings of the pre-intervention analyses done revealed that excepting with regard to some of the psychobiological autonomic indices (which are susceptible to have huge inter as well as intra-group inconsistencies[8,14,15,16], all other parameters assessed were free from pre-existing differences, and hence alterations observed during the mid and post-intervention analyses rationally could be attributed to the differential therapeutic interventions introduced to the participants of the experimental groups.

Based on the outcomes it could be confirmed that both of the interventions were effective enough to induce beneficial changes onto the psychomotor measure of upper-body movement coordination and bilateral movement coordination (tables 3 and 4) and in simple as well as in complex reaction and motor learning and skills test (tables 1 and 2); electromyography analysis outcome (tables – 8 and 9) and onto the performance parameters assessed (tables 5 and 6). Outcomes of tables 7 although revealed that pre-existing differences were existent, improvements on all of the autonomic (habituation paradigm phasic Sc) indices were clearly apparent. Further to add, the pre-existing differences would not necessarily mean that sample assessed was characteristically heterogeneous in nature, as in two-way repeated measure of ANOVA within and between interactions; participants are treated as their own control. Thus, findings in the post-intervention phase however revealed that, both APMR training and Sc biofeedback training helped the participants in regulation of their psychomotor, especially coordination related aspects both at the mid-term and post-intervention levels, and for the participants of the control condition, since they did not receive any intervention, in most of the aspects deterioration in the outcomes was evident.

With reference to the outcomes of psychobiological parameters, where pre-existing differences were evident in amplitude and in recovery time parameters, but similar beneficial changes were also evident in the reports obtained on the measures of phasic skin conductance outcomes (table 7), in which the post-intervention outcomes particularly revealed that psychobiological make – ups of the participants of both of the experimental groups were evidentially better compared to players who didn't receive any intervention. Findings here actually clarified that, players who received training of APMR and active relaxation interventions could enjoy the benefits of self-regulation training, and improvements in autonomic adaptation in desired directions were observed.

Now let us pay little detailed attention to the outcomes of the Tables 8 and 9, which however confirmed that both of the interventions were beneficial to yield improvement in the ability of the players to reduce their muscular fatigability and to maintain maximum peak contraction, which is the index of EMG MVC. The present finding of beneficial impact of both relaxation interventions got support from that of our previous

finding obtained on similar type of sample (Saha et al. 2013a[16]). Here one question may be raised with regard to attributing the observed improvements in differential EMG parameters to the intervention techniques employed. APMR as well as active relaxation interventions if incorporated following individual-specific standardized procedures is supposed to promote reduction in somatic anxiety, actually both could be helpful in reduction of muscle tension and in enhancement of neuromuscular regulations, which however might be helpful to the players in producing and sustaining MVC and in reducing muscular fatigability in the rectus femoris muscle by way of improvement in muscle potentiality[17]. Thus the interventions were observed to modify muscle potentiality; neuromuscular adaptation; psychomotor measures and in autonomic regulations too, together which might have resulted in coordination required for soccer juggling skill and with the ball agility performance (evident in the alteration in the main effects – table-11). In the next section we would like to scrutinize the relative contribution of different psychomotor and psychobiological factors in modulating soccer performance skills.

Now we should pay attention to the differential impacts of the interventions onto the coordination ability observed in the players. Logically APMR training is supposed to induce enhanced feeling of somatic resilience and calmness hence could have its beneficial impacts on neuromuscular adaptation which could lead to faster and regulated coordinative performance[18,19]. Active relaxation intervention on the other hand would mostly depend on body awareness and the individualistic skill and training onto development of imageries (which are cognitively mediated sensory-audio-visual illustrations) concerning enhanced muscular and somatic regulation. The tabular representations (tables 3 and 4) however clarified that in case of evaluation of bilateral coordination in the pre-intervention phase, players of all of the groups could display more or less moderate extent of coordinative skills, which however got altered during the mid-term intervention, since improvement in coordination was observed only in the players who received APMR intervention, but the players of both the control group as well of the experimental group II, who received training of active relaxation (autogenic rehearsal training) could display lower extent of movement coordination, which however didn't change in the post-intervention phase. Contrary to that, improvements in upper-body movement coordination as well as in the bilateral movement coordination were observed in the players who received APMR training. This might have happened owing to enhanced feeling of somatic resilience[18,19] and due to observed reduction in fatigability, as could be revealed through EMG fatigue ZCR analyses[17].

Now finally we need to get ascertained with regard to the complex relationship between agility; juggling skill and coordination ability of the players and how far changes in neuromuscular and motor conditioning can influence in the motor ability and coordination in the participants. The outcomes of repeated measure of ANOVA outcomes confirmed that agility; juggling skill as well as the coordination ability amongst the participants across different phases were different from each other (tables 10 and 11), and more so, all the main effects such as agility; juggling skill and coordination were evident as different from each other across different phases (table 11). The tabular representation revealed the improvements in juggling skill; agility performance in the players who received active relaxation training, but those changes were not as good as those appeared in case of their counterparts who received APMR training. Outcomes of measures of coordination however revealed that the soccer players, who received active relaxation training however could neither display improvement in upper body movement coordination nor in bilateral movement coordination, which might have led them to have shortcomings in soccer juggling skills task and also in the with the ball agility related soccer performance. Contrary to that, the APMR trainees had improvements in both of the afore-mentioned types of movement coordination skills, which might have contributed in observed heightened level of soccer skills, compared to their counterparts.

Table-1
Means of Simple reaction ability observed in three different groups across the experimental sessions

Groups	**Simple reaction ability (Sec.s)**		
	Pre-intervention	**Mid-intervention**	**Post-intervention**
Control	0.34	0.35	0.35
APMR	0.36	0.32	0.26
Active Relaxation	0.34	0.31	0.28
Mean Difference	-----	------	**($p < 0.01$)

Table-2
Means of Complex reaction ability observed in three different groups across the experimental sessions

Groups	Complex reaction ability (Sec.s)		
	Pre-intervention	Mid-intervention	Post-intervention
Control	0.38	0.37	0.38
APMR	0.38	0.35	0.28
Active Relaxation	0.37	0.36	0.31
Mean Difference	-----	------	**($p < 0.01$)

Table-3
Means of the extents of Upper Body Movement Coordination observed in three different groups across the experimental sessions

Groups	Upper Body Movement Coordination (in percentage scores)		
	Pre-intervention	Mid-intervention	Post-intervention
Control	12.54	11.51	8.48
APMR	13.18	24.15	35.78
Active Relaxation	11.77	12.42	13.48
Mean Difference	----	**($p < 0.01$)	**($p < 0.01$)

Table-4
Means of Bilateral Coordination observed in three different groups across the experimental sessions

Groups	Bilateral Coordination (Extent of symmetry – in percentage scores)		
	Pre-intervention	Mid-intervention	Post-intervention
Control	37.89	35.19	37.54
APMR	36.94	53.94	68.84
Active Relaxation	40.81	40.77	45.33
Mean Difference	----	**($p < 0.01$)	**($p < 0.01$)

Table-5
Means of Soccer agility skill observed in three different groups across the experimental sessions

Groups	Soccer with the ball agility skill (in min.s)		
	Pre-intervention	Mid-intervention	Post-intervention
Control	1.12	1.16	1.19
APMR	1.09	0.58	0.53
Active Relaxation	1.14	1.01	1.02
Mean Difference	----	*($p < 0.05$)	**($p < 0.01$)

Table-6
Means of Juggling Performance observed in three different groups across the experimental sessions

Groups	Juggling Performance (in No.s)		
	Pre-intervention	Mid-intervention	Post-intervention
Control	9.27	12.47	14.29
APMR	11.12	26.28	38.87
Active Relaxation	10.87	24.41	26.49
Mean Difference	----	*($p < 0.05$)	**($p < 0.01$)

Table-7
Means of Phasic skin conductance parameters for three different groups across the experimental sessions

Groups	Pre-intervention			Mid-intervention			Post-intervention		
	Orienting Latency (in Sec.s)	Amplitud elogmicro siemen	Recovery time (in sec.s)	Orienting Latency (in Sec.s)	Amplitud elogmicro siemen	Recovery time (in sec.s)	Orienting Latency (in Sec.s)	Amplitud elogmicro siemen	Recovery time (in sec.s)
Control	2.64	19.74	11.45	3.66	13.26	18.74	4.03	10.78	19.85
APMR	2.71	15.84	14.27	3.84	20.17	14.97	3.38	20.86	13.35
Active Relaxation	2.33	16.42	10.84	3.75	21.29	15.31	2.19	24.15	12.09
Mean Difference	----	*($p < 0.05$)	*($p < 0.05$)	----	**($p < 0.01$)	**($p < 0.01$)	**($p < 0.01$)	**($p < 0.01$)	**($p < 0.01$)

Table-8
Means of EMG Fatigue Zero Crossing rate for three different groups across the experimental sessions

Groups	EMG Fatigue Zero Crossing Rate - ZCR (Hz.)		
	Pre-intervention	Mid-intervention	Post-intervention
Control	18.2089	5.1808	48.0397
APMR	16.6731	128.8853	122.2982
Active Relaxation	17.9786	-132.7575	-178.4868
Mean Difference	----	**($p < 0.01$)	**($p < 0.01$)

Table-9
Means of EMG Peak Maximal frequency for three different groups across the experimental sessions

Groups	Peak Maximal frequency (Hz.)		
	Pre-intervention	Mid-intervention	Post-intervention
Control	347.2500	417.6667	406.7812
APMR	348.8125	416.7222	561.2876
Active Relaxation	348.8125	419.1944	496.2778
Mean Difference	----	-----	**($p < 0.01$)

Table-10
Mauchly's Test of Sphericity
Measure: MEASURE_1 Obtained from the Soccer Players

Measure: AveSpecAEMG							
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Agility with the ball	.558	5.248	2	.073	.694	1.000	.500
Juggling Skill	.984	.143	2	.931	.984	1.000	.500
Movement Coordination	.719	2.972	2	.226	.780	1.000	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept. Within Subjects Design: Agility2 (Agility in with soccer ball in 2nd phase + MotorSkill + Bilateral Coordination)

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table

Table-11
Tests of Within-Subjects Effects

Measure: AutonomicRecovery						
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Agility with the ball	Greenhouse-Geisser	85319.650	1.387	61508.124	245.980	.000
Juggling Skill	Sphericity Assumed	655.109	2	327.554	3.962	.036
Movement Coordination	Sphericity Assumed	69485.626	2	34742.813	297.892	.000
Agility2 * Movement Coordination	Greenhouse-Geisser	13910.766	20.807	668.564	2.674	.032
Juggling Skill * Movement Coordination	Sphericity Assumed	2449.972	30	81.666	.988	.523
Coordination * Two Arm Coordination	Sphericity Assumed	6156.408	30	205.214	1.760	.095

Conclusions

i. Both interventions were observed as beneficial for enhancement in autonomic adaptation as the faster orienting latency; higher Sc amplitude and faster recovery time indices were evident amongst the participants. ii. APMR intervention had beneficial impacts on the level of coordination, while no such improvement was observed in players who received active relaxation training. iii. Significant improvement in soccer juggling performance and in soccer agility was observed in the players who received APMR training, and outcomes implied that these improvements were mediated through enhanced coordination.

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