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Editor's Page

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Editor-in-Chief: Prof. (Dr.) S.K. Verma

With the publication of its fourth issue the *Journal of Exercise Science & Physiotherapy* (JESP) is poised for continued growth, and there are many signs that point to a bright, vibrant future for this journal. First and foremost, we are successful in bringing biannual publication of JESP for two consecutive years since 2007 when it was converted from an annual to a biannual publication. Annual publication of JESP in the starting years 2005 and 2006 made sense as the journal sought to gain a foothold in the academic community, but interest grew tremendously over the years and in the year 2007, Exercise Fitness and Health Alliance (EFHA) decided to publish it twice a year. We had a record 35 submissions this time and some of them were turned away simply because there was not room in no. 2 issue of Volume 4, 2008 and had to be considered for Vol. 5, No. 1 issue. This has resulted in an increase in the publication time. With so many submissions we do feel like we have a strong lineup of research manuscripts for the fifth volume of the journal to be brought out in the year 2009.

The response of the researchers both from India and abroad points to its growing readership. Another heartening observation is from the reviewers who have observed receiving higher quality and quantity of manuscripts submissions. This is a great news. The present issue of JESP contains twelve research papers covering important areas of exercise science. The editor and the board are making excellent efforts to publicize the title.

As always, we say thank you to all our colleagues who reviewed papers for this edition. Thanks to everyone for your support and we look forward to a successful future for *JESP*.

Sincerely,

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The Effect of Amount of Physical Activity on Cardio Respiratory Fitness and Body Composition

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Abstract

The goal of this study was to assess the effects of amount of ergometer cycle training on Vo_2max and body composition in overweight women. Forty-one sedentary premenopausal women, age 25 to 45 years, were randomly assigned in three groups. Cycle ergometer training consisted of one day per week for group A, two days per week for group B and three days per week for group C. Participants trained for 60 min in any session with moderate intensity (50-60% Vo_2max) for 12 weeks. Participants were counseled not to change their diet during the study period. There were no significant differences among variables in three groups at baseline. Means (±SD) of weight, body fat, WHR, BMI and Vo_2max in groups were 67.43±9.54kg, 31.56±4.6 percent, 0.82±0.05, 25.54±4.16 kg/m^2 and 31.72±7.2 $ml.kg^{-1}min^{-1}$ respectively. After 12 weeks, ANOVA test indicated there were significant differences among mean body composition among the three groups. Use of Tukey post-hoc tests showed that difference in theses groups is because of group C. Paired 't' test showed that there was significant difference between mean body composition ($p<0.01$) in group C. Vo_2max in group B and C improved 12% and 21% ($p<0.01$) respectively with ergometer training. But in group A it was not changed significantly. These findings indicate that the three days in week with 60 min of moderate-intensity, cycle ergometer training is sufficient to improve body composition and Vo_2max in over weight women. With two days training i.e. 120 min in a week only, Vo_2max improved. The results indicate that two days regular training improves Vo_2max in overweight women without change in body composition. With less of amount of physical activity neither body composition nor Vo_2max improve significantly. These findings strongly suggest that, in the absence of changes in diet, a higher amount of activity is necessary for improving body composition and Vo_2max.

Key words: Overweight, Body composition, Ergometer training, Cardiorespiratory fitness

Introduction

Obesity and over weight present significant public health concerns because of the link with numerous chronic health conditions *(Jakicic, 2003).* Also aerobic exercise capacity measured as maximal oxygen uptake (VO_2max) is a major predictor of all-cause mortality both in normal and cardiovascular disease subjects *(Myers et al, 2002 & Gulati et al, 2003).* Body fat content and VO_2max are both inversely associated with the risk of cardiovascular diseases and with all-cause mortality. Exercise is an important component of behavioral weight control and cardio respiratory fitness interventions. Recent clinical and epidemiological studies suggest that beneficial effects of regular physical exercise may depend on intensity or amount of work performed during training *(Gregg et al, 2003, Lee et al, 2003 & Rognmo et al, 2004).*

Based on studies it is gathered that change in body composition is related more to frequency than to intensity of exercise *(Bassulk, 2003 and Chambliss, 2003).* Scientific literature indicate that at least 60 minutes of moderate-intensity of physical activity may be necessary to

maximize weight loss and prevent significant weight regain (*Jakicic, 2003; Kemper et al, 2003; Hill & Wyatt, 2005).* But many researches suggest that high-intensity training is more effective in improving cardio respiratory fitness (Vo_2max) than moderate-intensity training *(Caspersen et al,* 1985 *& Chambliss, 2003*). Many over weight women can not be trained at high intensity level and prefer moderate level of physical activity. On the other hand for individuals constrained by a busy lifestyle, an exercise prescription that delivers benefits with the minimum investment of days is attractive *(Jakicic, 2003),* therefore the goal of this study was to assess the effects of amount of ergometer cycle training on Vo_2max and body composition in over weight women.

Material and Methods

This study has been completed in Tehran University of Tehran. Inclusion criterion were gender female, age (25-45 years), BMI (25-30 Kg/m^2) and freedom from serious concurrent medical or psychological problems. Forty-one sedentary premenopausal women were randomly assigned in three groups. Cycle ergometer training consisted of one day per week for group A, two days per week for group B and three days per week for group C. Participants trained 60 min in any session with moderate intensity (50-60% VO_2max) for 12 weeks. There were no significant differences among variables in three groups at baseline. Subjects provided written informed consent to participate in this study.

Participants took 60 minutes of cycle ergometeric training at 50-60% VO_2max for 12 week. It means that first group took one day in a week of 60 minutes of cycle ergometer training; second group took two days in a week equal to 120 minutes and third group took three days in week of 180 minutes of cycle ergometer training per week. The training was completed on a cycle ergometer (Monark), and heart rate was monitored, so as to control the intensity of the exercise training. During intervention, skilled exercise experts controlled the participant's training on cycle ergometer and provided encouragement and support to the participants for continuing the exercise program. All the participants were asked not to change their eating habits during the intervention period, and food diaries were kept and monitored weekly.

Height and weight were measured (shoes off) using a balance beam scale. Body mass index was calculated by dividing weight (kilograms) by height squared (meters square). The waist measurement was taken at the narrowest part of the torso between the rib cage and the iliac crest, after a normal expiration. Hip circumference was measured at the greatest gluteal protuberance while the subject stood with the feet together.

Percent body fat was measured by the using skin fold calipers (baseline) at three sites (triceps, subscapular & abdomen). Vo_2max was predicted by sub maximal Astrand test on cycle ergometer.

All the tests were repeated after the completion of 12-weeks of ergometer training.

Data analyses for this study were done by using SPSS statistical software

(version 11.0). Significance was set at $P<0.05$ for all tests. Analyses of the dependent variables (i.e., weight, BMI, percent body fat, and waist and hip circumferences) were performed in 2 steps. First, ANOVA was utilized to determine whether body composition and Vo_2max variables varied across activity groups. Tukey post-hoc tests was applied to find the the groups that differed from each other in statistical terms. Paired't' test was applied to evaluate the effect of twelve weeks of cycle ergometer training in statistical terms on the body composition and VO_2max in the the three groups.

Results

Baseline characteristics of the subjects' belonging to the three groups before the the start of the training program are presented in table 1.

Table 1: Subject Characteristics at Baseline for all groups

	First Group		Second Group		Third Group	
	Mean	±SD	Mean	±SD	Mean	±SD
Body Weight (kg)	67.00	9.10	67.04	9.10	68.40	10.70
%t body fat	30.84	5.30	31.90	5.01	31.10	4.20
BMI (Kg/m2)	24.44	3.30	25.78	3.02	26.50	2.35
WHR	0.82	0.03	0.81	0.07	0.82	0.06
Vo2max	31.84	5.30	29.90	5.01	30.10	4.20

All participants completed the 12-week program of exercise. The analysis of variance showed neither significant interactions nor differences among groups with regard to weight, body fat, WHR, BMI at baseline.

Means (±SD) of post-test weight, body fat, WHR, BMI in all the groups are shown in Table 2. After 12 weeks, ANOVA test indicated there was significant difference among mean body composition among the three groups. Use of Tukey post-hoc tests showed that difference in theses groups is because of group C. Paired 't' test showed that there was significant difference in mean body composition ($p<0.01$) in group C. These tests were used for Vo_2max too. Paired 't' test showed that Vo_2max in group B and C improved 12% and 21% ($p<0.01$) respectively. But in group A it did not change significantly.

Table 2: Body Weight, Percent body fat, Body Mass Index, and waist and hip Circumferences following 12 Weeks of training for all groups

	First Group		Second Group		Third Group		P
	Mean	SD	Mean	SD	Mean	SD	
Body Weight (kg)	66.45	9.05	67.10	8.50	66.50	9.80	0.03
%t body fat	32.67	4.40	31.40	4.30	29.95	3.90	0.03
BMI (Kg/m2)	28.28	3.40	26.65	2.80	25.02	2.40	0.03
WHR	0.82	0.04	0.79	0.05	0.78	0.05	0.02
Vo2max	32.14	3.30	34.90	4.07	38.10	5.00	

Discussion

This study investigated the effect of number of ergometer cycling days in a week on body composition and Vo_2max. The findings indicate that three days in a week with 60 min of moderate-intensity cycle ergometer training is sufficient to improve body composition and Vo_2max in over weight women. With two days training (120 min) in a week, only Vo_2max improved, so two days regular training without change in body composition is a useful strategy for improving Vo_2max in overweight women. With less of this amount neither body composition nor Vo_2max improve significantly. The data showed importance of the amount of training in a week. Amount of physical activity time to change body composition is in accordance

with *IOM report (2002)* that recommended 60 minutes of daily moderate intensity physical activity. Current population - level recommendations for levels of physical activity from the Centers for Disease Control and Prevention are also the same i.e. exercise of moderate or greater intensity per week *(Pate et al, 1995).* In the present study the first and second groups who were engaged for 60 and 120 minutes of physical activity per week did not reveal changes in the body composition. According to our study the exercising subjects in the third group who underwent 60 minutes of cycle ergometer training for three days a week showed significant reduction in body weight, percent body fat, body mass index, WHR while the values for the rest of the groups' actually decreased slightly over the same time frame. The fact that first and second groups of the present study did not lose weight is supported by other research studies that generally reveal that weight loss needs at least 150 minutes of moderate intensity of exercise per week *(Saris et al, 2003)*. Dutch standard for healthy levels of exercise also stipulates a minimum of thirty minutes of moderate exertion for adults preferably every day but on no less than five days per week *(Kemper et al, 2003).*

Secondly, our results suggest that two and three 60-min days of moderate-intensity training in a week significantly improve Vo_2max but one day training in a week is not sufficient to change Vo_2max. This finding is consistent with those of previous researchers (*Macfarlane et al, 2006)* who demonstrated the efficacy of 150 min of exercise training. Based on the results of the present and earlier studies, the health benefits of physical activity on Vo_2max are believed to relate more to the exercise intensity than to the volume *(Kemia et al, 2005).* Several publications report that the cardiovascular effects vary with the intensity or amount of exercise *(Wisløff et al, 2005)* and some investigations indicate that this amount and intensity of exercise should be sufficient in order to improve Vo_2max *(Myers et al, 2002)*.

Thirdly results of some investigators disclose that physical exercise alone without dieting (caloric restriction) has a modest effect on total body mass and fat loss *(Bouchard et al, 1993; Després and Lamarche, 1993; Stefanick, 1993)* and helps to maintain weight loss and prevent weight regain *(NIH, 1996 & Wing & Hill, 2001).* However in the present study subjects were requested not to change their dietary habit, it is possible that by reducing calorie intake they would have improved their body composition more. Many studies have divulged that over weight or obese people lose weight and improve in body composition better with a combination of dietary and exercise regimen than with dietary or exercise regimen alone *(Després and Lamarche, 1993 & Chambliss, 2003).*

These findings strongly suggest that, in the absence of dietary restrictions, a higher amount of activity is necessary for improving the body composition and Vo_2max. It is suggested that to have greater improvements in health and fitness one needs to increase the duration or days of physical activity alongwith creation of daily calorie intake deficit.

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Effect of Yoga Life Style Intervention on Body Weight and Blood Chemistry of Middle Aged Women

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Abstract

The present study aims to determine the effects of Yoga on body weight and blood chemistry [total cholesterol level, low density lipoprotein (LDL), high density lipoprotein (HDL) and serum triglyceride levels] of middle aged women. The sample for the study comprises of 50 females between the ages of 40 to 55 years. Sample was further divided into two groups (i) Experimental group (N=25), (ii) Control group (N=25). The subjects of the Experimental group went through a Yogic intervention for six months under the direct supervision of researchers. They performed – Dhanurasana, Bhujagasana, Sarvangasana, Halasana, Chakarasana, Shalabhasana, Paschimotanasana, Purnmatsyandrasana and Nadishodhana, Sithali, Sitakari, Brahmari, Bhastrika and Kapalbhati Paranayama early in the morning at 5.00 to 6.00 a.m. daily in the campus of C.R. College of Education. The Control group was engaged in daily routine work.The subjects of both the groups were tested before and after the experimental period of three months. The data was analyzed statistically by applying t-test. The results show that the Yoga helped the Experimental group effectively in decreasing the body weight, total cholesterol, LDL and triglycerides whereas on HDL, no significant effect was obtained. No significant changes were observed in the Control group. It is concluded that Yoga intervention helped in decreasing the body weight and improving the lipid profile of middle aged women which is beneficial for healthy life.

Key Words: Body weight, total cholesterol, low density lipo protein (LDL), high density lipo protein (HDL) and serum triglyceride

Introduction

Rising costs of prescribed drugs and increasing population are making alternative medicine increasingly more attractive. Yet there are few rigorous, scientific studies which are examining the safety and effectiveness of alternative and complementary therapies in fighting specific symptoms or diseases. Yoga is one of the promising and most appealing therapies in the recent times. It is increasingly gaining popularity as a means of exercise and fitness training. Indian philosophy of living (i.e. Yoga life) has gained a great momentum among the people of well developed nations but caution is needed because Yoga has now become a *"new fitness craze"*. Practicing of Yoga postures is claimed to improve the body's alignment, resulting in increased circulation, nervous system stimulation and increased energy. However it needs to be recognized more by health care professionals for a complement to conventional medical care rather than just a trendy leisure activity. Over the last 10 years, researches have shown that the Yogic exercise improve strength, flexibility, cardiovascular endurance and many more abilities in our body.

Galantino et al (2004), through a pilot program, examined the ability of Yoga for alleviating low back pain, the practice improved balance and flexibility and decreased disability for people with chronic back problems. *Narendranet al (2005)* suggested that integrated approach to Yoga during the pregnancy is safe. It improves birth weight, decreases pre-term

labour and decreases IUGR either in isolation as associated with PIH, with no increased complications.

After the age of 45 it becomes difficult to do the rigrous exercises. In addition to this, changes occur in the lifestyle, eating habits, day to day stresses etc during the middle age and are known to be associated with conditions of overweight, obesity, hypertension and diabetes.

Keeping in view the importance of Yoga, the present study was carried out to determine the effects of Yoga asanas and Paranyama on the middle aged women. The aim of the study therefore was to find out whether there was any effect of Yoga therapy on body weight, total cholesterol, serum triglycride, low & high density lipoproteins of middle aged women.

Material and Method

In the present study a purposive random sampling plan was used for the selection of samples. The sample for the study comprised of 50 females ranging in age from 45 to 55 years. The sample was further splited into two groups (i) Experimental group (N=25), (ii) Control group (N=25).

The selected sample of experimental group went through training for six months under the direct supervision of Yoga experts and the researchers. The intervention consisted of Dhanurasana, Bhujagasana, Chakrasana, Paschimotansana, Shalabhasana, Puran Matsyandrasana, Shavasan asanas and Nadishodhana, Sithali, Sitakari, Brahmari, Bhastrika, Kapalbhati and Paranyama which were performed early in the morning from 5.00 to 6.30 a.m. daily at C. R. College of Education, Hisar. The sample of control group was engaged in daily routine work.

Body weight and lipid profile (total cholesterol, low density lipoprotein, high density lipoprotein and serum triglicrides) were determined, taken on the first and last day of the training. Keeping in view the objectives as well as the design of the study, the appropriate statistical techniques such as t-test, mean and standard deviation were used to analyze the data.

Results

Table 1: Mean S.D. and t-ratio of pre-test and post-test on body weight (kg) for control group.

	N	Mean	SD	t-ratio
Pretest	25	58.96	7.9	0.037
Posttest	25	58.88	7.53	

Table 2: Mean S.D. and t-ratio of pre-test and post-test on total cholesterol (mg/dL**) for control group.**

	N	Mean	SD	t-ratio
Pretest	25	203.60	41.36	0.25
Posttest	25	204.20	40.34	

Table 3: Mean S.D. and t-ratio of pre-test and post-test on low density lipoprotein (mg/dL**) for control group.**

	N	Mean	SD	t-ratio
Pretest	25	154.80	38.69	0.092
Posttest	25	153.80	37.88	

Comparison of pre and posttest values of body weight and different components of lipid profile of the control group are presented in tables 1-5. Statistical comparisons reveal no significant differences between the mean values of pretest and posttest in all the variables of control group.

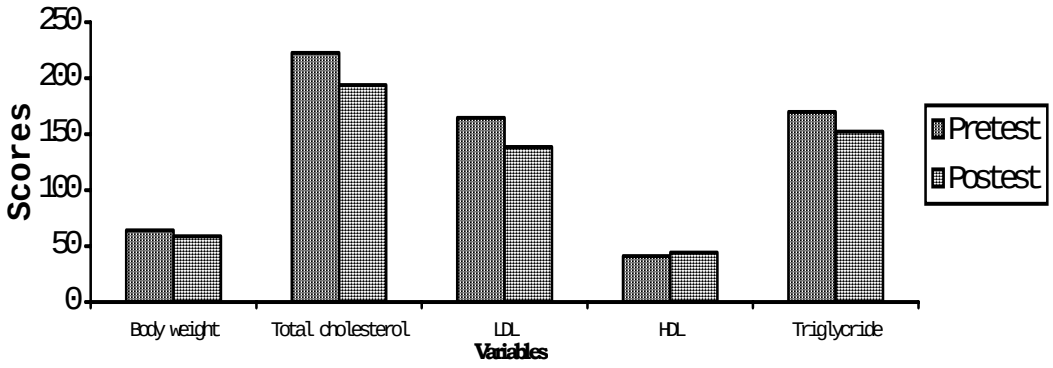

Figure 1: Comparison of pre and post mean values of body weight and lipid profile in the experimental group before (pretest) and after (posttest) yogic intervention programme

Table 4: Mean S.D. and t-ratio of pre-test and post-test on high density lipoprotein (mg/dL**) for control group.**

	N	Mean	SD	t-ratio
Pretest	25	40.76	8.47	0.225
Posttest	25	41.28	7.86	

Table 5: Mean S.D. and t-ratio of pre-test and post-test on serum tryglcride (mg/dL**) for control group.**

	N	Mean	SD	t-ratio
Pretest	25	157.40	20.49	0.035
Posttest	25	157.20	20.00	

Tables 6 to 10 compare the mean values of pre-test and post-test values of body weight and different components of lipid profile of the experimental group.

Table 6: Mean S.D. and t-ratio of pretest and posttest on body weight (kg) for experimental group.

	N	Mean	SD	t-ratio
Pretest	25	64.00	9.05	2.18 (P<0.05)
Posttest	25	58.76	7.94	

Table 6 shows that the t-ratio (2.18) for body weight that is significant at 0.05 level. Therefore, the lower mean value (58.76 kg) of posttest as compared to the higher mean value (64.00 kg) of pretest shows that Yogic exercise and Paranayama had a significant effect on the body weight of middle aged women. *Manchanda et al (2000)* also reported similar findings.

Table 7: Mean S.D. and t-ratio of pretest and posttest on total cholesterol (mg/dL**) for experimental group.**

	N	Mean	SD	t-ratio
Pretest	25	222.40	39.57	2.85 (P<0.01)
Posttest	25	193.60	31.41	

Table 7 shows that the t-ratio (2.85) for total cholesterol is significant at 0.01 level. *Cholesterol* helps the body form hormones, vitamin D and other important substances, but too much of it in the blood can clog and damage the blood vessels. Because it is a fat-like substance that doesn't mix with blood, cholesterol has to combine with proteins to form lipoproteins. Therefore the lower mean value (193.60 mg/dl) of the post test as compared to the higher mean value (222.40 mg/dl) of pretest shows that the Yogic exercise and paranayam had a significant effect on reducing the

total cholesterol of the middle age women. *Yogandra et al (2004)* and *Bijlani et al (2005)* in their study also found that with the help of Yoga one can reduce total cholesterol in the blood.

Table 8: Mean S.D. and t-ratio of pretest and posttest on low density lipoprotein (mg/dL**) for experimental group**

	N	Mean	SD	t-ratio
Pretest	25	164.80	34.88	2.88 (P<0.01)
Posttest	25	138.60	29.00	

From Table 8 it is found that the t-ratio (2.88) for LDL was significant at 0.01 levels. Build up of LDL in the blood increase the risk of heart disease in an individual. The scores of LDL are related to the health of an individual so the lower mean value (138.60 mg/dl) of post test as compared to mean value (164.80 mg/dl) of pre test shows that the Yogic exercise and Paranayam helps in reducing the level of LDL which in higher concentrations is known to be harmful in the body. Findings of the present study agree with those reported by *Manchanda et al (2000), Yogendra et al (2004)* and *Bijlani et al (2005*.

Table 9: Mean S.D. and t-ratio of pretest and posttest on high density lipoprotein (mg/dL**) for experimental group.**

	N	Mean	SD	t-ratio
Pretest	25	41.00	5.83	1.31
Posttest	25	44.16	5.46	

Table 10: Mean S.D. and t-ratio of pretest and posttest on serum tryglcride (mg/dL**) for experimental group**

	N	Mean	SD	t-ratio
Pretest	25	170.00	24.67	3.10 (P<0.01)
Posttest	25	152.40	14.00	

Table 9 indicates that the t-ratio (1.31) for HDL is not significant at 0.05 levels. HDL carries cholesterol to the liver, where it is removed from the body. In other words high HDL levels are good for health. Yoga therapy undertaken for six months time failed to show any significant impact on HDL of the middle aged women.

From Table 10 it was observed that the t-ratio (3.10) for serum triglycride is significant at 0.01 level. Triglycerides store energy for the body to use when it is needed. If there is too much, it can block blood vessels and cause other health problems such as abdominal pain and pancreatitis. Lower mean value (152.40 mg/dL) of the posttest as compared to the mean value (170.00 mg/dL) of posttest shows that Yogic intervention had a positive effect on reducing the level serum triglycride in the blood of middle aged women *Damodaran et al (2002) and Manchanda et al (2000)* also reported that Yoga decreases the level of triglycrides in blood and improved subjective well being and quality of life.

Conclusion

Based on the results of the present study it was concluded that Yoga therapy has a positive effect on reducing the body weight, total cholesterol, LDL and serum triglycride but no effect on HDL level in the blood of middle aged women. The results of the present study reveal a great potential of Yoga for healthier living. Future explorations are needed to know the mechanisms involved in producing positive effects on the body.

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Effect of High Intensity and Low Intensity Plyometric on Vertical Jump Height and Maximum Voluntary Isometric Contraction in Football Players

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Abstract

The study was conducted on 24 football players ranging between 21-32 years. The subjects were randomly divided into two groups and were named as high and low intensity plyometric groups. High intensity plyometric group was given exercises comprising of double and single leg vertical jumps alongwith single leg tuck jumps while low intensity plyometric group was administered split and cycled squat jumps. Both the groups were given plyometric training for four weeks. Vertical jump and maximum voluntary isometric contraction were recorded in both the groups at the start and 2nd and 4th week of training. In the present study, high intensity plyometric and low intensity plyometric exercises for four weeks showed different magnitudes of improvement in vertical jump height and maximal voluntary isometric contraction. Results of the study further show that High Intensity Plyometric training has significant effect on Vertical Jump Height and Maximum Voluntary Isometric Contraction as compared to Low Intensity Plyometric.

Key Words: Plyometric training, Football players, Vertical Jump, Maximum voluntary isometric contraction

Introduction

Because of the many benefits associated with sports success, athletes are always trying to improve their performances, usually under the guidance of skilled trainers, coaches and sports physiotherapists (*Williams, 1997)*. Sports performance is reported to increase by combining various training methods (*Siegler et al, 2003)* and is limited by various factors such as inadequate energy production, poor energy control and poor energy efficiency (*Williams, 1997)*. Supervised and periodized training has more potential for enhancing the performance and reducing the chances of injury in comparison with unsupervised and conventional training in various sports.

One of the most popular sports, played in every nation at varying levels of competence is Football. This is a multi-factorial event which requires simultaneous attention on body size, body composition, strength, power, quickness, reaction time, speed, agility and endurance for better performance. Incorporation of strength training program has greatly improved strength and performance profiles of football players at all levels of competition *(Willifor & Kirpatrik, 1994). Boisseau et al (2007)* has shown that the protein requirements of 14 year old male athletes are above the RDA for non-active male adolescents.

Studies have been reported which prove the effect of various training protocols in increasing the performance.

Training for enhanced performance and injury prevention employ a variety of muscles training regimens including conventional training and plyometric training.

The eccentric utilization ratio (EUR), which is the ratio of counter-movement jump to static jump performance, is suggested to be a useful indicator of power performance in athletes. Athletes in sports such as soccer, rugby have shown higher EUR values, which reflect the greater reliance on stretch shortening activities in these sports *(Mcguigan et al, 2006).* Plyometric training consists of a rapid stretching of a muscle (eccentric action) immediately followed by a concentric or shortening action of the same muscle and connective tissue *(Baechle & Earle, 2000).* Plyometric drills usually involve stopping, starting, and changing direction in an explosive manner. Muscle under this condition is known to generate higher force and deliver greater energy than without a pre stretch. The main purpose of giving plyometric training is to increase the excitability of the nervous system for improved reactive ability of the neuromuscular system which is helpful in sports. Soccer player's performance is measured by testing jumping ability *(Moore et al, 2005)* and knee extensor torques *(Kramer & Balsor, 1990).* Various training protocols have been formulated to measure the performance. It has been reported by *Kramer & Balsor (1990)* that, to optimize jump performance it appears that athlete should not perform jump immediately following resistance training.

Plyometric exercises vary in both complexity and intensity. It should be taught and progressed accordingly. Plyometric exercises are classified into four types, viz, low intensity, medium intensity, high intensity and shock exercises. High intensity plyometric is a vigorous, time taking, exhaustive training regime with a very rapid amortization phase in comparison to low intensity plyometric which is gentle and has a longer amortization phase. Low intensity exercises can produce the same effect being less exhaustive for the players and requiring less recovery time. Although plyometric training has been shown to increase performance variables like vertical jump and knee extensor strength and finally football performance, but no scientific information is available to determine the effect of high intensity and low intensity plyometric on football performance.

Therefore, the purpose of the study was to determine the efficacy of four weeks of high intensity versus low intensity plyometric exercises on vertical jump and knee extensor strength in football players.

Materials and Methods

A longitudinal experimental study was performed upon a total of 24 players with mean age of 21.05±1.32 yrs, mean height of 1.70±0.027 meters, mean weight of 63.95±1.99 kg and mean body mass index of 21.97±0.81. The players were selected from 125 football players of Sardar Bhagwan Singh Post Graduate Institute (SBSPGI), Balawala, Dehradun after a homogenous random sampling. The subjects were given exercises at the sports ground of SBSPGI and the measurements were conducted at Research Laboratory of Physiotherapy Department of the institute. Only those subjects were included who had a previous history of playing football for

one year and were not involved in plyometric exercises previously and possessed normal ROM at lumbar spine, hip, knee, ankle and a normal cardio-respiratory fitness level. Subjects were excluded if they had a history of fracture or suffered any pain during the regime or if they were irregular.

Subjects were asked to fill the consent form. Vertical jump height (VJH) and maximum voluntary isometric contraction was assessed at at the beginning of training i.e. zero week. Verbal instructions were given and the subjects were randomly separated into two groups on the basis of training administered, Group A being HIP (High Intensity Plyometric Group) and Group B being LIP (Low Intensity Plyometric Group). Each group did warm up exercises before the training regimen followed by a cool down session. Exercises were done three times a week for a span of 4 weeks. Measurements were then again taken at the end of 2nd and 4th week of training.

Vertical Jump Test (VJH) – The subjects were asked to stand erect with their dominant side next to the wall and foot flat. Chalk was given to the subject. He was instructed to reach as high as possible on the wall, with the highest point reached being marked and recorded. VJH was scored as a difference between the standing reach height and peak height achieved on jumping. Two readings were taken and an average was calculated.

Maximum Voluntary Isometric Contraction (MVIC) was tested for quadriceps muscle. The subject was made to sit on the quadriceps table with knees at 90 degree flexion and the strain gauge was attached to the subject's foot with the help of a chain. The subject was asked to contract the quadriceps muscle against the pull of the strain gauge attached behind. Three readings were taken and the average was calculated.

Plyometric exercise were given to both the groups A and B. High Intensity plyometric was given to Group A and Low Intensity plyometric was given to Group B.

Group A- High Intensity Plyometric

1. Double Leg Vertical Power Jump
2. Single Leg vertical Power Jump
3. Single Leg Tuck Jump

Group B- Low Intensity Plyometric

1. Split Squat Jump
2. Cycled Split Squat Jump
3. Squat Jump

All exercises were done 10 times. All the subjects were explained the exercises according to their groups. In Group A, two subjects were found to be irregular while coming to the field. Thus it being one of the exclusion criteria, these subjects were excluded from the study. In Group B one of the subjects discontinued during the first week and the second was injured during the practice match. The injury was diagnosed as anterior cruciate ligament injury. Thus both the players of Group B were excluded from the study.

Results

The data was analyzed. Unpaired t test was applied to vertical jump height and maximum voluntary isometric contraction between high intensity and low intensity plyometric groups.

Paired t test was applied within the group A and B each for the two variables - vertical jump height and maximum voluntary isometric contraction.

The table given below is a descriptive status of the study.

	High Intensity Plyometric Group (N=10)		Low Intensity Plyometric Group (N=10)	
	Mean	**SD**	**Mean**	**SD**
Age (yrs)	**21.40**	**1.26**	**20.73**	**1.33**
VJH at 0 Wk	**34.65**	**5.01**	**31.92**	**6.30**
VJH at 2 Wk	**36.11**	**5.33**	**32.96**	**6.32**
VJH at 4 Wk	**38.21**	**5.23**	**33.90**	**6.36**
MVIC at 0 Wk	**20.53**	**6.06**	**22.50**	**5.03**
MVIC at 2 Wk	**23.83**	**6.94**	**23.86**	**5.11**
MVIC at 4 Wk	**26.50**	**6.74**	**24.56**	**5.09**

Unpaired t test for each variable among the two groups showed significant differences in the means ($P > 0.05$). Mean differences in the Vertical Jump Height (VJH) compared at zero week and 4 week in the two groups were found to be significant with a value of $P < 0.007$ with Group-A with a value of 3.56 ± 1.066 and Group-B with a value of 2.27 ± 0.814. Thus VJH improved with High Intensity Plyometric exercises in Group A.

Maximum Voluntary Isometric Contraction (MVIC) when compared between 0 and 4 week showed a significant difference. Thus the values show that MVIC had a significant value at 0-4 week interval of time when Groups A and B were compared.

Paired t test showed the result that all the values were significant ($P \leq 0.05$) when the test was applied separately within each group A and B. The t value (probability) for VJH 0-2 week; 0-4 week and 2-4 week of Group A were - 8.184 ($P < 0.000$); -8.113 ($P < 0.000$) and -10.557 ($P < 0.000$) and for Group B were -5.016 ($P < 0.001$); -7.224 ($P < 0.000$) and -7.595 ($P < 0.000$) respectively.

The t value for MVIC 0-2week; 0-4 week and 2-4 week of Group B were -7.487 ($P < 0.000$); -0.270 ($P < 0.049$) and -6.760 ($P < 0.000$) respectively. Thus all values of paired t test show a significant change in the variables with plyometric training.

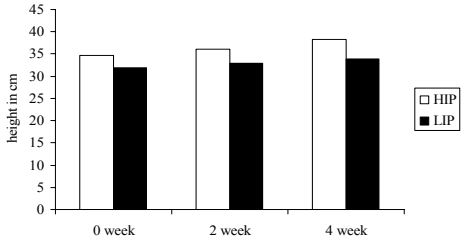

Fig. 1: Comparision of VJH of group A and B at 0 week, 2 week and 4 week

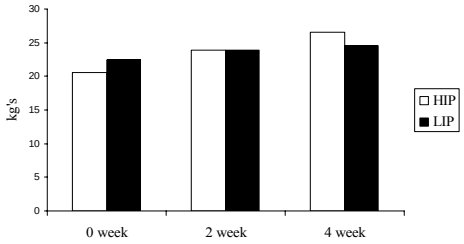

Fig. 2: Comparision of MVIC of group A and B at 0, 2 and 4 week

Discussion

This is an experimental study which compares the improvement in vertical jump height and maximal voluntary isometric contraction after high intensity plyometric and low intensity plyometric exercises in football players. The study is homogenous in nature as vertical jump height and maximal voluntary isometric contraction for both groups showed non-significant difference at the beginning of training. The results show a significant difference in vertical jump height and maximal voluntary isometric contraction following high intensity plyometric and low intensity plyometric exercises administered to the two groups of football players for a period of 4 weeks. At the same time, vertical

jump height and maximal voluntary isometric contraction increased in both the groups proving the efficacy of plyometric exercise. These results supported the finding of previous researches concerning the elastic loading of muscle.

The results of this study indicating improvement in vertical jump height and maximal voluntary isometric contraction in the two groups are in agreement with the similar findings reported by *Matavulj et al (2001); Toumi et al (2004); Wisloff et al (2004); Hoffman et al (2005)* and *McMillan et al (2005).* In the present study, high intensity plyometric and low intensity plyometric exercises of four weeks showed different magnitudes of improvement in vertical jump height and maximal voluntary isometric contraction. Power is the ability to produce muscular forces very rapidly and is therefore very important in the game like football. Plyometric exercises are specialized exercises that enable a muscle to reach maximal strength in the shortest space of time. This works by stretching a muscle and then relying on its elastic properties to produce greater forces than are normally possible in the reflex contraction (as the muscle returns to it's resting length). In order to achieve this greater muscular force, the muscle must contract with in the shortest possible time following lengthening *(www.playtheball.com).* High intensity plyometric training administered to Group A produced more improvement in vertical jump height and maximal voluntary isometric contraction as compared to Low intensity plyometric training.

It can be speculated that improvements were a result of enhanced motor unit recruitment patterns as suggested by *Potteiger et al (1999).* Another possible reason can be neural adaptation which can occur when athletes respond or react as a result of improved co-ordination between the CNS signal and proprioceptive feedback as mentioned by *Craig (2004).* However, the important action of shock absorption or spring like action cannot be forgotten. This eccentric – concentric coupling is also referred to as stretch shortening cycle. Several authors have shown that an eccentric contraction immediately preceding a concentric contraction will significantly increase the force generated concentrically due to storage of elastic energy.

Donald Chu considers plyometrics to be among the best that can improve speed, strength, acceleration and explosive power allowing him or her to remain at the cutting edge of their sport *(www.physioroom.com).* The study shows increase in vertical jump height that can be explained well with an example of a "dig" just prior to vertical jump. By lowering the centre of gravity quickly, the muscles involved in the jump are momentarily stretched producing more powerful movements. This phenomenon can be explained on the basis of two models, Mechanical model postulated by *Bosco et al (1982a)* which says that the stored energy during eccentric contraction is released when the stretch is followed immediately by a concentric muscle action. According to Hill, the effect is like that of stretching a spring which wants to return to its natural length. The spring in this case is a component of muscle and tendon called the series elastic component *(Hill, 1970).* The second theory is based on a neurophysiological model *(Gyton and Hall, 1995),* which explains the

stretch reflex. The stretch reflex increases the activity in the muscle undergoing the stretch or eccentric muscle action, allowing it to act much more forcefully. The result is a powerful braking effect on the potential for a powerful concentric muscle action (*Bosco et al, 1982b).* The ability to use the stored elastic energy is affected by three variables - time, magnitude of stretch and velocity of stretch. The quick change in direction is the important factor when using the elastic component of the muscle *(Roper, 1998).*

Not much effect has been seen of low intensity plyometric as compared with high intensity plyometric. According to a new study from Greece low intensity exercise is best for overall weight loss, while high intensity exercise is best for maintaining muscle mass *(www. bodycomposition.com).*

It is well documented that vertical jump height and maximum voluntary isometric contraction are assessment tools for anaerobic energy system. Football is one of the sports in which anaerobic energy is also utilized along with aerobic and ATP-CP. Thus as vertical jump height and maximum voluntary isometric contraction show an improvement with the low intensity and high intensity plyometric exercises, it gives an indication of improvement of the anaerobic system of the athlete. Any increase in the anaerobic energy system helps in increasing the football players prformance. Thus choice can be made by coaches, athletes or physiotherapists between high intensity plyometric and low intensity plyometric for a sport specific activity. The results indicate towards the more acceptance of high intensity exercises to gain the improvement in vertical jump height and maximal voluntary isometric contraction. Low intensity exercises can be used effectively in increasing the anaerobic system of the athlete also.

Conclusion

Results of the study show that High Intensity Plyometric has significant effect on Vertical Jump Height and Maximum Voluntary Isometric Contraction as compared to Low Intensity Plyometric. Thus there is need to undergo High Intensity Plyometric if one wants to get the improvement in performance for competition.

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A Comparative Study between Postisometric Relaxation and Isometric Exercises in Non-Specific Neck Pain

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Abstract

Postisometric relaxation is commonly used to treat patients with neck pain. No randomized controlled trial examining the outcomes of this treatment in symptomatic populations has been reported in the literature. The objective of the study was to evaluate the efficacy of postisometric relaxation in patients with non-specific neck pain. A Convenient sample of thirty seven subjects diagnosed with non-specific neck pain was randomly allocated to one of the two treatment groups on the basis of the inclusion criteria. The experimental group (n=19) received postisometric relaxation and control group (n=18) received isometric exercises. Visual analogue scales (VAS), range of motion (ROM) and neck disability index (NDI) scores were recorded on 1st, 8th, 15th and 22nd day. Both groups received the selected treatment for three weeks. Non-paramametric tests demonstrated a statistically significant difference with experimental group showing greater improvement in ROM, VAS and NDI than the control group and significant difference within group also. Conclusion: Postisometric relaxation may be more effective in decreasing pain and disability and increasing cervical range of motion in patients with non-specific neck pain. In order to generalize the results, the studies should be done on wider population including different subjects with different age group.

Key words: Non-specific neck pain, Postisometric relaxation, range of motion, neck disability index

Introduction

Neck pain is a common musculoskeletal disorder in the general population. Although probably not as frequent and disabling as low back pain, neck pain still constitutes a major burden on patients in terms of pain, disability and absence from work. *Cote & Cassidy (1998)* reported lifetime prevalence of neck pain up to 67%.

Non-specific neck pain is defined as mechanical pain located anywhere between the occiput and upper thoracic spine and surrounding muscles without any specific etiology *(Gemmel and & Miller, 2006).* The International Association for the Study of Pain (IASP) has defined neck pain as: "Pain perceived as arising from anywhere within the region bounded superiorly by superior nuchal line, inferior by an unoriginally transverse line through the tip of first thoracic spinous process, and lateraly by saggital plane tangential to the lateral border of neck. A frequently seen cause of the neck pain is awkward occupational postures, heavy lifting and physically demanding work *(Douglas and Bope, 2004).*

Neck muscles show a strong tendency to develop hypertonus and spasm and alter proprioceptive input. Therefore; common cause of neck pain is muscle tightness. Clinically positive signs include tenderness in the posterior neck region, asymmetry, increased tension and restriction of movements *(Grant, 2002).* The diagnosis is mainly based on clinical examination. Various imaging techniques may be helpful in diagnosing specific conditions responsible for neck pain. Usually they are of little help when no

underlying pathology condition is suspected.

In the review of literature, various studies revealed that specific treatment for non-specific neck pain ranges from cervical collar, cervical traction, moist heat, cervical mobilization, cervical manipulation, strengthening training routines, postural re-education, pharmacological treatment etc *(Lucas et al, 2001).* Manual therapy for neck pain includes manipulation and mobilization. Various studies have shown that high velocity, low amplitude techniques may correct joint restriction, but not the restriction due to muscles. Postisometric relaxation is claimed to be an effective method for acute tension in soft tissue problems that preclude immediate spinal adjustments, reduces muscle spasm that is responsible for spinal fixation, reduces pain and lengthen the tightened neck muscles to normalize gross cervical range of motion *(Digiovanna & Schiowitz, 1996)* and is very effective for muscles in acute and sub-acute non-specific neck pain. This treatment is based on the mechanism of neuromuscular inhibition *(Hertling and Kessler, 1996; Chaitow, 2001; Donatelli and Wooden, 2001 and Siegfried and Simons, 2001).*

The present study aimed to determine the effectiveness of postisometric relaxation over the isometric exercises in non-specific neck pain, yet there is dearth of clinical trials related to the effectiveness of post-isometric relaxation *(Cassidy and Lopes, 1992; Bentley, 1996; Schnek and MacDiarmid, 1997; Fryer, 2000; Ballantyne & Fryer, 2003; Lenehan & Fryer, 2003; Wilson & Payton, 2003; Fryer and Ruszkowski, 2004; Denise et al, 2006)*. No randomized controlled trial examining the outcomes of this treatment in symptomatic populations has been reported in the literature. Therefore, the purpose of the study was to compare postisometric relaxation with isometric exercises with respect to neck pain, range of motion and functional outcome in non-specific neck pain. The research hypothesis investigated was that postisometric relaxation would be more effective than isometric exercises for patients with non-specific neck pain.

Material and Methods

This study utilized randomized controlled trial design. A convenient sample of 37 subjects in the age group of 18 to 45 years (24.03±3.44) enrolled from Physiotherapy Department at Sarvodya hospital, Arya Samaj Charitable Clinic and Faridabad Institute of Health Sciences, Faridabad were included in the study after obtaining their informed consent. Out of 37 subjects, 19 subjects participated in the Experimental Group and 18 subjects in the Isometric Group. All the patient data was collected before randomization. Eligible patients were randomized to one of the two treatment groups on the basis of permuted block randomization.

Inclusion criteria included age between 18-40 years, both male and female and patients having acute or sub-acute non-specific neck pain. The criterion given by *Lucas et al (2001)* was used for defining acute or sub-acute non specific pain. As per this criterion for acute neck pain, pain should not last longer than 4 weeks and for sub acute not longer than 4-12 weeks. Subjects who had cervicogenic headache, radiculopathies,

patients having radiating pain, severe osteopenia, whiplash associated disorders, previous cervical spine surgeries, vascular diseases of neck, progressive neurological deficit, serious medical conditions like hypertension, renal failure, rheumatoid arthritis and verteberobasilar insufficiency (VBI) were excluded from the study. These states were assessed mainly by medical history and clinical examination before the study.

Couch, Hot packs, Standard Inclinometer, Visual Analogue Scale (VAS) and Neck disability index (NDI) were the instruments used during the study (*(Youdas & Garret, 1992; Cynthia, 1998; Bronfort, et al, 2001; Werner, 2001)*

The study protocol was reviewed and approved by the Institutional Research Committee of Department of Therapies and Health Sciences, Faridabad. After the process of screening, examination and informed consent, the patient rated their pain intensity on Visual Analogue Scale, functional outcomes on Neck Disability Index and followed by an inclinometer examination of cervical Range of Motion. Thereafter, subjects were randomly allocated to experimental group and control group. Treatment was given alternatively for four days a week and was followed for 3 weeks. Each session lasted for 30 minutes. All the subjects were taught home exercise program and postural re-education.

The subjects in the experimental group received post-isometric relaxation (PIR). In this procedure the physiotherapist and patient's force matched. Initial effort involved approximately 20% of the patient's maximum strength. Duration of contraction was 7-10 seconds. 3-5 repetitions were given and neck was gently guided to new restriction barrier *(Chaitow, 2001).* Subjects in the control group were treated with isometric exercises of the neck. Single series of 15 repetitions of isometrics was done in the forward, obliquely toward right and left and directly backward. Each repetition was held for 10 seconds. Post-treatment measurements of Visual Analogue Scale, Range of Motion and Neck Disability were taken for both the groups on 8^{th}, 15^{th} and 22^{nd} day. Both the groups were given home program, comprising of postural correction exercises, cervical exercises-cervical range of motion exercises, scapular retraction exercises.

Subjects were advised to continue the above-mentioned exercises regularly, three times a day for three weeks.

Pain score and Range of Motion (ROM) values were recorded at the baseline, and then on 8^{th}, 15^{th} and 22^{nd} day and functional outcome were collected at the baseline and after intervention on 22^{nd} day.

Results & Discussion

Due to the nature of outcome measures, non-parametric statistical analysis was used for the baseline characteristics of the two interventions. Wilcoxon test was used for within group analysis and Mann-Whitney test was used for between group analyses. The significance level set for this study was $p < 0.05$. The software program used for the data analysis was SPSS version 12.00. Mean scores of Visual Analogue Score, Neck Disability Index and Range of Motion for cervical flexion, cervical extension, left and right lateral cervical flexion alongwith the statistical constants are enlisted in the table.

Table: Mean values of VAS, NDI and ROM in the experimental and control groups

Variable	1st Day				22nd Day				% Change From Day 1 TO 22	
	Experimental group		Control group		Experimental group		Control group		Experimental group	Control group
	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD		
VAS	5.74	0.99	5.28	1.18	0.00	0.00	1.44	0.98	100	72.33
NDI	16.32	4.58	14.78	4.22	0.47	0.96	2.28	1.57	97.12	84.66
Cervical Flexion	50.53	5.50	49.33	6.31	74.53	5.10	63.89	6.04	49.05	31.24
Cervical Extension	48.53	7.04	47.62	5.06	66.74	3.74	58.83	4.96	39.43	24.28
Left Lateral Flexion	26.68	3.80	27.50	4.68	41.40	2.70	36.94	4.90	54.65	35.95
Right Lateral flexion	26.37	4.63	27.89	6.42	40.47	3.84	35.56	6.93	56.98	29.82

It is evident from the mean scores that both the postisometric relaxation and isometric exercises caused improvements in VAS, NDI and ROM with the course of treatments. Within group analysis revealed that both experimental and control groups demonstrated significant improvements ($P<0.001$) in VAS, NDI and ROM parameters. Between groups analysis revealed that percentage change in VAS score was more in the experimental group at on 22nd day. In the experimental group during the study, pain levels as judged from VAS scores declined to 'zero' at Day 15th with the results maintained at the total follow-up of 22 days. However, in the control group, the pain values though declined on Day 22 but without reaching zero level.

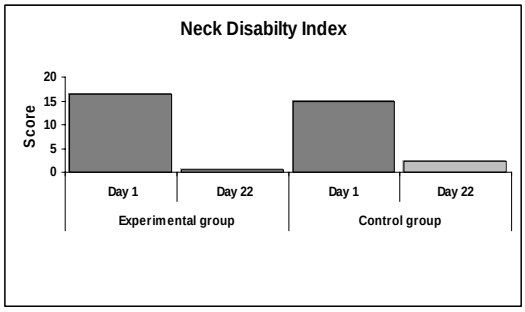

Figure 1: Changes in NDI scores in the Experimental and Control groups

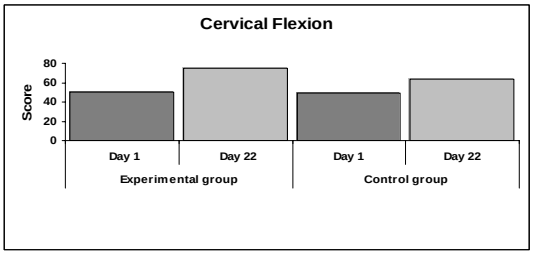

Figure 2: Changes in Cervical Flexion scores in the Experimental and Control groups

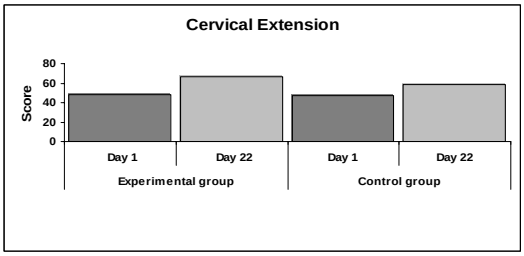

Figure 3: Changes in Cervical Extension scores in the Experimental and Control groups

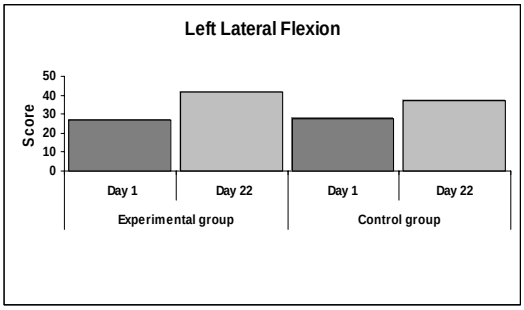

Figure 4: Changes in the Left Lateral Cervical Flexion scores in the Experimental and Control groups

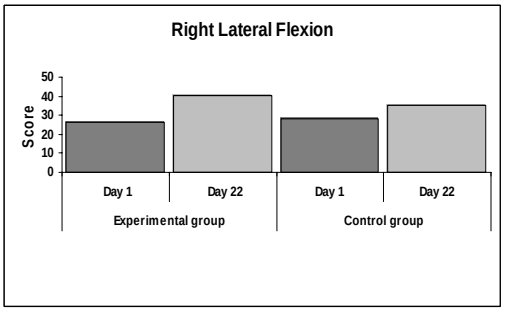

Figure 5: Changes in Right Lateral Cervical Flexion scores in the Experimental and Control groups

This study demonstrated that there was significant improvement in neck pain, range of motion and functional outcome in the experimental group as compared to the control group. Although there are numerous studies that have addressed the issue of manual therapy in neck pain, but no studies have utilized postisometric relaxation as intervention study in neck pain and so it compliments with previous studies that investigated the effect of muscle energy technique on cervical, thoracic and lumbar range of motion *(Schnek & Kimberly, 1994; Schnek, and MacDiarmid, 1997; Lenehan & Fryer, 2003; Denise et al, 2006).*

The percentage increase in range of motion was more in the experimental group as compared to the isometric group. These findings are comparable to the research of Capt. Eric Wilson, which showed that muscle energy technique decreases disability and improves function, range of motion in patients with low back pain *(Wilson, & Payton, 2003). Cassidy & Lopes (1992)* tested the immediate effect of muscle energy technique but our study tested the effect of postisometric relaxation after three weeks. So, it was difficult to compare the results of our study with this study.

Recent study clearly demonstrated significant improvement in pain (VAS), disability (NDI) and cervical range of motion in both groups (Figs 1-5). This improvement in experimental group possibly may be due to rapid hypoalgesic effects of mobilization –induced analgesia and is generally consistent with the proposed mechanisms of action for the postisometric relaxation and is used to treat somatic dysfunctions that result in cervical motion restriction.

In a recent randomized clinical trial *(Bronfort et al, 2001)* substantial improvement in the neck disability index was observed in the groups, but no significant differences between groups reported ($p > 0.05$). In contrast to these findings, our study demonstrated that experimental group had significantly improved in neck disability score ($p <$ 001) than isometric group after three weeks of treatment. Because the neck disability index assesses different aspects of neck pain and consists of pain intensity, daily activities, it is suggested that improvement in the score might be due to combined effects of reduction in pain and improvement in neck muscle strength.

All the subjects showed marked reduction in VAS when compared to their baseline values. The improvement was more in the experimental group as compared to the control group as most of the subjects reported pain to be zero on day 15 and during subsequent follow up sessions. In the control group though there was improvement, but most of the subjects showed slight VAS sore on Day 22. Improvement might be due to improvement in cognitive perception of pain and fear avoidance belief about physical activities that may increase pain threshold and subjects who showed some VAS score at the end might be due to

poor patient compliance towards home exercise program or because of certain abnormal work posture, but no definite reason could be stated for this trend in pain scores. It is also noted that number of treatment sessions required for the experimental group were less when compared to the control group. Most of the subjects of the experimental group showed improvement on Day15.

Range of motion improved more markedly for the experimental group as compared to the control group. The rationale behind the superiority of PIR over isometrics is reduced reflex activity associated with its technique. Postisometric relaxation modifies stretch perception as compared to isometrics and nociceptive nerve endings in the joint and muscle play important role via neurotransmitter modulation or gate control. Repetitive light muscle contractions increase venous, lymphatic drainage and relieve paraspinal congestion *(Schnek, and MacDiarmid, 1997).* According to J.B. Feland, maximal voluntary contractions are intense enough to produce symptoms of delayed onset muscle soreness, may increase the risk of injury and rapid fatigue from static holding caused by compression of capillaries during the contraction of muscle, which prevents sufficient blood supply of O_2 and removal of waste products *(Werner, 2001 and Denise et al, 2006).* The current study followed the recommendations set out by the previous cervical, thoracic and lumbar MET studies as postisometric relaxation can be used in symptomatic patients.

This study supports the validity of using postisometric relaxation within cervical spine to improve ROM, pain and functions. Further studies can be done with wider sample including different subjects with different age group. Postisometric relaxation can be applied in the treatment of somatic dysfunctions not only in the spine, but also in ribs, extremities and pelvis. The results of this study are in agreement with the findings that postisometric relaxation reduces pain, disability and increases ROM and more specially, with studies illustrating the benefits in subjects with non-specific neck pain.

Conclusion

Postisometric relaxation is more effective in decreasing pain and disability and improving cervical range of motion as compared to isometric exercises over a period of three weeks in patients having non-specific neck pain.

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Effect of Combination Therapy [TENS & Ultrasound] and Ischemic Compression in the Treatment of Active Myofascial Trigger Points

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Abstract

Myofascial trigger points are discrete palpable hyperirritable loci within taut bands of skeletal muscles. At present various interventions are available to treat myofascial trigger points. However, there are not many studies that have analysed the effects of combination therapy and ishchemic compression in the treatment of active myofascial trigger points. The aim of this study was to find out the effect of combination therapy and ishchemic compression in the treatment of active myofascial trigger points. Fifteen subjects were randomized in each combination therapy group (A) and as well as ishchemic compression group (B). Both groups received treatment daily for one week. In group A, combination therapy was given for 10 minutes, whereas in group B, subjects received gradual compression of 60 seconds for 3 to 4 times. Outcome was evaluated by visual analog scale and range of motion. Study showed significant ($p<0.05$) reduction in pain and also increased range of motion in both groups. But the pain reduction and increased range of motion was more significant in-group A than group B. Combination of TENS and ultrasound therapy proved more effective treatment modality in active trigger points and provided prompt relief of symptoms than the ischemic compression alone.

Key Words: Myofascial, Trigger points, Ischemic compression, Combination therapy, Tens, Ultrasound

Introduction

Myofascial pain syndrome is among the most commonly encountered disorders seen by physiotherapists. It is characterized by trigger points, which are defined as hyperirritable spots within taut bands of skeletal muscle fibers. The syndrome is associated with tenderness in the muscle, characteristic referred pain, spasm, and restriction of motion *(Hsueh et al, 1997).*

Trigger points are classified as being active or latent, depending on their clinical characteristics *(Han and Harrison, 1997).* An active trigger point causes pain at rest and is tender to palpation with a referred pain pattern that is similar to the patient's pain complaint *(Ling & Slocumb, 1993; Hong & Hsueh, 1996; Han and Harrison, 1997).* Occupational or recreational activities that produce repetitive stress on a specific muscle or muscle group commonly cause chronic stress in muscle fibers, leading to trigger points *(Rachlin, 1994).* Structural imbalances may also result from chronically shortened muscle groups. These muscle groups are likely to restrict range of motion and distort the body's posture. The distortion may perpetuate overloading of other muscles, keeping trigger points active in them. In effect, the shortened muscles perpetuate myofascial pain syndromes of the other muscles *(Finn, 1994).*

Travell & Simons (1999) have claimed that myofascial trigger points from neck and shoulder muscles might play an important role in the genesis of mechanical neck pain. The exact pathology of mechanical neck pain is not clearly understood and has been purported to be related to various anatomical structures including, intervertebral joints, neural tissues, discs, muscular disorders and ligaments *(Travell & Simons, 1999; Maitland et al, 2000).*

In the literature, many treatment approaches such as ischaemic compression, stretching exercises and physical therapy modalities, including ultrasound therapies have been reported in the management of neck pain. Various studies demonstrated that ischaemic compression can be used as prophylactic or preventive measures in trigger points. It lends credibility to the common notion that ischaemic compression is superior to the other treatment approaches like the spray and stretch, heat packs, ultrasound etc.

Jaeger & Reeves (1987) reported that stretching technique reduced the intensity of referred pain and reduced the sensitivity of the trigger points treated. Many other authors recommended that stretching alone is not enough but it is helpful as an adjunct to ischaemic compression *(Travell & Simons, 1999).*

Previous studies have confirmed the utility of TENS in the treatment of myofascial trigger points *(Graff et al, 1989),* but these researchers did not study the impact of treatment in improving the mobility and degree of muscle stretching and effect on quality of life of the patients *(Travell & Simons, 1999).* Clinically some therapists find the application of ultrasound an effective means of inactivating trigger points *(Travell & Simons, 1999; Majlesi & Ynalan, 2004).* Many earlier reports suggest that the effectiveness of a treatment approach can often be enhanced by including supplemental or various combination techniques *(Bonica, 1957 and Novich, 1965).*

From the literature reviewed, it is gathered that little is known about combination therapy using ultrasound and TENS together in the treatment of active myofascial trigger points.

The present study compared the effects of combination therapy with ischemic compression therapy in regard to acute upper back myofascial trigger point pain.

Material and Methods

The ethical committee of SDM Medical College approved the study. Thirty patients (15 women and 15 men) with pain at one side of upper back (including neck) muscles who came in the outpatient section of SDM Hospital were included in the study.

Inclusion Criteria:

1. Presence of at least one active myofascial trigger points at one side of the upper back muscles.
2. Symptoms lasting for 0-2 weeks.
3. Age between 18 to 60 years.
4. Patients with primary myofascial pain syndrome; low pain at any other area than the corresponding trigger point; pain mostly on contralateral bending of the head; negative spurling test.
5. Had not undergone application of any physiotherapy or medications to relieve pain.

Exclusion criteria:

1. Signs of cervical disc prolapse, systemic disease migraine.
2. Other neurological, orthopedic conditions.
3. Pregnancy.

The patients that fulfilled the inclusion criteria were invited to participate in the trial after obtaining their verbal as well as written consents. The total duration of the study was six days. Active trigger points were diagnosed.

Patients who met the inclusion criteria were randomly assigned to the two treatment groups (Group A and Group B). Patients in the Group A (N=15) received combination therapy consisting of ultrasound and TENS together while the patients in Group B (N=15) received ischemic compression treatment only.

Outcome measures: All the assessments were performed before the first sessions and at the termination of each session. Measurement of subjective pain using a visual analog scale (VAS) and active lateral bending of the cervical spine with the help of a goniometer were done before the first session and after each session. The anchor points of the VAS, of which all patients were informed were 0 (no pain whatsoever) and 10 (worst pain imaginable).

Treatments:

Group A subjects received a combination of ultrasound and TENS treatment, the intensity of ultrasound was 1.5 w/cm^2 (1 MHz) with a duration of 5 minutes. In this technique high-power, pain threshold, ultrasound therapy was applied in continuous modes with the probe placed directly on a trigger point and motion associated with a gradual increase of the intensity until the subject's pain tolerance was reached. It was kept at the level for 4-5 seconds and then reduced to the half intensity for another 15 seconds. This procedure was repeated three times as described by *Travell & Simons, (1999)*.

Along with ultrasound, TENS current delivered was by means of two carbon electrodes which were kept at either end of the muscle belly. The parameter for TENS were used as a negative monophasic impulse, high voltage (<300V), low intensity (<10μA), short duration (10-40μs) with a spike of short duration (7ns). To administer the above two treatments simultaneously Combi 200 device (Gymna Unity NV), was used for the treatment.

Group B subjects received ischaemic compression therapy. In this procedure muscle was placed in position of mild stretch and then gradual pressure or compression from thumb for 10-25 seconds was applied on trigger point, followed by compression again. Stretch was given to the muscle to see any change in pain and range of motion. This procedure was repeated 3-4 times.

All the subjects in both the groups were asked to actively stretch the muscles at the end of each therapy session by maximum voluntary contraction for 30 seconds. This procedure was repeated 5 times.

Statistical analysis:

Continuous variables were represented as mean ± standard deviation (SD). To test the differences between the groups, student 't' and Mann Whitney U tests were used (depending on the necessity of using parametric or non-parametric posts). A significant level of 0.05 was used for all comparisons. All analyses were performed with statistical software.

Results and Discussion

A total of 30 upper back pain subjects ranging in age from 18-60 years mean (29.93 yrs ± 7.22 SD) were studied. Out of the total sample of 30 subjects, 15 were men with mean age (28.6 yrs ± 6.24 SD) and 15 women with mean age (31.2 yrs ± 8.11 SD). No significant differences existed between groups in terms of age and gender (table 1).

Table 1: Demographic and clinical characteristics of the two groups

AGE	GROUP A	GROUP B	p
Men (years)	28.62 ± 6.84	28.71 ± 6.01	>0.05
Women (years)	30.42 ± 8.07	31.80 ± 8.64	>0.05

VAS score

DAYS	pre	post	p	pre	post	p
1st day	7.0	6.0	<0.05	7.5	6.8	<0.05
2nd day	6.6	4.1	<0.05	6.1	5.9	>0.05
3rd day	4.3	2.6	<0.05	5.9	5.9	>0.05
4th day	2.9	2.5	>0.05	5.7	4.9	<0.05
5th day	2.4	1.8	>0.05	4.1	4.1	<0.05
6th day	2.0	1.6	>0.05	3.1	2.7	>0.05

ROM score

DAYS	pre	post	p	pre	post	p
1st day	30.53	37.40	<0.05	28.13	33.40	<0.05
2nd day	37.93	39.33	<0.05	33.47	35.80	<0.05
3rd day	38.27	40.33	>0.05	36.33	38.87	<0.05
4th day	40.33	41.60	>0.05	38.40	40.73	<0.05
5th day	41.93	42.93	>0.05	41.20	43.13	<0.05
6th day	42.93	44.73	<0.05	43.20	44.87	<0.05

Figs 1 & 2 compare the average VAS scores among the two groups before the start of treatment session and after the treatment session on different days.

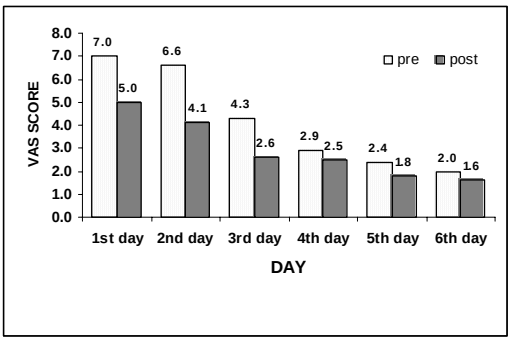

Figure 1: Comparison of pre and post VAS score in Group A subjects

Application of Wilcoxon test revealed existence of statistically significant differences between pre and post treatment session VAS score in Group A subjects' on first, second and third days of treatment (Table 1). On the other hand by using Wilcoxon test for pre and post VAS score in Group B, statistically significant results were found on 1st day (Z=2.20, p<0.05), 4th day (Z=2.02; p<0.05) and 5th day (Z=2.20, p<0.05) of treatment.

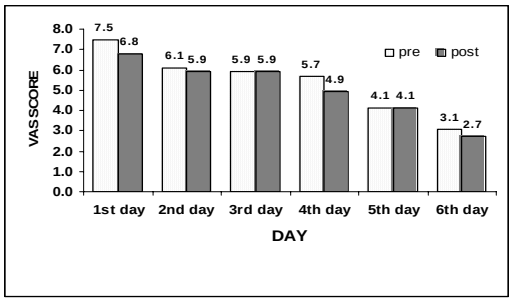

Figure 2: Comparison of pre and post VAS score in Group B subjects

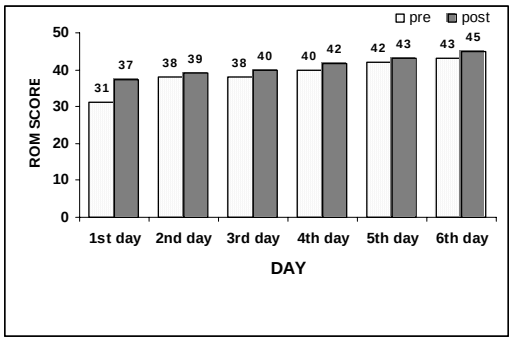

Figure 3: Comparison of pre and post ROM score in Group A subjects

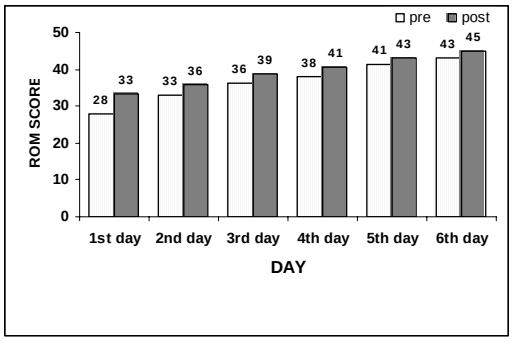

Figure 4: Comparison of pre and post ROM score in Group B subjects

Figs 3 & 4 compare the average ROM scores among the two groups before the start and after the treatment session on different days.

Application of Wilcoxon test revealed existence of statistically significant differences between pre and post treatment session ROM score in Group A subjects' on first, second and sixth days of treatment (Table 1). On the other hand by using Wilcoxon test for pre and post VAS score in Group B, statistically significant results were found on 1st day through 6th day of treatment.

Table2: Comparison between different days of VAS scores in Combination Therapy Group (A)

Treatment Gain	N	T-value	Z-value	p-level
Day 1 & Day 2	15	26.00	0.62	0.53
Day 1 & Day 3	15	35.50	0.27	0.78
Day 1 & Day 4	15	9.50	2.31	0.02*
Day 1 & Day 5	15	6.00	2.40	0.02*
Day 1 & Day 6	15	2.50	2.71	0.01*
Day 2 & Day 3	15	32.00	0.94	0.35
Day 2 & Day 4	15	7.50	2.82	0.00*
Day 2 & Day 5	15	6.00	2.59	0.01*
Day 2 & Day 6	15	2.50	3.14	0.00*
Day 3 & Day 4	15	13.00	2.04	0.04*
Day 3 & Day 5	15	18.00	1.92	0.05
Day 3 & Day 6	15	9.50	2.52	0.01*
Day 4 & Day 5	15	18.50	0.47	0.64
Day 4 & Day 6	15	20.00	0.76	0.44
Day 5 & Day 6	15	17.00	1.07	0.28

* Significant p< .05

Statistical comparisons of pre VAS score with post VAS score recorded at different days of combination therapy is summarized in table 2. It is observed that that a significant effect of treatment started appearing from day 4. In Group B, similar statistical comparison however revealed no significant differences between pre VAS score with post VAS score recorded at different days of combination therapy.

For comparison of VAS score between Group A and Group B, Mann-Whitney t-test was chosen. The 5% significant level was used for hypothesis testing.

Table 3: Comparison between Different Days of VAS Scores in Combination Therapy Group (CTG) and Ishaemic Compression Group (ICG)

Treatment	Time	Rank Sum CTG	Rank Sum ICG	U value	Z value	p-level
1st day	Pre	209.00	256.00	89.0	-0.97	0.33
	Post	158.50	306.50	38.5	-3.07	0.00
	Diff.	283.50	181.50	61.5	-2.12	0.03
2nd day	Pre	241.50	223.50	103.5	-0.37	0.79
	Post	180.50	284.50	60.5	-2.16	0.03
	Diff.	318.00	147.00	27.0	-3.55	0.00
3rd day	Pre	178.50	286.50	58.5	-2.24	0.02
	Post	142.50	322.50	22.5	-3.73	0.00
	Diff.	293.00	172.00	52.0	-2.51	0.01
4th day	Pre	164.50	300.50	44.5	-2.82	0.05
	Post	179.00	286.00	59.0	-2.22	0.03
	Diff.	222.50	242.50	102.5	-0.41	0.68
5th day	Pre	162.00	303.00	42.0	-2.92	0.00
	Post	176.50	288.50	56.5	-2.32	0.02
	Diff.	225.50	239.50	105.5	-0.29	0.77
6th day	Pre	178.50	286.50	58.5	-2.24	0.02
	Post	173.50	291.50	53.5	-2.45	0.01
	Diff.	226.00	239.00	106.0	-0.27	0.79

Significant p< .05

Table 3 shows descriptive measures and rank sums for both groups. A significant difference between all days VAS scores for the two groups was found. The table also shows difference of mean, which is compared for both the groups for all days.

For both the groups paired t-test was used to analyze the difference between pre and post ROM scores on different days of treatment. In Group A, using paired t-test for pre and post ROM, significant difference was found on first day ($t - 4.88$, $p < 0.05$), 2nd day ($t - 2.67$, $p < 0.05$) and 6th day ($t - 3.54$, $p < 0.05$) (table 1). Whereas in Group B, using paired t-test for pre and post ROM a very significant difference was found in all days of treatment. In both the groups maximum ROM changes were noticed on 1st day (table 1).

Table 4: Comparison between different days of ROM scores in Combination Therapy Group (A)

Day	Mean	SD	Mean Diff	% effect	SD Diff	paired t-value	Signi.
1	-6.87	5.45	-5.47	79.61	5.77	-3.67	p< .05
2	-1.40	2.03					
1	-6.87	5.45	-4.80	69.90	6.16	-3.02	p< .05
3	-2.07	3.77					
1	-6.87	5.45	-5.60	81.55	7.31	-2.97	p< .05
4	-1.27	2.94					
1	-6.87	5.45	-5.87	85.44	6.41	-3.54	p< .05
5	-1.00	2.62					
1	-6.87	5.45	-5.07	73.79	5.98	-3.28	p< .05
6	-1.80	1.97					
2	-1.40	2.028	0.67	-47.62	3.81	0.68	p> .05
3	-2.07	3.77					
2	-1.40	2.03	-0.13	9.52	3.25	-0.16	p> .05
4	-1.27	2.94					
2	-1.40	2.03	-0.40	28.57	3.66	-0.42	p> .05
5	-1.00	2.62					
2	-1.40	2.03	0.40	-28.57	1.92	0.81	p> .05
6	-1.80	1.97					
3	-2.07	3.77	-0.80	38.71	4.31	-0.72	p> .05
4	-1.27	2.94					
3	-2.07	3.77	-1.07	51.61	4.17	-0.99	p> .05
5	-1.00	2.62					
3	-2.07	3.77	-0.27	12.90	3.71	-0.28	p> .05
6	-1.80	1.97					
4	-1.27	2.94	-0.27	21.05	3.41	-0.30	p> .05
5	-1.00	2.62					
4	-1.27	2.94	0.53	-42.11	3.44	0.60	p> .05
6	-1.80	1.97					
5	-1.00	2.62	0.80	-80.00	3.00	1.03	p> .05
6	-1.80	1.97					

Table 5: Comparison between Different Days of ROM Scores in Combination Therapy Group (CTG) and Ishaemic Compression Group (ICG)

		CTG		ICG			
		Mean	SD	Mean	SD	t-value	p-value
1st day	Pre	30.53	9.64	28.13	9.36	0.69	0.49
	Post	37.40	8.05	33.40	9.49	1.24	0.22
	Diff.	-6.87	5.45	-5.27	5.55	-0.79	0.43
2nd day	Pre	37.93	7.99	33.47	9.57	1.39	0.18
	Post	39.33	7.25	35.80	8.71	1.21	0.24
	Diff.	-1.40	2.03	-2.33	2.19	1.21	0.24
3rd day	Pre	38.27	8.19	36.33	7.67	0.67	0.51
	Post	40.33	5.86	38.87	5.76	0.69	0.49
	Diff.	-2.07	3.77	-2.53	3.36	0.36	0.72
4th day	Pre	40.33	5.86	38.40	6.08	0.86	0.38
	Post	41.60	4.89	40.73	5.51	0.46	0.65
	Diff.	-1.27	2.94	-2.33	3.54	0.89	0.38
5th day	Pre	41.93	4.73	41.20	5.62	0.39	0.70
	Post	42.93	3.59	43.13	4.73	-0.13	0.89
	Diff.	-1.00	2.62	-1.93	2.99	0.91	0.37
6th day	Pre	42.93	3.59	43.20	3.49	-0.21	0.84
	Post	44.73	2.79	44.87	3.64	-0.11	0.91
	Diff.	-1.80	1.97	-1.67	2.02	-0.18	0.86

Significant p< .05

Table 4 represents comparison between pre ROM scores of before combination treatment with post combination treatment ROM scores for all days.

In Group B, (Ischaemic Compression), no statistically significant differences were found in the ROM scores recorded before treatment and post treatment on all the days.

For comparison of ROM scores between Group A and Group B, independent t-test was chosen. A two-tailed test was conducted with alpha set at 0.05 (table 5). No statistical significant difference between all day's ROM scores for the two groups was found. Table 5 show descriptive measures alongwith the difference of mean which is compared for both groups for all days.

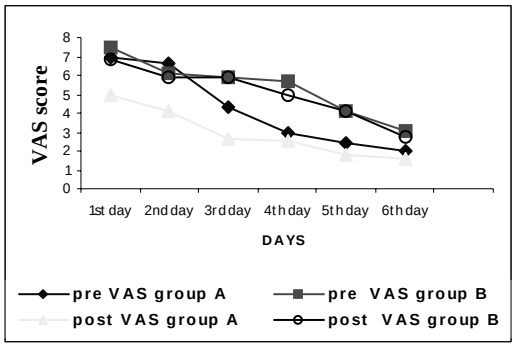

Figure 6: Comparison of pre and post VAS score for Group A and Group B on different days of treatment

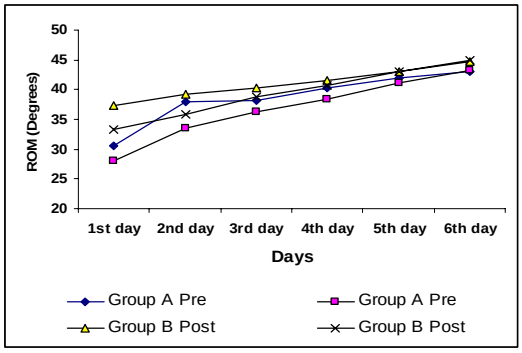

Figure 7: Comparison of pre and post ROM scores for Group A and Group B on different days of treatment

Discussion

In our study all the subjects with neck pain had trigger points in the upper fibers of the trapezium muscles in right and/or left sides. It was also observed that associated with pain there was muscle spasm with limitation of joint range of motion in auricle vertebrae. This study showed that both the treatment groups (A & B) had a reduction in pain intensity of myofascial trigger points as well as an increase in the ranges of motion in the neck followed by treatment.

According to *Horal (1969)* and *Bovin et al (1994),* neck pain is common with an estimated point prevalence of nearly 13% & a lifetime prevalence of 50%. Different conservative management of mechanical neck pain has been tested in the literature but with conflicting results and at present no treatment strategy is generally accepted *(Aker et al., 1996).* The application of two therapeutic modalities simultaneously and at the same site is reported in the literature and described as combination therapy. The most widely used conservations are Ultrasound & TENS. The justification for the use of combination therapy is principally suggested because the beneficial effects of both modalities may be achieved at the same time. The use of combination therapy is to enhance the effect of one therapy upon the other making the combination more effective than either of the therapy alone.

TENS and Ultrasound are being used in physical therapy to inactivate trigger points. Many papers have been published in the issues of the effect of ultrasound & TENS in musculoskeletal disorders (*Travell & Simons, 1999)*. But very few studies studied both effect of Ultrasound & TENS on pain & range of motion *(Bonica, 1957 & Novich, 1965)*.

Ischaemic compression technique is non invasive & seems to be free of adverse effects if applied after accurate diagnosis with knowledge of regional anatomy. This technique can be used as a prophylactic or preventive measure. The virtue of this technique is that it is painless & imposes no additional strain on any attachment trigger points & there by avoids aggravating them (*Travell & Simons, 1999)*.

There are not many published studies that have analysed the effects of combination therapy & ischaemic compression in the treatment of active myofascial trigger points.

This study revealed decrease in the pain immediately following combination therapy than ischaemic compression treatment. Study also revealed appearance of the effect of treatment from day 1 & 2 in the case of the combination therapy group.

Travel & Simmons (1999) noticed etiology of trigger points is because of dysfunctional motor end plates. Application of Ultrasound undoubtedly cause tissue heating, which could result into inhibition of releasing acetylcholine & reduce end plate dysfunction.

TENS on the other hand helps in the pain modulation by inhibition of pain pathways at spinal cord level. The additional benefits of this modality are that, it helps in improving the quality of life, which in turn help the patient to achieve increased mobility & degree of muscle stretching (*Travell & Simons, 1999)*. Based on these effects Group A

showed immediate & early reduction in pain & range of motion.

Group 'B' also showed decrease in the pain. This can be explained in terms of Ischeamic pressure that probably might have lead to temporarily occlusion of blood supply & causing reactive hyperaemia, which in turn helped in flushing out the muscle of inflammatory exudates & pain metabolites, breaking down scar tissue, & reducing muscle tone. There wasn't any significant difference found in terms of range of motion in both the groups. In the present study cervical range of motion increased more in group 'A' as compared to Group 'B'. This effect can be due to more effective decrease in spasm along with pain induced by combination therapy. Along with these treatment techniques stretching also lead to the increase in the range motion in both groups. According to *Travel & Simmons (1999),* stretching helps in releasing the contractured sarcomeres of the contraction knots in the trigger point.

Several study limitations should be noted as the present study report only a comparison of treatment techniques in case of active trigger point pain. The study contained no long-term follow up & no measures of functional improvement.

Conclusions

Combination therapy resolves acute active trigger point's pain & increases range of motion rapidly than Ischaemic compression treatment technique.

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Regression Equations to Predict VO_2 Max in Untrained Boys and Junior Sprinters of Kolkata

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Abstract

The purpose of the study was to validate the applicability of the 20-m multi stage shuttle run test (20-m MST) in untrained boys and junior sprinters of Kolkata, India. 35 sedentary boys from different schools and 25 sprinters from different sports academies (age range 13 ~ 16 yr.) were recruited for the study. Direct estimation of VO_2 max comprised treadmill exercise followed by expired gas analysis by scholander micro-gas analyzer whereas VO_2 max was indirectly predicted by 20-m MST. In case of sedentary boys, the difference between the mean (+/- SD) VO_2 max values of direct measurement (VO_2 max = 42.99 +/- 5.16 ml/kg/min) and 20-m multi stage shuttle run test ($SPVO_2$ max = 42.69 +/- 5.06 ml/kg/min) was statistically significant ($p<0.01$). In case of sprinters, the difference between the mean (+/-SD) VO_2 max values of direct measurement (VO_2 max =52.31 +/- 3.04 ml/kg/min) and 20-m multi stage shuttle run test ($SPVO_2$ max = 51.97 +/- 2.92 ml/kg/min) was also statistically significant ($p<0.01$). Although, for both the cases of sedentary boys and junior sprinters, limits of agreement analysis suggest that 20-m MST may be applied in the studied populations for estimation of maximum oxygen uptake. For better prediction of VO_2 max in the studied populations, new equations have been computed based on present data.

Key Words: VO_2max, Aerobic capacity, Cardiorespratory fitness, Beep test, Sprinters, Sedentary

Introduction

Maximum oxygen uptake (VO_2 max), when directly determined after exercise involving a sufficient number of muscle group, is considered as a good index of physical fitness of an individual (*Astrand and Rodahl, 1970*). But the test of direct measurement of VO_2 max is difficult, exhausting and often hazardous to perform regardless the type of ergometer used (*Fox, 1973*). This is why scientists often perform this test in indirect protocols to predict VO_2 max (*Das & Bhattacharya, 1995*). But before applying any indirect protocol for the prediction of VO_2 max, the validity of the test should be established in particular population to be assessed. The 20-meter multistage shuttle run test (*Leger et al, 1988, Leger & Gadoury, 1989*), popularly known as Beep test, is often used world wide for measurement of aerobic capacity (*Wong et al, 2001; Mota et al, 2002; Guerra et al, 2002; Vicente-Rodriguez et al, 2003, Vicente-Rodriguez et al, 2004*). *Cooper et al (2005)* studied the repeatability and criterion related validity of the 20-m multistage fitness test as a predictor of maximal oxygen uptake in active young men. *Suminski et al, (2004)* established the validity of the 20-m MST for measuring aerobic fitness of Hispanic youth of 10 to 12 years of age. However, studies on the validity and suitability of this test are scanty in India (*Chatterjee et al, 2005*) and it has not been undertaken in an organized way for different Indian populations.

Recent study has indicated that there are sport-specific differences when predicting VO_2 max from the multistage

shuttle run test (*Gibson et al, 1998*). In another recent study by *Cetin et al. (2005)* on Taekwondo athletes, the authors conclude that Maximal oxygen consumption (VO_2 max) can be predicted from shuttle run test scores, but not as indicated with the test package. In order to obtain the true score one must apply a regression equation. Keeping in view, all these aspects, we wanted to examine the applicability of the 20-m MST to predict VO_2 max in untrained boys and junior sprinters of Kolkata, India.

Materials and Methods

Subjects: 35 untrained boys from different schools of Kolkata and 25 sprinters from different sports academies of Kolkata volunteered for this study. The physical characteristics of the subjects are shown in table 1 and table 2. All the sprinters have a training background of 2-3 years. All the subjects signed a statement of informed consent. All institutional policies concerning the human subjects in research were followed. An approval from competent local ethics committee was taken.

Experimental Design: Maximum oxygen consumption of each subject was determined in a random counter-balanced order by both indirect and direct methods at an interval of 4 days. Subjects were asked to take complete rest at least for half an hour prior to the exercise, so that pulmonary ventilation and pulse rate might come down to steady state. They had a light breakfast 2 - 3 hours before the test and refrained from any energetic physical activity for that period.

Prediction of maximum Oxygen uptake capacity by 20-m MST: Subjects started running back and forth a 20 m course and must touched the 20 m line. The initial speed was 8.5 km/h which got progressively faster (0.5 km/h. every minute), in accordance with a pace dictated by a sound signal on an audiotape. Several shuttle runs made up each stage, and subjects were instructed to keep pace with the signal for as long as possible. When the subjects could no longer follow the pace, the last stage announced was used to predict maximal oxygen uptake using the equation of *Leger et al (1988)*.

Direct measurement of maximum oxygen uptake capacity: The subjects walked on a treadmill to warm up at a speed of 4 km/h at a 4.5 inclination for duration of 5-min. Running at a constant speed of 7 km/h. for a maximum duration of 5 min followed this. The gradient was increased successively from 4.5 until the subject was unable to continue the task. In no case did it exceed 7.5 inclinations. The criteria for maximality was exhaustion and withdrawal from running within the scheduled 5 min period, when the heart rate was about their predicted maximum heart rate and when a further increase of inclination did not bring about any significant rise in oxygen uptake.

Gas Analysis: Low resistance high velocity Collin's Triple "J type" plastic valve was used for the collection of gas by open circuit method. The valve was connected with the Douglas bag (150-liter) and the expired gas was collected in the second minute of the exhausting final workload if signs of severe exhaustion supervened. No gas collection was made in the first minute of the workload. The expired gas measured in a wet gasometer (Toshniwal, Germany CAT No. C G 05.10) and the aliquots of gas samples were analyzed in

a Scholander micro gas analysis apparatus (India) following the standard procedure *(Consolazio et al, 1963).*

Validity of the results: Repeatability was investigated where 22 subjects performed the test (20-m MST) twice. The results showed non-significant bias between the two applications of the 20-m MST (mean of the difference +/- standard deviation of the difference = -0.1+/-1.0 ml /kg/min; t = -0.48 p = 0.73 with 95% limits of agreement).

Statistical Analysis: Paired t-test, Pearson's product moment correlation, linear regression statistics and Bland and Altman approach for limit of agreement were adopted for statistical analysis of the data. Statistical Package for Social Sciences (SPSS) MS windows Release 11.5 was used for statistical analysis.

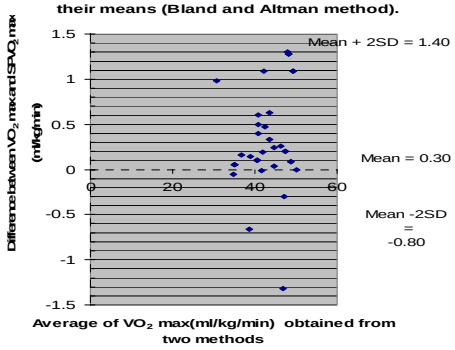
Results and Discussion:

Table 1. Physical parameters, predicted and measured VO_2 max of the untrained boys (n=35)

Parameters	Min	Max	Mean	SD
Age (yr.)	14.0	16.0	15.23	0.69
Height (cm)	150	175	162.22	5.68
Weight (kg)	32.0	71.0	46.93	9.00
VO_2max (kg/ml/min)	31.30	50.30	42.99	5.16
$SPVO_2$max (kg/ml/min)	30.32	50.25	42.69	5.06
Maximal Shuttle run Speed (km/h)	9.0	12.5	10.95	0.92

Means and standard deviations of physical characteristics, shuttle predicted VO_2 max ($SPVO_2$ max) by 20-m multi stage shuttle run test and directly measured VO_2 max of the untrained boys and junior sprinters are presented in the table 1 and table 2 respectively. For untrained boys the mean value of the VO_2 max determined by direct method was 42.99 +/- 5.16 ml/kg/min (range 31.30~50.30 ml/kg/min). The mean value of the predicted VO_2 max by 20-m MST was 42.69 +/- 5.06 ml/kg/min (range 30.32~50.25 ml/kg/min). These two values showed significant variation ($p<0.01$). The mean difference between VO_2 max and predicted VO_2 ($SPVO_2$max) max was 0.30 ml/kg/min with 95% confidence interval -0.49 to -0.11 ml/kg/min indicating that 20-m MST predict the maximum oxygen uptake capacity within the range of -0.49 to -0.11ml/kg/min.

Figure 1: Sedentary Boys: Plotting of difference between VO_2max values against their means (Bland and Altman method).



Analysis of data by *Bland and Altman (1986)* method of approach for limits of agreement between VO_2 max and predicted VO_2 max ($SPVO_2$max) reveals that limits of agreement are 1.40 and -0.80. These are small enough parameter for 20-m MST to be used confidently in place of direct procedure, and from Bland & Altman analysis it is indicated that 20 meter MST may be used within the sedentary boys' population of Kolkata. But significant difference ($p<0.01$) between VO_2 max and shuttle predicted VO_2 max ($SPVO_2$ max), indicated that it would not be justified to accept the prediction of maximum oxygen uptake as an equivalent to the direct value in the studied population in its existing form. For obtaining a better score, a regression equation should be computed. Highly significant correlation (r =0.97, p

< 0.01) existed between the maximal speed of the 20-m MST and VO_2max measured by direct method. The following equation, derived on the basis of present data will better predict the aerobic fitness in untrained boys.

$$Y= 5.77 + 5.66X -1.63A$$

Where

Y= VO_2max (ml/kg/min)
X= Maximal shuttle run speed (km/h)
A= Age (yr.)

Figure 2: Sprinters: Plotting of difference between VO_2 max values against their means (Bland and Altman method)

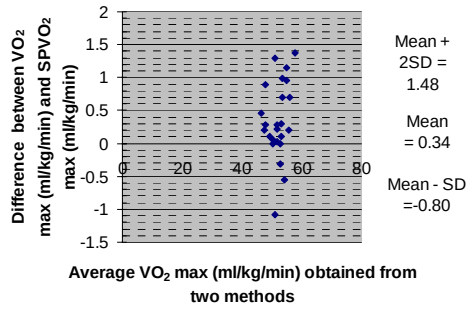


Table 2. Physical parameters, predicted and measured VO_2 max of the junior sprinters (n=25)

Parameters	Min	Max	Mean	SD
Age (yr.)	13.0	16.0	14.80	0.95
Height (cm)	143.5	172.5	158.50	7.80
Weight (kg)	29.50	54.00	43.04	6.49
VO_2max (kg/ml/min)	46.50	58.50	52.31	3.04
SPVO_2max (kg/ml/min)	46.00	57.10	51.97	2.92
Maximal Shuttle run Speed (km/h)	12	14	12.52	0.54

For the junior sprinters, the mean value of the VO_2 max determined by direct method was 52.31 +/- 3.04 ml/kg/min (range 46.50 ~ 58.50 ml/kg/min). The mean value of the predicted VO_2 max by 20-m MST was 51.97 +/- 2.92 ml/kg/min (range 46.00 ~57.10 ml/kg/min). These two values showed significant variation ($p<0.01$). The mean difference between VO_2 max and predicted VO_2 (SPVO_2max) max was 0.34 ml/kg/min with 95% confidence interval -0.57 to -0.10 ml/kg/min indicating that 20-m MST predict the maximum oxygen uptake capacity within the range of -0.57 to - 0.10 ml/kg/min.

Analysis of data by *Bland and Altman (1986)* method of approach for limits of agreement between VO_2 max and predicted VO_2 max (SPVO_2max) reveals that limits of agreement are 1.48 and -0.80. These are small enough parameter for 20-m MST to be used confidently in place of direct procedure, and from Bland & Altman analysis it is indicated that 20 meter MST may be used within the junior sprinters population of Kolkata. But as there is significant difference ($p<0.01$) between directly measured (VO_2 max) and shuttle predicted VO2 max (SPVO_2 max), it is concluded that 20 meter MST can be applied for the studied population but not in its present form. For more accurate and reliable assessment of VO_2 max in junior sprinters, a regression equation should be computed.

Highly significant correlation ($r = 0.89$, $p < 0.01$) existed between the maximal speed of the 20-m MST and VO_2max measured by direct method. The following equation, derived on the basis of current data will better predict the aerobic fitness in junior sprinters of Kolkata, India.

$$Y= 2.36 + 5.62X -1.38 A$$

Where

Y= VO_2max (ml/kg/min)
X= Maximal shuttle run speed (km/h)
A= Age (yr.)

Conclusions

Therefore, from the present observations it is concluded that the 20-m multistage shuttle run test is recommended as a valid method to evaluate aerobic fitness in terms of VO_2max within the untrained boys and junior sprinters (age 13~16 yr.) of Kolkata, India. For better prediction of VO_2max in the studied populations we recommend the equations developed on the basis of the present data.

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Comparison of Occurrence of Injuries to Footballers at Low and High Level of Achievement

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Abstract

The primary aim of the investigation was to compare the occurrence of injuries to footballers at low and high level of achievement with regard to various stages viz. ground conditions, location, field positions, training and competition. Information on injuries was collected from members of eight Indian football teams which were participating in the All India Mayor Trophy football tournament by questionnaires. In all 98 injuries were observed, 40 related to the low achievement and 58 to the high achievement group of footballers. A significant difference in the occurrence of injuries between the two achievement groups of footballers was found. Occurrence of injuries due to field conditions and position of playing were also found to be significantly different in the two achievement groups. No significant differences in injury occurrence were found between group of footballers with respect to location. Significant difference in the occurrence of injuries were observed in the groups with respect to the frequency of competition and training periods ($t=2.46$, $p<.05$) of footballers. While comparing causes and nature of injuries, no significant differences were found between the low and the high level of achievement footballers. The high level of achievement footballers revealed more injuries than the low level of achievement footballers. Those football players directly involved in attack or defence are more likely to be injured. Lower limb injuries were found to be predominant. The results of the study provide a useful insight into the injuries in relation to the field position, nature and location of injury in competitive football players.

Keywords: Footballers, Injuries, Training, Achievement level

Introduction

Football is one of the most popular sports in the world. Currently FIFA unified 203 National Associations and represents abouts 200 million active players, of which about 40 million are women. The incidence of football injuries is estimited to be 10 - 35 per game hour. An athlete plays on average about 100 hours of football per year (ranging between 50 hours per player of a local team to upto 500 hours per player for a professional team).

Australian Football Association reported 4681 injuries between 1992 and 1998 (*Orchard et al, 1997 & 1998*). In this report, it was reported that players from teams in Northem states were slightly more (14%) likely to be injured than players from teams in Victoria (RR 1.14, 95% CI 1.07-1.21). There was no significant difference in the risk for injury to upper limb, trunk or head and neck regions. However incidence of incurring injuries to the lower limb (ankle injuries, calf and quadriceps strain etc) was reported to be greater in players from Northen teams than the teams from Victoria.

Football has been demonstrated to be among the most hazardous of organized team sports and injury is a frequent event in football (*Griffith, 1989; Saxby, 1989; Seward & Patrik, 1992; Watson, 1993; Junge, 2004; Singh, 2004, 2006; Singh & Pagare, 2007*). Football

requires a variety of physical attributes and specific playing skills therefore participants need to train and prepare to meet at least a minimum set of physical, physiological and psychological requirements to cope with the demands of the game and to reduce the risk of injury *(Griffith, 1989)*. It is an enjoyable and social sport that can be played from childhood to old age, either at a recreational level or as a competitive sport.

Football playing largely involves accelerating, running, slopping, twisting, and turnning at various ranges of movement alongwith stretching, jumping and kicking action (*Griffith, 1989; Pardon, 1997)*. All these factors place the players to a greater risk of injury. The aim of the present study is to campare the injuries in low and high level of achievement footballers.

Material & Methods

The investigator has made an attempt to classify or define the level of footballers based on the class of the games of the footballers. Accordingly two groups of footballers were targeted; low and high level of achievement footballers aged between 16 to 30 years. The low level achievement footballers were those who were regularly participating for three years in the National football competitions and the high level of achievement footballers were regularly participating for three years in the International football tournaments.

Information on injuries was collected from eight Indian football teams, which were participating in the All India Mayor Trophy football tournament that was held in September 2006, in the city of Aurangabad, Maharashtra. A questionnaire prepared by *Cromwell & Gromely (2000)* for elite Gaelic football players and modified by the investigator was used. T-ratio was computed to compare the occurrence of injuries between the low and the high level of achievement footballers. The investigator personally contacted the team managers and coaches of the eight teams and the purpose of the study was explained to them. Further instructions were given by the investigator to the players for the completion of the questionnaire.

Results & Discussion

The mean(±S.D.) of the age of the low level achievement footballers was 19.66(±1.33) years, height 167.33(±8.33) cm., weight 61.25(±8.77) kg, training duration 1.66(±0.42) hours and the competition frequency/year 6.74(±2.33). On the other hand, the mean(±S.D.) of the age of the high level achievement footballers was 21.08(±1.78) years, height 170.52(±8.33) cm, weight 62.44(±8.98) kg., training duration 4.91(±1.21) hours and the competion frequency/year 10.06(±3.78). The statistics of the results of injuries in football players are shown in Tables 1 to 8. With regard to the occurrence of incidence of injuries in the low and the high level of achievement footballers, mean values of 0.67 and 0.98 respectively were observed (Table-1). The obtained t=2.58 was significant at 0.05 level indicating that the high level of achievement footballers had greater incidence of injuries than the low achievement footballers.

Table 1: Mean Scores, Standard Deviation and t-ratio of injuries to footballers at low and high level of achievement.

Achvuevement Level (Injury Incidence)	N	Mean	S.D.	t-ratio
LAF (40)	59	0.67	0.64	2.58 *
HAF (58)	59	0.98	0.78	

* Significant at .05 level.

Table 2: Statistical information related to occurrence of injuries due to ground condition in low and high level of achievement footballers.

Achvuevement Level (Injury Incidence)	N	Mean	S.D.	t-ratio
LAF	40	0.17	0.37	3.11**
HAF	37	0.45	0.49	

** Significant at .01 level.

As per table 2, a significant injury differences were found out in the low and the high level achievement footballers ($t=3.11$, $p<.01$).

High level achievement footballers demonstrate significantly greater incidence of occurrence of injuries due to ground conditions as compared to the low level achievement footballers.

Table 3: Statistical information of incidence of injuries recorded in low and high level of achievement footballers with respect to their field position.

Field Position	Achvuevement Level (Injury Incidence)	N	Mean	SD	t-ratios
Center Forward	LAF (3)	2	1.5	0.25	3.59 *
	HAF (8)	3	2.66	0.47	
Left Full back	LAF (2)	3	0.66	0.42	2.38 NS
	HAF (7)	5	1.4	0.6	
Left Halves back	LAF (4)	6	0.83	0.47	3.89**
	HAF (7)	4	1.75	0.43	
Center Halves	LAF (7)	9	0.77	0.41	3.04**
	HAF (9)	6	1.5	0.5	
Goal Keeper	LAF (5)	8	0.62	0.61	2.07 NS
	HAF (14)	12	1.66	0.54	
TOTAL	LAF (21)	28	0.75	0.43	5.13***
	HAF (45)	30	1.5	0.67	

*significant at .05 Level. **significant at .01 Level, ***significant at .001 Level. NS = Not significant.

Table 3 shows, the means, SDs. and t-ratios of occurrence of injuries to the low and the high level of achievement footballers as well as combined sample for different field positions. Incidence of the occurrence of injuries is depicted for only five different field positions.

In case of inside left (forward) outside right (forward), right full back, outside left (forward) and non specific mid fielder no injury was reported in both the high and the low level of achievement footballers, hence, these field positions were not included.

Similarly in case of right halves back and inside right only low level achievement footballers reported injuries while none of the high level achievement footballers engaged in these field positions reported injuries, hence could not be included for comparison. Statistically significant differences in the occurrence of injuries were found in the high and the low achievement group of footballers with respect to center forward ($t=3.59$, $P<0.05$), left halves back ($t=3.89$, $P<0.05$), center half playing position ($t=3.04$, $P<0.01$), while in case of goal keepers ($t=2.07$), and left full back ($t=2.38$) no significant differences were found.

Table 4 indicates the existence of statistically significant differences among the high and the low achievement footballers with respect to the location of occurrence of injuries. Significant differences were found in the occurrence of injuries with respect to ankle ($t=3.53$, $P<0.01$), shoulder ($t=5.5$, $P<0.001$), knee ($t=2.37$, $P<0.05$) among the high and the low achievement footballers while differences in the occurrence of injury in hamastring region ($t=0.42$) was found not significant.

In case of other regions like back, wrist and quadriceps; injuries were reported by LAF only, while HAF revealed injuries in the head, hip, hand, and groin regions, hence, these locations could not be included in this study for comparison.

Table 4: Statistical information of incidence of injuries recorded in low and high level of achievement footballers with respect to location of injury.

Location	Achvuevement Level (Injury Incidence)	N	Mean	SD	t-ratios
Ankle	LAF (10)	04	2.5	0.5	3.53**
	HAF (13)	09	1.44	0.51	
Hamstring	LAF (3)	02	1.55	0.5	0.42^{NS}
	HAF (5)	04	1.25	0.83	
Shoulder	LAF (11)	10	1.1	0.3	5.5***
	HAF (11)	05	2.2	0.4	
Knee	LAF (6)	05	1.2	0.30	2.37*
	HAF (16)	09	1.77	0.62	
TOTAL	LAF (30)	15	2	0.58	0.89^{NS}
	HAF (45)	27	1.66	0.47	

*significant at .05 Level. **significant at .01 Level, ***significant at .001 Level. NS = Not significant

Table 5: Statistical information of incidence of injuries recorded in low and high level of achievement footballers during competition and training period.

	Injury Incidence during Competition		Injury Incidence during Training		Total	
	LAF	HAF	LAF	HAF	Competition	Training
N	13	19	24	21	37	40
Means	1.44	1.11	1.04	1.71	1.08	1.45
S.Ds.	0.82	0.30	0.20	1.03	0.48	0.83
t-ratios	1.47 NS		3.04 **		2.46 *	

NS= Not Significant, ** Significant at .01 level. *Significant at .05 level.

Table 5 depicts the statistical information of incidence of injuries recorded in the low and the high level achievement footballers during competition and training period periods. Significant differences in the occurrence of injuries are found out in relation to both the competition and the training periods in the combined sample ($t=2.46$, $p<0.05$),

Low level achievement footballers incur significantly less number of injuries as compared to the high level of achievement footballers during the training period ($t=3.04$, $p<.01$). Whilist no significant difference in the incidence of injuries were found between the low and the high level of achievement footballers during the competition period ($t=1.47$).

Table 6: Statistical comparison of incidence of injuries recorded in low and high level of achievement footballers with respect to Lower and Upper Limbs

	Upper Limb (UL).		Lower Limb (LL)		Total (Injury)	
	LAF (18)	HAF (19)	LAF (23)	HAF (30)	UL (37)	LL (53)
N	16	17	22	30	33	52
Means	1.12	1.11	1.04	1.26	1.12	1.01
S.Ds.	0.48	0.47	0.20	0.62	0.45	0.28
t-ratio	0.06 NS		1.83 NS		0.60 NS	

NS = Not Significant

Table 6 gives the statistical comparison of incidence of injuries recorded in the low and the high level achievement footballers with respect to Lower and Upper Limbs. No significant differences were observed in the occurrence of injuries between the low and the high level achievement footballers with respect to the lower and upper limbs.

Table 7: Statistical comparison of incidence of injuries recorded in low and high level of achievement footballers with respect to the causes of injury.

Cause of Injury	Achievement	N	Mean	SD	t-ratios
Foul	LAF	06	0.24	0.57	1.53 NS
	HAF	19	0.70	0.87	
Tackle	LAF	03	0.08	0.27	0.41 NS
	HAF	06	0.15	0.35	
Stumble	LAF	10	0.29	0.51	1.00 NS
	HAF	03	0.07	0.26	
Collision	LAF	09	0.24	0.25	1.11 NS
	HAF	02	0.05	0.21	
Running	LAF	06	0.16	0.36	0.28 NS
	HAF	04	0.10	0.30	
Kicking the ball	LAF	01	0.02	0.16	0.14 NS
	HAF	02	0.05	0.21	
Contact the ball	LAF	02	0.05	0.21	0.29 NS
	HAF	04	0.12	0.39	

Ns = Not significant.

Table 7 depicts the statistical comparison of incidence of injuries recorded in the low and the high level of achievement footballers with respect to the cause of injury. No significant differences were observed between the low and the high level of achievement footballers with respect to different causes like foul play ($t=1.53$), tackle ($t=.41$),

stumble (t=1), collision (t=1.53), running (t=.28), kicking the ball (t=.14) and the ball contact (t=.29).

Table-8: Statistical comparison of incidence of injuries recorded in low and high level of achievement footballers with respect to the nature of injury.

Nature of injury	Achv	No.	Mean	S.D.	t-ratios
Muscle	LAF	14	0.45	0.70	0.32 NS
	HAF	09	0.35	0.75	
Ligament	LAF	11	0.29	0.45	2.55 NS
	HAF	23	0.8	0.73	
Tendon	LAF	5	0.13	0.33	0.02 NS
	HAF	5	0.12	0.34	
Fracture	LAF	3	0.08	0.27	0.21 NS
	HAF	6	0.15	0.35	
TOTAL :	LAF	33	0.23	0.37	0.97 NS
	HAF	43	0.35	0.44	

NS =Not Significant

Table 8 compares the incidence of injuries in the low and the high level of achievement footballers with respect to the nature of injury. Results indicate that no significant differences in nature of injury are found when comparison is made between the low and the high level of achievement footballers.

Discussion:

This study reveals that the high level achievement footballers suffered more injuries as compared to low level achievement footballers. This may be due to the fact that high level achievement footballers spend more time in training and competition. Increased occurrence of injuries in the high level achievement footballers may also be attributed to their increased intensity of the competitive temperament. While considering occurrence of injuries to the footballers belonging to the different field positions, significant differences of injuries were found. The results clearly indicate that those players directly involved in attack or defence are the ones most likely to be injured in this regard, most of the injuries were sustained by the center halves and center forward. With regard to the occurrence of injuries during training and competiton, a significant difference of injuries were found from the combined sample, the high level of achievement footballers was found to have got more injuries as compared to the low level achievement footballers. The relatively high incidence of injuries during training was probably due to the bad technique, low fitness and large amount of over training by the high level of achievement footballers. *Zelisko et al (1982), Ekstrand et al (1983) and Maughan & Miller (1983)* also reported training related injuries in footballers, basketballers and marathon runners and ascribed them to the wrong techniques and poor fitness level of athletes. While comparing the occurrence of injuries between lower and upper limbs, no signifancant differences of injuries were found between the low and the high level of achievement footballers. With respect to the causes of injuries, no significant differences were found in the combined sample. No significant difference between the low and the high level of achievement footballers was found with regard to nature of injury. Similarly comparison of the occurence of injuries with respect to location, revealed no significant difference in the combined sample in the case of hamstring, however, significant injury differences were found in ankle ($t = 3.53$, $P<.01$), shoulder ($t = 5.5$, $P <.001$), and knee ($t = 2.37$, $P <.05$).

Conclusion

Within the limitations of the study, the results provide a useful insight into the cause, nature, location and

outcome of injuries in football at the highest level. It is the first study in India to examine injuries to footballers having low and high level of achievement. This can provide a platform for further research in the area.

Acknowledgement

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Relationship of Anxiety and Acheivement Motivation to Goal Keeping among Secondary School Level Girl Hockey Players

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Abstract

The present investigation has been conducted with the aim to find out the relationship of Anxiety and Achievement motivation to goal keeping among Secondary School level girl hockey players. The study was conducted on ten girl hockey goalkeepers from different schools of Madhya Pradesh, India. Their age ranged between 14-19 years. The Sports Achievement motivation test standardized by Kamlesh and the State and Trait Anxiety inventory of Speilberger was selected for this study. To determine the relationship of anxiety and achievement motivation to goal keeping among girl hockey players, Pearson's product moment method of correlation was used. The level of significance was set at 0.05 level in order to check the significance of calculated correlation. On the basis of findings of the study, significant relationship of state anxiety and trait anxiety to goalkeeping performance was observed for state (0.904) and trait anxiety (0.844) while no significant association with achievement motivation was found.

Key Words: Hockey, Pearson's product moment method, Achievement motivation, State anxiety, Trait anxiety

Introduction

India has been the most powerful field Hockey nation in Olympic history, a fact, which is not as unusual as, one might think. It is due to the popularity of this sport in India. There was a golden era for Indian Hockey between 1928 and 1956, when India won six gold medals and 30 consecutive games. Despite its popularity and performance, in India, scientific studies on Hockey are scanty. Now-a-days girls are also participating actively in Hockey and during last few years our Indian Women's Hockey team has performed well at International level.

The development of sportsman to enable him to achieve high is not only confined to physical process of physical fitness rather it is an accepted phenomena that psycho-socio traits are also required to maintain the balance. Psychology as a behavioral science has made its contribution in improving sports performance.

The success and failure of an individual athlete depends upon his/her physical ability, conditioning, training, mental preparation and the ability to perform well under pressure. It is not uncommon to hear, coaches and athletes express disbelief on how poorly their team performed against a certain opponent or how they feel apart in a crucial situation.

In modern competitive sports, the anxiety developed in sportsmen and sportswomen affect their performance. The sportsmen like other athlete are anxiety prone while participating in competitive sports. Anxiety is a type of emotional disturbance, it may be a motivating force or it may interfere with successful performances.

In the field of physical education and sports, no athletes can win or show better performance without motivation. An understanding of the nature of achievement motivation is helpful in understanding kinds in general as well as individually in terms of what they do, how well they do and how long they continue in sports.

Dureha (1995) administered Sports Achievement Motivation Test *(Kamlesh, 1993)* and Rainer's Sports Competition Anxiety Test to find out achievement motivation and pre-competition anxiety among Indian Inter-varsity Hockey players. He compared high and low pre-anxiety, competition anxiety groups and its effect on achievement motivation. It was concluded that there is a significant relationship between achievement motivation and pre-competition anxiety of Hockey players and significant difference in the level of achievement motivation of high and low pre-competition anxiety group of inter-varsity level male Hockey players.

In modern day sports psychological aspects of the player plays a major role in training and achieving high performance. Because of this, investigation of various psychological aspects related to particular sports and their relation has been a prime importance. The present investigation has been conducted with the aim to find out the relationship of Anxiety and Achievement motivation to goal keeping among Secondary School level girl hockey players.

M**aterial & Method**

The study was conducted on ten girl Hockey goalkeepers from different schools of Madhya Pradesh, India. Their age ranged between 14-19 years. For the selection of questionnaires, the research scholar made sincere efforts to review the related literature, and then held a series of discussions with the experts. Secondly, availability of reliable and valid questionnaire is also an important consideration in directing one's ingenuity for the choice of variable. The sports achievement motivation test standardized by *Kamlesh (1993)* and the state and trait anxiety inventory of *Speilberger et al (1970)* were selected for this study.

The Pearson's product moment correlation method was used to find out the relationship of anxiety and achievement motivation to goalkeeping among girl Hockey players. Descriptive statistics - mean and standard deviation was used to describe the average and variability of trait anxiety, state anxiety and goalkeeping performance.

Results & Discussion

The descriptive measures in terms of means and standard deviation of the girl Hockey players in achievement motivation, trait and state anxiety scores, and goalkeeping performance are shown in table-1.

Table 1: Mean and standard deviation of girl Hockey players in sports achievement motivation, trait and state anxiety and goalkeeping performance

Variable	Mean	S.D.
Sports Achievement motivation	21.60	15.80
Trait Anxiety	38.20	25.14
State Anxiety	35.30	20.80
Goolkeeping Performance	4.70	4.52

Table 1 show that the mean and standard deviation of girl Hockey players in sports achievement motivation were 21.6 and 15.8. In case of trait and state anxiety the mean and S.D. were 38.2 ±

25.14 and 35.3±20.8 respectively. For goalkeeping performance the mean and S.D. were 4.7 and 4.52.

Table 2: Relationship of Trait & State anxiety and Achievement Motivation to goalkeeping performance among girl Hockey players

Variables	Correlation Coefficient
Trait Anxiety and Goolkeeping Performance	-0.844*
State Anxiety and Goolkeeping Performance	-0.904*
Achievement Motivation and Goolkeeping Performance	-0.380

Significant at 0.05 level

Table 2 shows the relationship of trait anxiety to goalkeeping among girl Hockey players and indicates a correlation value of – 0.844, which was significant as it was negatively correlated with value of 0.632 required for significance at 0.05 levels. Table – 2 indicates a correlation value of –0.904 for the state anxiety to goalkeeping, which was significant as it was negatively correlated with value of 0.632 required for significance at 0.05 level.

The findings of the study showed significant negative correlationship of state and trait anxiety to goalkeeping performance. Further achievement motivation levels of goalkeepers were found to be unrelated to goal keeping performance. Competitive sporting situation always arouses anxiety *(Singh, 1982)*; fear of failure is most prominently identified as principal factor of arousal of anxiety in such context. Anxiety in both the forms i.e. trait and state leads to perception of situation or surrounding with feeling of apprehension and threat leading ultimately to heightened emotional condition. Emotionally charged state of mind interferes with normal functioning of nervous system. In this state of mind the focus of attention rapidly fluctuate between situational perceptions and resultant physical and physiological responses. This nervous, physical and physiological disturbance, which is resultant of anxiety ultimately, affects mental and physical preparedness of sportsman and interferes further with concentration, reaction time, co-ordination, and accuracy of movement thereby affecting the sports performance *(Ghosh et al, 1991).* Hence the negative relationship of both trait and state anxiety to goalkeeping performance may be attributed to this factor.

The subjects for this study were of school level. By comparison, the standard was below average. Hence the players were of lesser standard and of average achievement motivation level. This may be the reason that no significant relationship was found between motivation and goalkeeping performance. On the basis of findings of the study the hypothesis that there will be significant relationship of state anxiety, trait anxiety and achievement motivation to goalkeeping performance is accepted for state and trait anxiety and rejected for achievement motivation.

Table–2 shows the relationship of achievement motivation to goalkeeping among girl Hockey players and indicates a correlation value of 0.38 which was not significant as it was lesser than the correlation value of 0.632 required for significance at 0.05 levels.

Conclusion

- Trait anxiety is negatively related to goalkeeping performance.

- State anxiety of inter school level goalkeeper has negative co-relation with their goalkeeping performance.
- Trait and state anxiety may negatively affect goal-keeping performance.
- The level of schoolgirl goalkeepers is of average level and therefore level of achievement motivation has no relationship with their performance.

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Double Crossed Syndrome in Cricketer's Shoulder: RCT

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Abstract

The purpose of the study was to identify the effect of stretching and strengthening exercises on double crossed syndrome in cricket bowlers. This study was carried out at Belgaum Cricket Club and Union Gymkhana, Belgaum. The sample consisted of 30 male fast bowlers with double crossed syndrome. Their demographic data was collected and participants were randomly allocated into two groups (Study & Control) of 15 each after obtaining their informed consent. Pre-interventional measurements were taken in terms of Forward Head Posture (FHP), Forward Shoulder Posture (FSP), Head to Shoulder Translation (HST), Head to Ankle Translation (HAT), Shoulder to Ankle Translation (SAT), New York Postural Rating Scale (NYPRS). Shoulder stretching and strengthening exercises were carried out using a theraband for a period of six weeks, following which post interventional measurements were taken. Interventional group showed statistically significant differences in terms of FSP, HST, SAT, NYPRS when compared with the control group. It is concluded that shoulder stretching and strengthening exercises are effective in reducing the muscular imbalance pattern in double crossed syndrome.

Key Words: Cricket bowlers, Forward shoulder posture, NYPRS.

Introduction

Cricket is one of the major international sports played in more than 60 countries. In India, cricket has always been much more than a sport. Although a non-contact sport, injuries in cricket are common and have been documented as far back as 1751 *(Brasch, 1971).* In 1970, cricket was regarded as a sport of 'Moderate Risk Injuries'. These days' cricketers are more susceptible to high risk injuries and cricket ranks 5th among causes of non-fatal accidents, because today players are expected to train themselves longer, harder and earlier in life, to excel in sport *(Weightman & Browne, 1971).* Cricket bowlers like other throwing sports involve repeated forceful ballistic arm actions which will put a great deal of eccentric load on the shoulder rotator cuff muscles predisposing them to injuries *(Stretch, 2001).* Bowling has been found to be the major cause of cricket injuries with 38% to 47.4% of schoolboy bowlers sustaining injuries in cricket *(Stretch, 1995 & Honcock & Hawkins, 1996).* Scapular instability is found in as many as 68% of rotator cuff problems and 100% glenohumeral problems. The abnormal scapular biomechanics that occur as a result of this dysfunction create imbalance between agonist and antagonist muscles and predispose the shoulder to injuries *(Voight & Thomson, 2000).*

To achieve peak performance during overhead activity, there must be optimal balance between mobility and stability. Most of the shoulder problems are due to improper technique and unbalanced upper body workouts. In highly trained athletes, an adaptation of increased activation of agonist over antagonist muscles has been reported in both upper and lower extremities. As a result of these neuromuscular and strength adaptations, the commonly observed forward head and rounded shoulder in bowlers develop overtime *(Kluemper et al, 2006).* Possibly this phenomena is

caused by the stronger internal rotator and adductor muscles pulling the clavicle and scapula forward over the weaker external rotator and abductor muscles, leading to the forward shoulder posture *(Kluemper et al, 2006)*.

Wide varieties of physiotherapy approaches have been suggested for strengthening and stretching of rotator cuff muscles for the correction of forward shoulder posture. *Kendall et al (1993)* and *Suhrmann (2002)* suggested that stretching of tight muscles and strengthening of the antagonist muscles is the appropriate intervention for correcting this positional or postural fault caused by muscle imbalance. If this forward shoulder posture can be addressed through a program of stretching and strengthening, perhaps the risk of shoulder injuries can be reduced.

The purpose of the study was to evaluate the effectiveness of six weeks stretching and strengthening program on forward shoulder posture in young competitive fast bowlers.

Materials and Methods

Thirty male high school and college age competitive cricket fast bowlers from Belgaum Cricket Club and Union Gymkhana, Belgaum served as subjects in the study. Subjects were included in this study if they fulfilled the following criteria:

- Cricket fast bowlers with forward shoulder posture, without shoulder pain, with no restriction in bowling and no restriction in training as a result of shoulder pain.

Subjects with recent humerus fractures, recurrent shoulder dislocation, recent shoulder surgeries, neurological pain like cervical radiculopathy and bowlers with any other associated problems other than that of forward shoulder posture (rotator cuff tendonitis, impingement syndrome etc) were not included.

Testing procedure

Measurements of both the right and left shoulder of each subject were taken before and after a 6-week stretching and strengthening program. A device known as carpenter's trisquare and New York Postural Rating Scale (only shoulder component) was used for the measurements.

Participants were asked to stand the way they usually do (without footwear). A plumb line was hung vertically slightly anteriorly to the ankle in the saggital plane. The posture of the shoulder was then scored as per New York Postural Rating Scale (NYPRS) and the scoring was given as 5, 3 or 1 as described by *Arnold et al (2000).* For the next measurement, participants were asked to stand with their back toward the wall without leaning on the wall. Various measurements were taken (from wall till tragus of ear, from wall till 2 cms below the acromion process, from the wall till lateral most aspect of the lateral malleolus).

Exercise Programme

Six weeks of stretching and strengthening program along with normal training was administered to the interventional group after recording the initial measurements. At the first session, the participants were introduced to the different levels of theraband exercise bands. These bands are colour coded with each colour representing a different resistance. The participants were given

the opportunity to do 5-repetitions of each exercise with several levels of theraband in order to estimate which level was appropriate for them. While these test exercises were being conducted, the participants were evaluated for proper technique. The participants then carried out the prescribed protocol for the first week of strength training; 3 sets of 10 repetitions of all the strengthening exercises i.e. scapular retraction, external rotation and shoulder flexion for lower trapezius. After the end of the third week the participants progressed to the next higher level of resistance using the theraband. This exercise progression was based on the work of *Wang et al (1990)* in which a similar protocol produced significant strength gains. The exercises were conducted three times per week.

The nature of stretching exercises were demonstrated and described to the participants. The first stretch for anterior chest muscles required the participant to assume a supine position on a 5-inch diameter from roll, which ran down the centre of the back. The subject's partner was asked to grasp the subject's shoulder and slowly press down in the direction of the floor until instructed to stop and hold for 30 seconds. This was repeated twice per training session. The second stretch for shoulder internal rotators required the subject to assume a kneeling position in front of his standing partner and lace his fingers behind the subject's scapulae, lacing his fingers together as well. The partner was asked to pull in a diagonal direction, both up and back from the subject's trunk, until instructed to stop. The stretch was held for 30 seconds and repeated twice per training session The change in forward head posture, forward shoulder posture, head to shoulder translation, head to ankle translation, shoulder to ankle translation and New York Postural Rating Scale (NYPRS) measurement was calculated (posttest score – pretest score) for both shoulders in each group. To determine the effectiveness of the intervention, the difference score was used to compare the two groups and statistical evaluation was done by using a student unpaired-t-test.

Results and Discussion

Table 1: Demographic Variables

Variable	Control Group	Study Group	't' value	Df	'p' value
Age	19.07 ± 2.02	18.8 ± 2.14	0.35	28	0.728
Height	167.87 ± 3.94	168.27 ± 4.10	0.27	28	0.787
Weight	63.93 ± 3.43	61.93 ± 7.09	0.98	28	0.334
BMI	22.33 ± 1.11	21.67 ± 2.06	1.10	28	0.279

The difference between the pretest and post test measurement of FHP, FSP, HST, HAT, SAT and NYPRS (shoulder component) are presented table 2. The interventional group showed statistically significant decrease in FSP (mean difference -5.2 ± 0.67 as compared to -1.4 ± 0.50, observed in control group ($p = 0.000$), increase in NYPRS score (mean difference 3.46 ± 0.91 as compared to 0.67 ± 0.97, in control group $p = 0.000$). Student unpaired 't' test was used as a test of significance to evaluate the intragroup effectiveness of the two treatment protocols under consideration in the present study.

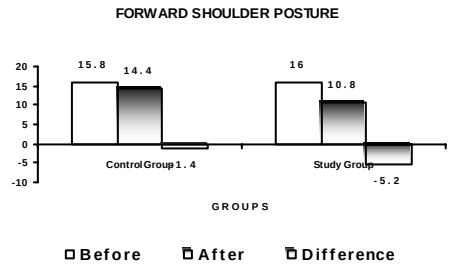

Figure 1: Effect of training on Forward Shoulder Posture

Table No. 2: Effect of training on study variables

Parameters		Control Group (Mean±SD)	Study Group (Mean±SD)	't' value	df	'p' value
FHP	Pre	8.40±0.63	8.40±0.74	0.00	28	1.00
	Post	8.40±0.74	8.40±0.74	0.00	28	1.00
	Diff	0.00	0.00	-	28	-
FSP	Pre	15.80±0.68	16.00±0.93	00.67	28	0.51
	Post	14.40±0.74	10.80±0.77	13.04	28	0.00*
	Diff	-1.40±0.50	-5.2 ± 0.67	17.41	28	0.00*
HST	Pre	7.40± 0.74	7.60 ± 1.06	00.60	28	0.55
	Post	6.00± 0.76	2.40 ± 1.06	10.73	28	0.00*
	Diff	-1.40±0.50	-5.20±0.67	17.41	28	0.000*
HAT	Pre	4.13± 0.83	4.33± 1.05	00.57	28	0.57
	Post	4.13± 0.83	4.33± 1.05	00.57	28	0.57
	Diff	0.00	0.00	-	28	-
SAT	Pre	11.53±0.92	11.93±1.10	1.08	28	0.29
	Post	10.13±0.99	6.73± 0.80	10.34	28	0.00*
	Diff	-1.40±0.50	- 5.20±0.67	17.41	28	0.00*
NYPRS	Pre	1.00±0.00	1.40± 0.83	1.87	28	0.07
	Post	1.67±0.98	4.87±0.52	11.22	28	0.00*
	Diff	0.67±0.97	3.46±0.91	8.10	28	0.00*

* 'p' < 0.05 Significant

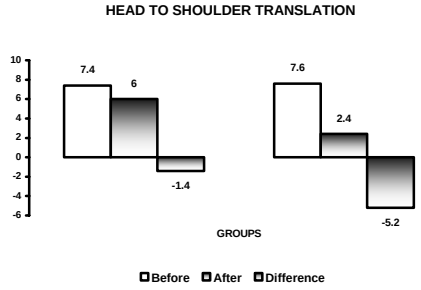

Figure 2: Effect of training on Head to Shoulder Translation

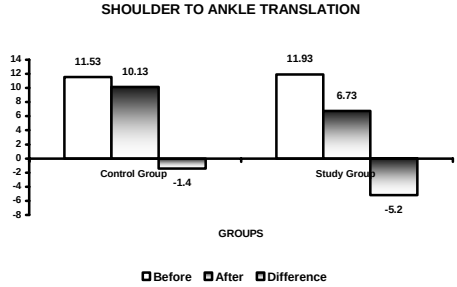

Figure 3: Effect of training on Shoulder to Ankle Translation

Discussion

The present study showed that six weeks stretching and strengthening exercise program of shoulder muscles along with normal training would be of benefit in correcting the forward shoulder posture in Cricket fast bowlers. There was significant difference in forward shoulder posture, head to shoulder translation, shoulder to ankle translation and New York postural rating scale (shoulder component) on the forty-second day as compared to the first day. Based on the theories of muscle imbalance, clinicians postulate that strengthening of the posterior scapular stabilizers combined with stretching of pectoral muscles can correct posture and muscle imbalance and can alter scapulohumeral rhythm thus helpful in promoting shoulder injuries *Wang et al (1990)*.

The exercise progression used in this study was based on the work of Wang

et al in which a similar exercise protocol of stretching of tight muscles and strengthening of weak muscles produce significant strength gains, reducing the shoulder injuries thus by correcting the posture of the shoulder. *Rozier and Schafer (1981)* compared the maximum isometric and isotonic muscle torques before and after six-week exercise program (three times per week and daily for five times per week). They showed that the strength gains were significant in both groups.

Shoulder impingement syndrome may result form altered shoulder posture and decreased scapular upward rotation. This belief is based on the notion that when the shoulder is abducted overhead with insufficient scapular upward rotation, the greater tuberosity and acromian becomes too close and therefore the soft tissues in the subacromial space may be pinched by the bony structures. Based on this idea exercises focusing on scapular muscles must be prescribed to improve the scapular upward rotation thus improving the posture of the shoulder (*Piane and Voight, 1993).* Weak muscles cannot be strengthened if their antagonist counterparts are not stretched. Thus it is important to stretch anterior chest muscles, such as pectoralis major and minor before starting the strengthening exercise protocol for scapular muscles to correct the rounded shoulder posture.

Studies with different population, using a different series of strengthening exercises showed an increase in strength and correcting shoulder posture (*Lukasiewicz et al, 1999).* Combining stretching of the hypertrophied anterior shoulder muscles with strengthening of relatively weaker posterior muscles might have a significant synergistic effect on shoulder posture. A stretching program that requires a 30 second hold and repeats each exercise two times has been demonstrated to increase the muscle length in hamstrings *(Bandy et al, 1997).* This focused stretching routine, aimed at lengthening the shoulders internal rotator and adductor muscles combined with the strengthening exercise improves the posture of the shoulder.

Conclusion

Shoulder stretching and strengthening exercises are effective in reducing the muscular imbalance and correcting the forward shoulder posture in cricket fast bowlers. Thus shoulder stretching and strengthening exercises should be incorporated in the regular training of cricket fast bowlers to prevent shoulder injuries.

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Effect of Aerobic Training on Body Mass Index on Sedentary Obese Men

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Abstract

The aim of this study was to investigate the effect of Aerobic training on Body Mass Index on sedentary obese men. Thirty obese Men were selected randomly and equally divided into two groups - Experimental group and Control group. The experimental group was administered aerobic training programme, five days in a week for a period of 8-weeks. The control group did not involve in any fitness programme or training programme. Once in 2 weeks the load was increased. The Body Mass Index (BMI) was selected as variable. The collected data were analyzed by using 't' ratio. From the findings it is quiet interesting to know that the sedentary obese men have positive influence upon their Body Mass Index due to the training programme given. The aerobic training helped the subjects to decrease the weight and BMI. It is thus concluded that mild aerobic training can be adopted by obese men to decrease the magnitude of obesity.

Key Words: **Body mass index, Sedentary obese, Aerobic training programme**

Introduction

There has been outstanding advancement in the medical field which has taken place during the last few years, in arresting and finding cures for many incurable maladies, but obesity has so far successfully eluded most of them, as has cancer. The present generation is in constant quest for a remedy for this malady. New solutions for slimming are coming up every other day, in the form of pills and potions that are gaining entrance in many physicians consulting rooms. Many are manufacturing ultra modern drugs with tall claims of weight reducing effects.

Crash diets are experimented with varying effects *(Keil, 2002 and Alison et al, 2007)*. Stay trim devices are being manufactured and advertised in order to lure those who wish to lose weight, to go in for a trial. Fast weight reductions have been reported to cause gall stone formations (*Liddle et al, 1989, Totani, et al, 2008).* Health clubs that advertise fitness and weight reducing programmes are attracting young and old from all corners. Some of these programmes are no doubt effective, but they cost too much and consume a lot of energy. Sometimes except for an over all well being, they never help reduce a single pound. Reducing weight can be a natural activity and an enjoyable pastime for those who do not suffer from any other serious disease. They can reduce by adopting a method that suits their physical, mental and psychological needs. However, the proper weight reducing remedies are those, which do not leave the individual with, any bad or undesirable after effects and at the same time have a lasting effect. Obese people, who lead a fairly comfortable and carefree life, may detect

the very idea of having to really toil for achieving a thing like a trim figure or good health. Their mistaken conception is, that if external help is available, they can achieve better results in reducing their weight without themselves doing anything much. Through such help though some modes of treatment is available, they require the actual participation and absolute co-operation of the individual during the course of treatment. This is because unless the individual realizes that it is his responsibility to lose weight, the weight-reducing program will be a total failure.

Automation has modified the need for physical activities. Elevators, automobiles, two and four wheelers and the like have replaced walking, cycling and other natural exercises in the lives. Competition in every field has created a tendency towards more brainwork than physical work for a large group of people. They consequently take up tension-ridden jobs. Physical neglect caused by this is resulting in obesity in most cases. Aerobic exercise is recommended to lose weight. Aerobic exercise does not mean that you should work your muscles strenuously to some tune played in a recorder as it is found in many health clubs. Aerobic is a system of exercising by means of rhythmic activities. These include walking, swimming, cycling, rowing, skating and many such activities. Even rope, skipping is an aerobic exercise. The aim of such exercise is to improve fitness through increased oxygen consumption *(Park et al, 2003; Wong et al, 2008).* Aerobic exercise programs have been reported to improve body composition, lipid profile and lipid utilization in the body of normal and obese subjects (*Blaak et al, 2002; deGlisezinski et al, 2003; Nassis et al, 2005; Okura et al, 2005; Polak et al, 2006*). Dancing to a tune and exercising the muscles is not recommended for persons suffering from complicated health problems. One should select the type of aerobic exercise that suits his need instead of doing exercises recklessly. Waking is the best aerobic exercise that even a heart patient can do. Most obese people do have at least some minor heart and lung ailments.

Material and Method

The aim of this study was to investigate the effect of aerobic training on Body Mass Index (BMI) on sedentary obese men. The investigators randomly selected 30 obese men and divided them into two groups, 15 subjects were assigned to an experimental group and 15 subjects to the control group. Prior to the administration of test, the investigators held a series of meetings with the subjects and made them clear about the objectives and purposes of the test. The testing procedure was explained to them in detail. They were requested to co-operate and participate in the training programme. BMI was selected as variable. The experimental group was administered physical training programme five days in a week for a period of 8 weeks. The control group did not involve in any fitness program or training programme.

The subjects were given warming up exercises for a period of 10 minutes before starting the training session. It included jogging, stretching, rotation at various joints, walking on heels and toes, forward bend, backward bend, sideward stretch, rotation of shoulder joints, hip joints, stretching of calf and quadriceps muscle groups.

The details of the training schedule are given below.

Training Schedule

WEEK	TRAINING IN MINUTES
First two weeks	5 min. walking and 5 min. Jogging
3 - 4 weeks	10 min. walking and 5 min. Jogging
5– 6 weeks	15 min. walking and 10 min. Jogging
7– 8 weeks	30 min. walking and 20 min. Jogging
Warm Down	10 min.

After the training sessions the subjects were asked to go for limbering down exercises. It included slow jogging, light stretching and slow rotation exercises.

The BMI of a subject was calculated by measuring the height in meters and body weight in kilograms. The following equation was used to calculate the Body Mass Index.

$$\text{BMI}=\frac{Weight(kg)}{Height(m)^2}$$

A persons Body Mass Index calculation can be compared with the following ranges:

< 20 is underweight;
20 to 25 is desirable weight,
25 to 30 is overweight;
30 to 30 is obese and
> 35 is very obese.

To compare the mean difference between initial and final scores of experimental and control group, 't' test was employed with Body Mass Index.

Results & Discussion

Table 1: Mean standard deviation, standard error and 't' ratio of Experimental and Control groups in Body weight and Body Mass Index.

Variables	Groups	No	Mean		Mean Difference	SD	SEM	'T'
Body Weight	Group I	15	Initial	88.65	1.15	3.60	0.93	9.65*
		15	Final	87.50		3.57	0.92	
	Group II	15	Initial	90.19	073	2.58	0.67	1.70
		15	Final	90.26		2.51	0.65	
Body Mass Index	Group I	15	Initial	30.79	0.47.	0.78	0.20	6.83*
		15	Final	30.32		0.71	0.18	
	Group II	15	Initial	31.08	0.02	0.79	0.20	1.70
		15	Final	31.10		0.77	0.20	

* Significant at 0.01 levels.

In Table 1, the calculated 't' value for experimental group in the case of body weight was 9.654 which was significant in statistical terms. But in the case of control group the calculated't' ratio was 1.703 which was lower than the required table value. This shows that the training program resulted in a significant reduction in the body weight of experimental group. The calculated' value for experimental group in Body Mass Index was 6.826 which was higher than the required table value at 0.01 levels. But in the case of control group the calculated't' ratio was 1.696 which was lower than the required table value. This shows that the training programe caused a significant reduction in the Body Mass Index in the experimental group.

Discussion

All the subjects of the experimental group involved in this study had undergone regular aerobic training

programme for a period of eight weeks. From the table it was evident that in the case of Body Mass Index there were significant changes noticed after eight weeks of regular Aerobic training. As regard to control group no changes were seen in the Body Mass Index.

From the findings it is quiet interesting to know that the sedentary obese men have positive influence upon their Body Mass Index due to the training programme given. The Aerobic training helped the subjects to decrease the weight and also helped them to keep the heart healthy.

Conclusion

Participation in eight weeks of aerobic training resulted in improved in Body Mass Index.

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Specific Skills Profile of Male Handball Players

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Abstract

The purpose of this study is to prepare the 'norms profile' of specific skills of handball players with a view to compare and evaluate further planning of handball game as it's not being practiced in our country at present. So, an objective was set by the researchers to prepare the norms for each important specific skill of handball game at school, university and senior level of performance. Total of five hundred eighty six (N=586) players of handball were examined during School National championship (N=200), All India Inter University championship (N=195) and Senior National championship (N=191). The tests of specific skills of Handball, standardized by Singh (2007) were used to record the specific skills of handball players. The percentile values were distributed through SPSS. These prepared norms are presented in tabular form. The research evaluation highlights that there is an increase of specific skills with participation level of handball players. Speaking specifically, the 'different levels' include the level of school to university and then from university to senior level. The implicational interpretation will result in the form of an increased competitive ability of the players.

Key words: Skills, Norms, Profile and Handball Players.

Introduction

Specific skills are always considered as the fundamental and important aspects of the game. *Neil and Mezey (1981)* believe that, "first consideration in the training programme in handball must be given to skills". *AAHPER (1969)* concluded, "skill tests and norms always help the students to evaluate their performance in the game and to provide an impetus to improvement". In field hockey *Brar (1975)* prepared the norms of hockey players, *Subramaniam (1981)* in basketball and *Kumar (2002)* standardized the test and prepared the norms of each skill of soccer players. *Dey and Parthasarthy (1998)* prepared the percentile norms of Eastern Region and North-Eastern Region children for comparison with SAI manual and they found the norms have a great importance particularly in talent spotting in these regions. *Bosen et al (1984)* compared the physical fitness level of Indian javelin throwers with international norms and found, our throwers are poor in fitness level. But norms of specific skills, especially of handball players for the purpose of comparison and evaluation for further planning of handball game, are yet not available in our country. So the objective was set by the researchers to prepare the norms for each important specific skill of handball game i.e. catching, passing, shooting, throwing, footwork and dribbling at school, university and senior level.

Material and Methods

In this study a total of five hundred and eighty six (N = 586) male handball players were evaluated for the construction of percentile norms of specific skills for school, university and senior level. The total comrised of two hundred (N=200) players who participated in the School National championship held at Amritsar (Pb.) and Delhi; one hundred ninety five (N=195) players of All India Inter University championship held at Raipur (Chhatishgarh), and Annamali (Tamil Nadu); one hundred and ninety one (N=191) players of Senior National championship held at Jamshedpur (Jharkhand). The age of subjects ranged from 16 to 32 years. The mean age of school players was 17.70, university players 22.02, and senior players 24.16 years. The data was collected skill and level wise. Specific skills recorded included catching, passing, throwing, shooting, footwork and dribbling by following the tests standardized by *Singh (2007).* The percentile values were obtained through the Statistical Package for Social Sciences (SPSS).

Results

The percentile norms of male handball players are presented in tables 1, 2 and 3.

Table 1: Percentile Values of Specific Skills of School Level Handball Players (N = 200)

Skills	Percentiles								
	20th	30th	40th	50th	60th	70th	80th	90th	10th
Catching (Scores)	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
Passing (Scores)	6.00	8.00	8.00	8.00	10.00	10.00	10.00	12.00	12.00
Throwing (Scores)	2.00	2.00	3.00	4.00	4.00	6.00	6.00	8.00	8.00
Shooting (Scores)	4.00	4.40	6.00	6.00	6.00	6.00	8.00	8.00	8.00
Foot work (Scores)	13.00	14.00	14.00	15.00	15.00	16.00	16.00	17.00	18.00
Dribbling (Time)	9.80	9.28	8.58	8.19	7.82	7.50	7.25	6.89	6.54

Table 2: Percentile Values of Specific Skills of University Level Handball Players (N = 195)

Skills	Percentiles								
	10th	20th	30th	40th	50th	60th	70th	80th	90th
Catching (Scores)	13.00	14.00	15.00	16.00	16.00	17.00	18.00	18.00	20.00
Passing (Scores)	8.00	9.00	10.00	11.00	12.00	12.00	12.00	14.00	16.00
Throwing Scores)	6.00	6.00	7.00	8.00	8.00	8.00	9.00	10.00	10.00
Shooting (Scores)	6.00	6.00	6.00	8.00	8.00	8.00	8.00	8.00	10.00
Foot work Scores)	14.00	14.00	15.00	16.00	16.00	17.00	17.00	18.00	18.00
Dribbling (Time)	8.48	7.92	7.40	7.10	6.78	6.46	6.25	5.96	5.74

Table 3: Percentile Values Of Specific Skills of Senior Level Players (N = 191)

Skills	Percentiles								
	10th	20th	30th	40th	50th	60th	70th	80th	90th
Catching (Scores)	18.00	18.00	19.00	20.00	20.00	20.00	21.00	22.00	23.00
Passing (Scores)	12.00	14.00	14.00	16.00	16.00	16.00	18.00	18.00	20.00
Throwing (Scores)	8.00	10.00	10.00	11.00	12.00	12.00	13.00	14.00	14.00
Shooting (Scores)	8.00	8.00	9.20	10.00	10.00	10.00	10.00	10.00	12.00
Foot work (Scores)	16.00	17.00	18.00	19.00	19.00	20.00	21.00	22.00	23.00
Dribbling (Time)	6.94	6.50	6.25	6.10	6.00	5.92	5.76	5.63	5.40

It is observed from table1, 2 and 3 that percentile values of each skill at 10th, 50th and 90th percentile increase in number as the level goes higher whereas dribbling time decreases as the level goes higher.

Discussion

Skill acquisition involves learning to execute movements with the minimum effort to achieve predetermined effects. The discussion on construction of percentile norms of specific skills for male handball players is based on the manifest that performance level of players goes higher as the age and level of player increases i.e., from school to university and from university to senior level. Since an individual is limited to perform one complex task at a particular time, an individual may have to divert all of his intentional capacity toward a new task. As individuals practice a particular motor skill, they eventually learn to eliminate extraneous movement and to effectively coordinate muscles to act as a single functional unit. As skills become automatic, considerably less thought is necessary to effectively complete the task. This allows skilled performers to attend to other relevant cues in the environment instead of the particular movement. The variation in specific skills between school, University and senior players may be due to age, level, training age, quality of practice and it may also be the difference in habit as reported by *Malina (1988).*

Younger players are in general faster learners than older players, but how much the player will learn from training also depends on the skill level he possesses. If the skill level is lower than the training will be faster. Training on very low skill level is many times faster than on medium skill level, and training on very high skill level is slower than on medium skill level. Apart from age and skill level, there are four factors deciding the effects of training: the intensity of training, training type, the amount of stamina training, and the quality of the coaching given. It is further evaluated that the skill ability will show a remarkable increase in terms of competitive performance if the skill training is introduced to the young players at an early age.

The results of previous studies conducted by *Sangral (1986),* prepared the norms of specific skills of male hockey players on goal shooting,

dribble and push, scoop for accuracy dribble and hit, hitting and stopping. *Singh (1990)* presented the norms of specific skills of male volleyball players on volleying, lifting and serving. *Shergill (1990)* presented percentile of female hockey players on specific physical fitness abilities. They concluded that as the age and level of player's increases, the performance level also goes higher. Players and trainers can employ these results for improving their specific skills and competitive performance.

Conclusion

The percentile norms have been prepared to record the performance of male handball players of school, university and senior level. Norm values showed the increasing trend from school to university and university to senior level.

Implications

These norms can find utility in planning training strategies for the handball players.

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A Comparative Study of Growth Pattern and Motor Quality of Boys of Jawahar Navodaya Vidyalaya and Kendriya Vidyalaya in Chhattisgarh, India

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Abstract

A cross sectional study of the physical growth and physical fitness was carried out on 900 boys, aged 10+ to 18+ years in Jawahar Navodaya Vidyalaya (JNV) and Kendriya Vidyalaya (KV) of Chhattisgarh. The study was aimed to find out the growth pattern of the boys of JNV, which is a residential school of children from the rural area, and was compared with the boys of KV, a non-residential school of the children of Central government employees including defense personnel. Anthropometric measurements taken in to consideration are stature, body weight, sitting height, biacromial diameter, biilliocristal diameter, upper arm circumference, calf circumference and triceps, biceps and sub scapular skin folds. Data was also collected for vertical jump and pull-ups to measure motor fitness components. All anthropometric measurements show increasing trend with age in both groups, but it is not uniform in all the ages. However, comparison revealed that, the JNV boys' show lower values for almost all the anthropometric measurements in most of the ages but the motor fitness variables exhibited better scores for JNV boys. When height and weight of the JNV and KV boys were compared with all India (ICMR) boys, the JNV and KV boys are observed to be taller and heavier than the all India boys at all ages.

Key Words: Physical growth, Physical fitness, Boys

Introduction

Human growth is a dynamic changing process and is being influenced by heredity and environment. Genetic component and environment both contribute to attain final body structure. Certain factors like disease, proper diet, time, cultural pursuits, geographical conditions etc. have tremendous influence in the growth of a child.

Concern for the welfare of the school children is the next impetus to the study of growth. It has been realized that only mental or academic activity can adversely effect the growth and development of a child as most of the blood circulation is towards brain depriving other organs from it.

Health and physical education programs aid students in achieving their fullest potential through the acquisition of knowledge and skill necessary to attain healthy levels of well being and to maintain active life styles through out life span. Healthy and physically active life style of a person helps to increase capacity for effective work, positive behavioral choices and increased academic pursuits.

It has been observed that growth curves of various body dimensions vary from one population to another *(Tanner, 1960; Hiernaux, 1964, 1968)*, while growth differences of this kind are primarily genetical in origin, they may be considerably influenced by environmental factors. *Mitra & Singrol (1982)* in a study reported growth pattern of Chhattisgarh girls to be superior to Manali Rajput girls but inferior to Orriya urban girls, whereas age, weight growth pattern of Chhattisgarh

girls is inferior to Manali Rajput girls and some what superior to girls of south India.

Many factors are known that affect growth and development *(Tanner, 1961; Johnston et al, 1980).* Heriditary *(Susanne, 1980)* as well as environmental factors are important in the process of growth and development *(White Law, 1971; Cook et al, 1973; Malcom, 1974; Lindgren, 1976; Johston, 1980).* Results of body composition have shown that children living under better social circumstances are not only heavier, because they have more developed skeleton and musculature but also have more body fat (*Bodzsar, 1999). Mayuri & Madhvilata (2000)* in a study of physical development of rural adolescents found that age, class and overall socio-economic status scores were significantly related to weight and stature. *Singh & Singh (2000)* reported that there was difference in the body dimensions of affluent and non-affluent Meitei boys of Manipur aged 12-18 years. Similar results were reported by *Chang (1969), Bailey (1970), Miller et al (1972) and Evelenth & Tanner (1976)* in developing and developed countries. Comparable findings were also reported in Indian context by *Udani (1963), Sharma & Kaul (1970), Banik et al (1972), ICMR (1972), Garg (1978) and Singh & Malhotra (1991).*

Material & Methods

The present study was conducted on students of Jawahar Navodya Vidyalaya [JNV] and Kendriya Vidyalaya [KV]. JNV is a residential school, predominantly for the children of rural area whereas the KV is a non residential school, mainly for the students belonging to urban area.

A total of 900 boys formed the sample for the present study, 450 boys from JNV and KV each. The age of the students ranged from 10+ years to 18+ years. The students were classified into four categories according to the surname, personal identification and certificate issued by Government of India/Chhattisgarh. The categories were ST, SC, OBC & General. Accordingly it is indicated that a higher percentage of boys of JNV belonged to ST from rural areas whereas boys belonging to caste population were more in KV as compared to JNV. Keeping in mind the differences with regard to ethnicity, geographical locale as well as socioeconomic status between the two schools, the study was conducted to compare the growth pattern of JNV and KV boys. Stature, body weight, sitting height, biacromial diameter, biilliocristal diameter, upper arm circumference and calf circumference were recorded according to the standard procedures *(Weiner and Lourie, 1969).* Physical fitness test for explosive strength and shoulder strength were measured by vertical jump and pull ups. Descriptive analysis was carried out and comparative statistics was used to observe difference between JNV & KV boys on various anthropometric measurements and physical fitness components. Correlation coefficient was computed to see the relationship between anthropometric and physical fitness variables. SPSS was used to compute data *(Nie et al, 1975).*

Results

All anthropometric measurements exhibit uniform increase with advancement of age in both groups. However, the JNV boys had lower value in all anthropometric measures as compared to KV boys. The difference

being statistically significant at almost all ages.

Figure 1: Distance curve of stature among the boys

The distance curve of height shows gradual increase during the growth period from 10+ to 18+ years age among JNV and KV boys. The maximum difference between two successive ages is 5.63 cm among JNV boys and 6.11 cm among KV boys, which is in correspondence with adolescent growth spurt. Second increment in case of stature was observed at 14+ years in JNV boys and 17+ years in KV boys. Higher standard deviation in case of JNV at 14+ and KV at 11+ years age may be due to higher individual variability. KV boys seem to be taller than JNV boys in almost all the age groups.

Table 1: Mean and standard deviation for anthropometric measurements of JNV and KV boys by age

AGE GROUP (YRS.)	N	HEIGHT (CM)		WEIGHT (KG)		SITTING HEIGHT (CM)		BIACROMIAL DIAMETER (CM)		BIILIOCRISTAL DIAMETER (CM)		UPPER ARM CIRCUM. (CM)		CALF CIRCUM. (CM)	
JNV Boys		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
10+	50	139.18	6.98	33.28	6.36	71.78	4.50	31.14	1.09	20.92	1.79	18.50	1.43	25.85	3.23
11+	50	142.10	7.84	34.02	6.85	72.41	3.66	32.06	0.27	21.20	2.42	18.96	1.75	26.93	2.09
12+	50	146.96	7.72	34.14	5.68	73.08	4.64	33.29	1.88	22.13	1.91	19.78	1.62	28.43	1.73
13+	50	150.58	7.25	37.26	4.59	76.31	4.06	34.31	3.41	23.50	1.69	20.96	1.91	29.50	2.37
14+	50	156.21	8.05	40.08	3.81	78.11	4.71	35.28	3.56	29.52	1.59	21.05	2.57	31.30	2.61
15+	50	161.64	6.15	45.31	6.56	81.00	4.23	36.06	3.58	24.98	2.31	22.65	2.37	32.10	3.34
16+	50	165.36	5.60	48.07	5.37	83.86	3.27	37.18	3.45	25.10	1.63	23.76	2.13	32.57	2.54
17+	50	169.04	6.00	51.11	6.88	85.88	3.78	38.13	3.08	25.69	3.71	24.44	1.88	32.58	2.37
18+	50	170.08	7.54	53.08	4.82	87.43	4.54	39.16	4.89	26.02	2.91	25.32	2.71	34.35	4.16
								KV Boys							
10+	50	141.00	6.56	33.83	7.23	72.78	5.63	32.17	2.80	22.23	2.82	20.34	3.33	27.15	2.87
11+	50	144.04	9.18	34.71	6.83	73.36	6.03	32.38	2.40	22.96	2.28	20.56	2.42	27.47	2.57
12+	50	150.15	8.00	40.87	9.19	77.98	4.87	34.06	2.93	23.61	2.14	20.74	2.74	29.44	3.17
13+	50	155.89	6.48	45.38	9.98	79.40	5.35	35.91	2.94	24.15	2.43	22.06	2.81	29.93	2.85
14+	50	160.68	8.47	45.97	7.27	81.41	4.47	36.24	2.27	25.16	2.80	22.62	2.45	30.24	2.69
15+	50	163.91	7.68	50.87	8.58	82.49	4.15	38.00	3.24	25.95	3.25	23.72	3.10	32.93	3.29
16+	50	167.02	6.71	54.52	10.31	85.26	3.94	38.18	2.87	26.03	4.36	24.29	5.37	33.01	6.78
17+	50	170.92	4.83	55.32	7.95	88.20	4.42	39.19	2.13	26.22	2.22	24.76	3.28	33.61	4.33
18+	50	172.80	4.91	55.72	7.79	88.99	3.47	40.06	2.29	26.38	2.85	25.86	2.73	34.89	4.18

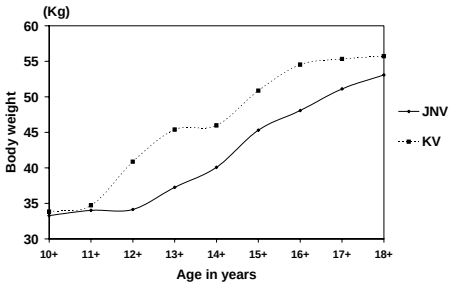

Figure 2: Distance curve of weight among the boys

The mean weight of JNV and KV boys was almost same at the age of 10+ and 11+ years but after 11+ years the mean weight of KV boys crossed the distance curve of weight of JNV boys. From 11+ years onwards there was rapid increase in weight of KV boys. The maximum increase in weight was 5 kg among JNV boys between 14+ and 15+ years and 6.16 kg for KV boys between 11+ and 12+ years which are in

concurrence with growth spurt in both the groups. Second phase of increment in weight was observed at 15+ years for both groups.

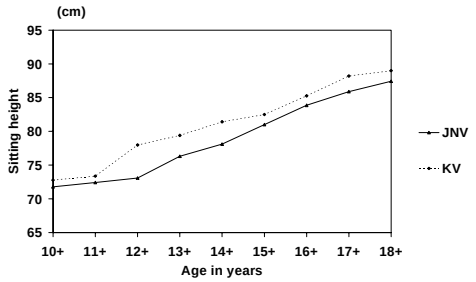

Figure 3: Distance curve of sitting height among the boys

The distance curve of sitting height for KV boys remains slightly higher than the JNV boys throughout the age range under study. The increment for both the groups was gradual and uniform. The maximum age group difference in sitting height between two successive age groups is 3.23 cm among JNV boys between 12+ and 13+ years and 4.62 cm among KV boys between 11+ and 12+ years indicating the adolescent growth spurt. Next increment was observed at 15+ years for JNV boys and at 16+ years for KV boys. Higher standard deviation was observed at 12+ years in JNV boys and 14+ years in KV boys.

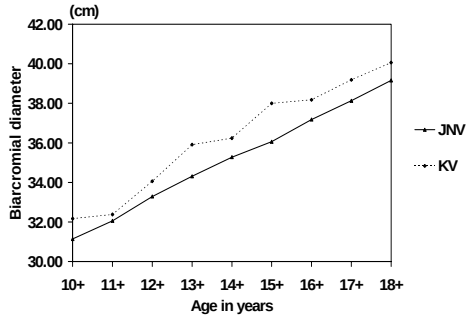

Figure 4: Distance curve for biacromial diameter among boys

Biacromial diameter for two groups shows that the distance curve for KV boys crosses that of JNV boys after 11+ years and then continues to rise at more rapid rate than the JNV boys. The growth pattern in this variable was gradual for both the groups but uniform in JNV boys. The maximum increase of 1.23 cm between 11+ and 12+ years in JNV boys and 1.85 cm between 12+ and 13+ years for KV boys were observed. A comparison of distance curves of the biacromial diameter for two groups reveal that the curve for KV boys was higher than those of JNV boys through out the age under study. Second spurt of growth was observed at 15+ years for JNV boys and at 13+ years for KV boys.

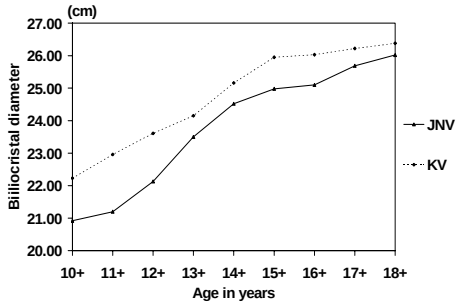

Figure 5: Distance curve for bicristal diameter among boys

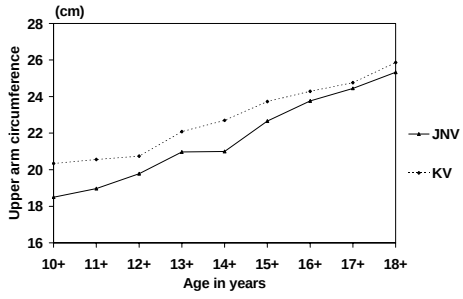

Figure 6: Distance curve for upper arm circumference

A comparison of distance curve of biiliocristal diameter exhibits that KV boy's remains at a higher level than JNV boys through out the ages. The growth

spurt was observed at the age 14+ years for JNV boys and at 13+ years for KV boys. The difference between the two successive age groups was 1.01 cm and 1.37 cm for JNV boys and KV boys respectively.

Upper arm circumference exhibits gradual and smooth increment throughout the age groups. KV boys seem to be slightly on higher side in all the age groups. The maximum age group difference between two successive age groups is 1.66 cm between 14+ and 15+ years and 1.34 cm between 12+ and 13+ years for JNV and KV boys respectively, which indicates the adolescent growth spurt of the two groups.

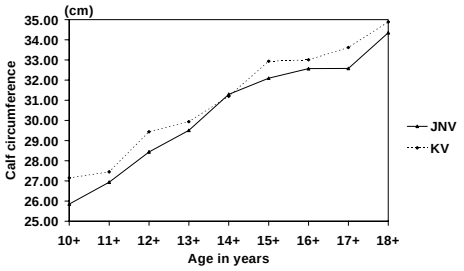

Figure 7: Distance curve for calf circumference

The KV boys had slightly higher value for calf circumference as compared to JNV boys. The growth increment was smooth, gradual and almost parallel for the two groups. Adolescent growth spurt was observed at 12+ years for JNV boys as the maximum age group difference was 1.91 cm between 14+ and 15+ years whereas in KV boys the maximum age group difference was 1.99cm between 11+ and 12+ years, corresponding to the growth spurt.

The performance in vertical jump increased with increase in age in both the groups. The performance recorded were 34.13/26.53 cm at 10+ to 48.86/47.60 cm at 18+ in JNV & KV children respectively. Performance of JNV children were significantly higher in all the age groups accept at 18+. The scores of pull ups test for shoulder followed same trend like other motor component JNV children scores were significantly high. Minimum and maximum mean scores were 22.26 & 17.52 at 10+ and 37.62 & 28.34 at 18+ for JNV & KV respectively.

Table 2: Mean, SD and t-value of selected motor ability tests of JNV & KV boys (10+-18+ years)

		Vertical Jump, Cm		Pull-Up Test Score	
		JNV	KV	JNV	KV
10+	Mean	34.13	26.53	26.26	17.52
	SE	0.82	0.50	0.87	0.54
	SD	5.84	3.54	6.16	3.83
	t test	7.86 **		8.51**	
11+	Mean	34.41	31.00	28.18	18.40
	SE	0.75	0.68	1.12	0.64
	SD	5.32	4.83	7.93	4.54
	t test	3.35 **		7.56**	
12+	Mean	38.20	35.10	31.92	19.06
	SE	0.93	0.95	1.40	0.64
	SD	6.59	6.78	9.92	4.53
	t test	2.32 *		8.33**	
13+	Mean	40.75	35.27	34.28	18.62
	SE	1.04	0.95	1.51	0.57
	SD	7.38	6.77	10.69	4.06
	t test	3.87**		9.68**	
14+	Mean	44.19	37.82	32.56	20.72
	SE	1.08	1.19	1.34	0.65
	SD	7.70	8.47	9.50	9.64
	t test	3.94**		7.91**	
15+	Mean	44.68	38.04	33.06	20.80
	SE	0.86	0.71	1.00	0.53
	SD	6.09	5.04	7.12	3.77
	t test	5.94**		10.75**	
16+	Mean	48.00	43.58	36.32	22.48
	SE	0.65	0.90	1.10	0.67
	SD	4.66	6.40	7.83	4.77
	t test	3.94**		10.66**	
17+	Mean	48.54	44.01	37.62	27.32
	SE	0.66	0.55	0.81	0.51
	SD	4.73	8.93	5.76	3.61
	t test	5.20**		10.70**	
18+	Mean	48.86	47.60	33.24	28.34
	SE	0.60	0.68	0.71	0.58
	SD	4.27	4.81	5.02	4.14
	t test	1.38		5.32**	

*p <0.05, ** p<0.01

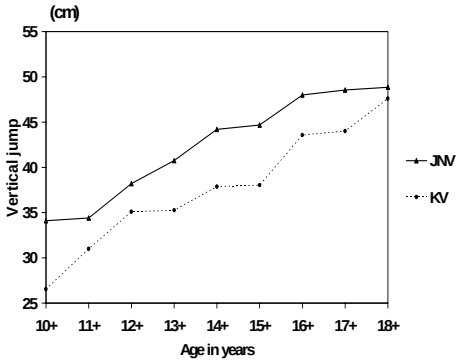

Figure 8: Distance curve for vertical jump

The distance curve of Vertical jump shows a gradual increase during growth period of 10+ to 18+ years age among JNV & KV boys. The JNV boys exhibited higher scores than KV boys throughout the growth period under study. The maximum difference between two successive ages is 11.01 cm among JNV boys between 11+ and 12+ years and 16.80 cm among KV boys between 10+ and 11+ years.

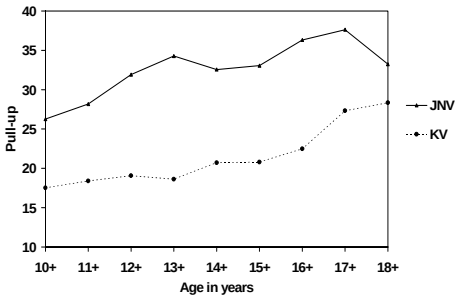

Figure 9: Distance curve for Pull up

The distance curve of Pull-up shows gradual increase during the growth period of 10+ to 18+ years age among JNV & KV boys. The JNV boys showed better score than KV boys throughout the growth period under study. The maximum difference between two successive ages is 13.27 among JNV boys, between 11+ and 12+ years and among KV boys the maximum differences recorded was 21.53 between 16+ and 17+ years.

The Vertical jump of JNV boys when compared with KV boys was found to be higher in all the age groups. However, the inter group difference is non-significant at 18+ years of age. The scores of Pull-up of JNV boys when compared with KV boys were found to be higher in all the age groups. The inter group difference is significant in all the ages.

The difference in mean stature, weight, sitting height, biacromial diameter, upper arm circumference and calf circumference between JNV and KV boys are shown in table 2. The KV boys were taller than JNV boys at 13+ and 14+ years ($p<0.01$) and 17+ years ($p<0.05$) of age. Significant difference between the two groups was observed in weight, the KV boys being heavier at 12+, 14+, 15+, 17+ years ($P<0.01$) of age and at 18+ years of age ($p<0.05$). The boys of KV have significantly higher sitting height at 12+, 14+, 18+ ($p<0.01$) and 17+ ($p<0.05$) years of age.

Biacromial diameter exhibited significant differences between the two groups at age group 10+, 13+ and 17+ years. KV boys showed significantly higher values at 0.01 level. Higher values for biiliocristal diameter was also observed for KV boys at age 10+, 11+ and 13+ years ($p<0.01$). In case of upper arm circumference there was significant difference between the two groups for 10+, 11+, 12+, 13+ and 14+ years of the age groups, KV boys showed higher values than JNV boys. Calf circumference was higher in KV boys at 10+, 12+ and 14+ years of age.

Table 3: Test of signification of various Anthropometric measurements between the JNV and KV boys

Age Group (Yrs.)	Height (Cm)	Weight (Kg)	Sitting Height (Cm)	Biacromial Diameter (Cm)	Biiliocristal Diameter (Cm)	Upper Arm Circumference. (Cm)	Calf Circumference. (Cm)
10+	1.35	0.40	0.98	2.42*	2.78**	3.57**	2.13*
11+	1.33	0.51	0.95	0.73	3.74**	3.76**	1.15
12+	2.02	4.40**	5.15	1.58	3.66**	2.14*	1.97*
13+	3.02**	5.52	3.25**	2.50*	1.56	2.27*	0.82
14+	2.71**	5.06**	3.60**	1.60	1.45	3.12**	1.99*
15+	1.63	3.64**	1.77	2.83**	1.73	1.93	1.25
16+	1.34	3.92**	1.92	1.58	1.40	0.65	0.44
17+	2.34*	2.83**	2.82**	2.01*	0.87	0.59	1.48
18+	1.15	2.04*	1.99*	1.17	0.63	0.99	0.65

The comparison of 5th through 95th percentile indicates that 90% of the 10+ year boys of JNV & KV have attained weight of 25.28 kg and 23.00 kg to 62.80 and 69.23 kg respectively while at 18+ years of age 90% boys' attained weight ranging from 45.92 and 44.33 Kg to 62.80 and 69.23 Kg.

Stature of JNV & KV boys when compared with 5th and 95th percentile of 10+ years showed that 90% of the boys attained stature of 128/128.64 cm to 154.18/152.52 cm, the corresponding stature values for 18+ years boys of JNV & KV ranged from 153.65/165.21 cm to 179.28/179.85 cm respectively. This shows gradual widening range of variation with increase of age from 10 to 18+ years.

Percentile scores on biacromial diameter showed that 90% of JNV & KV boys of 10+ to 18+ years measured between 31.14 and 32.17 cm to 39.16 and 40.06 cm respectively. Similarly comparison of percentile score of biiliocristal diameter showed wide range variation with increase of age, 5th percentile score of girth measurements also showed wide range of variation from 5th to 95th percentile for the two groups of different ages. 90% of the JNV & KV boys measured between 21.53 and 21.90 cm at 10+ years of age to 28.33 and 28.60 cm at 18+ years of age respectively.

Comparison of upper arm girth between 5th & 95th percentile of 10+ years boys of JNV & KV showed that 5th percentile score of JNV and KV boys observed were 16.28 and 16.78 cm at 10+ years and 21.12 and 26.73 cm 18+ years of age respectively. It is evident from the percentile scores that the increase in 5th percentile between 10 to 18 years is 16.28 and 22.55 cm while during the same age increase in 95th percentile is 21.12 and 31.50 cm respectively in JNV and KV boys.

It is evident from the percentile values of vertical jump of JNV and KV boys that vertical jump shows steady rise from one age to the next but not uniform in all ages and also the upper limit (95th percentile) of age group 10+ year does not overlap with the lower limit (5th percentile) of age group 18+ years. The comparison between 5th and 95th percentile of all ages of JNV and KV boys shows that most of the children scored between 24.73/56.58–19.51/56.01 cm. The striking feature is that both in JNV and KV boys, between 5th and 95th percentiles of each group, the data ranges

has increased along with the advancement of age.

The percentile value of Pull-up scores of JNV and KV boys showed steady rise from one age to the next but not uniform in all ages and also the upper limit (95th percentile) of age group 10+ year does not overlap with the lower limit (5th percentile) of age group 18+ years. The comparison between 5th and 95th percentile of all ages of JNV and KV boys shows that most of the children scored between 18.00 to 42.90 and 13.10 to 36.0 respectively. The striking feature is that both in JNV and KV boys, between 5th and 95th percentiles of each group, the data ranges has increased along with the advancement of age.

Table 4: Correlation between anthropometric and physical variables among JNV boys

	Weight	Biacromial Diameter	Bicristal Diameter	Upper arm circumference	Calf circumgerence	Vertical Jump	Pull up
Height	**.80****	**.63****	**.63****	**.70****	**.71****	**.68****	**.32****
Weight		**.62****	**.63****	**.76****	**.72****	**.64****	**.27****
Biacromial Diameter			**.48****	**.55****	**.51****	**.48****	**.26****
Bicristal Diameter				**.61****	**.66****	**.58****	**.25****
Upper arm circumference					**.74****	**.60****	**.27****
Calf circumgerence						**.60****	**.30****
Vertical Jump							**.40****

*p <0.05, ** p<0.01

Table 5: Correlation between anthropometric and physical variables among KV boys

	Weight	Biacromial Diameter	Bicristal Diameter	Upper arm circumference	Calf circumference	Vertical Jump	Pull up
Height	**.77****	**.78****	**.51****	**.50****	**.57****	**.70****	**.54****
Weight		**.79****	**.57****	**.66****	**.73****	**.56****	**.43****
Biacromial Diameter			**.52****	**.52****	**.59****	**.59****	**.45****
Bicristal Diameter				**.45****	**.50****	**.34****	**.28****
Upper arm circumference					**.82****	**.39****	**.32****
Calf circumgerence						**.45****	**.33****
Vertical Jump							**.57****

*p <0.05, ** p<0.01

Table 6: Comparison of body weight of JNV boys and KV boys with other Indian studies

Age (yrs.)	A Present study		B Inter national Studies (NCHS)		t-test (A &B)	C Indian studies (ICMR, 1972)		t-test (A and C)
JNV Boys	**Sample**	**Mean**	**Sample**	**Mean**		**Sample**	**Mean**	
10+	**50**	**33.28**	**334**	**35.4**	**2.14***	**961**	**23.6**	**10.08****
11+	**50**	**34.02**	**324**	**39.8**	**5.16****	**1012**	**26.2**	**7.90****
12+	**50**	**34.14**	**349**	**44.2**	**10.06****	**990**	**28.6**	**6.76****
13+	**50**	**37.26**	**348**	**49.6**	**6.67****	**930**	**32.4**	**2.78****
14+	**50**	**40.08**	**359**	**56.9**	**11.36****	**941**	**35.9**	**3.05****
15+	**50**	**45.31**	**359**	**61.0**	**6.03****	**904**	**40.3**	**2.41***
16+	**50**	**48.07**	**349**	**66.8**	**10.95****	**918**	**43.9**	**2.61****
17+	**50**	**51.11**	**339**	**67.5**	**8.15****	**785**	**46.5**	**2.40***
18+	**50**	**53.08**	**1758**	**73.9**	**15.65****	**724**	**47.9**	**3.95****
				KV Boys				
10+	**50**	**33.83**	**334**	**35.4**	**1.41**	**961**	**23.6**	**9.47****
11+	**50**	**34.71**	**324**	**39.8**	**4.59****	**1012**	**26.2**	**8.60****
12+	**50**	**40.87**	**349**	**44.2**	**2.33***	**990**	**28.6**	**9.37****
13+	**50**	**45.38**	**348**	**49.6**	**2.74****	**930**	**32.4**	**9.08****
14+	**50**	**45.97**	**359**	**56.9**	**9.73****	**941**	**35.9**	**9.50****
15+	**50**	**50.87**	**359**	**61.0**	**8.14****	**904**	**40.3**	**8.52****
16+	**50**	**54.52**	**349**	**66.8**	**7.91****	**918**	**43.9**	**7.18****
17+	**50**	**55.32**	**339**	**67.5**	**9.37****	**785**	**46.5**	**7.67****
18+	**50**	**55.72**	**1758**	**73.9**	**15.94****	**724**	**47.9**	**6.92****

*p <0.05, ** p<0.01

Table 7: Comparison of stature of JNV and KV boys with other Indian studies

Age (yrs.)	A Present study		B Inter National Studies(NCHS)		t-test (A & B)	C Indian studies (ICMR, 1972)		t-test (A & C)
JNV Boys	**Sample**	**Mean**	**Sample**	**Mean**		**Sample**	**Mean**	
10+	**50**	**139.18**	**334**	**140.9**	**1.64**	**961**	**128.6**	**10.58****
11+	**50**	**142.10**	**324**	**146.4**	**6.64****	**1012**	**133.5**	**7.54****
12+	**50**	**146.96**	**349**	**152.2**	**4.48****	**990**	**138.3**	**8.25****
13+	**50**	**150.58**	**350**	**159.2**	**7.63****	**930**	**144.6**	**5.64****
14+	**50**	**156.21**	**359**	**167.1**	**8.93****	**941**	**150.2**	**5.00****
15+	**50**	**161.64**	**359**	**170.8**	**9.64****	**904**	**156.5**	**15.54****
16+	**50**	**165.36**	**349**	**174.5**	**10.39****	**918**	**160.1**	**6.19****
17+	**50**	**169.04**	**338**	**175.5**	**6.94****	**785**	**162.6**	**7.16****
18+	**50**	**170.08**	**1755**	**176.6**	**6.04****	**724**	**163.8**	**5.66****
KV Boys								
10+	**50**	**141.00**	**334**	**140.9**	**0.10**	**961**	**128.6**	**12.92****
11+	**50**	**144.04**	**324**	**146.4**	**1.74**	**1012**	**133.5**	**7.98****
12+	**50**	**150.15**	**349**	**152.2**	**1.69**	**990**	**138.3**	**10.22****
13+	**50**	**155.89**	**350**	**159.2**	**3.25****	**930**	**144.6**	**11.76****
14+	**50**	**160.68**	**359**	**167.1**	**5.06****	**941**	**150.2**	**8.38****
15+	**50**	**163.91**	**359**	**170.8**	**5.99****	**904**	**156.5**	**6.56****
16+	**50**	**167.02**	**349**	**174.5**	**7.33****	**918**	**160.1**	**6.99****
17+	**50**	**170.92**	**338**	**175.5**	**5.87****	**785**	**162.6**	**11.09****
18+	**50**	**172.80**	**1755**	**176.6**	**5.35****	**724**	**163.8**	**12.00****

*p <0.05, ** p<0.01

The stature and weight of the present study were compared with *NCHS (1990) & ICMR (1972)* data. The weight scores of JNV & KV boys were lower than NCHS at all the ages and the difference is statistically significant. When compared with National standard *(ICMR, 1972)* data on weight and stature were significantly lower than the boys of present study.

Discussion

Analysis of various body measures and nature of the distance curves reveals that the mean values of the different body measurements were representing more or less increasing trend with advancement of age. The rate of increase was however, not uniform in all the age groups. Further, it was noted from the distance curves that up to the 11+ years of age, KV boys remain at a higher level than JNV boys for most of the measures.

It was also observed that most of the body measure show age group difference which extended between 11+ to 15+ years in JNV boys and 11+ to 14+ years in KV boys which suggests that adolescent period last for about two to three years. The age group difference at many age levels was close to "HPV" for various body measurements indicating a high degree of multimodality growth spurt.

The growth gradient values of various measures revealed that more than 90 percent of total growth took place before 13+ years of age. The KV boys were found to have significantly higher values for body weight, stature, biacromial and biiliocristal diameter and upper arm and calf circumference measurements. It was also observed that the scores of physical fitness test i.e. vertical jump and pull ups test were higher in JNV boys as compared to KV boys.

From the percentile values it can be concluded that the growth pattern of JNV and KV boys was faster than the all Indian children but slower than NCHS. There may be several socio-cultural and environmental factors associated with this

phenomenon. The factors responsible for the same have to be identified and proper intervention strategies are to be evolved in future.

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