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

I am happy that the **Volume 8, No. 2 issue** of **Journal of Exercise Science and Physiotherapy** ***(JESP)*** is ready for the readers. This issue of JESP contains twelve research articles on different important aspects of exercise science. **Sinku from Nanded, Maharashtra** examined the effects of health related physical fitness programmes that are covered in the academic programme of physical education department in different colleges of the Swami Ramanand Teerth Marathwada University Nanded, Maharashtra on the cardio respiratory functions of sedentary students and that the programme was beneficial to the students from improving their health related physical fitness. **Kumar, Ashok et al from Punjab** investigated the effects of anaerobic training on Hoffmann reflex (H- reflex) response parameters in sprinters & non-athletes and found that training of skeletal muscles lead to the differences in H- reflex response parameters between sprinters & non-athletes. **Kumar et al from Haryana** evaluated the effect of PNF techniques on the gait parameters and functional mobility in hemiplegic patients and demonstrated that the PNF technique had significant effect on gait parameters & functional mobility as compared to conventional therapy in patients with hemiplegia. Theie findings show that the walking speed has a significant effect on functional mobility in stroke patients. **Kaur & Narkeesh** from Patiala, Punjab tested the Reliability and Validity of Integrated Proprioception Screening Scale & Its Sensitivity in Parkinson's disease and concluded that it is a valid & sensitive scale to any change or deficit in proprioception. Bala et al from Panipat, Haryana investigated the effect of endurance exercises on trunk extensor muscles endurance and pain on 38 subjects of both genders ranging in age between 18 to 40 years suffering from subacute non specific low back pain and concluded that both trunk extensors endurance training and general mobility stretching strengthening exercises are equally effective in reducing pain and increasing endurance in patients with non-specific subacute low back pain. **Kumar et al from Patiala, Punjab** observed the effects of different workloads (i.e. volume patterns-3 RM, 6 RM, 9 RM) of power clean on blood lactate production in female weight lifters. They concluded that the blood lactate response depends upon the maximum absolute load lifted by the weight lifters as compared to the volume of load lifted. **Egwu et al from Obafemi Awolowo University, Ile – Ife, Nigeria** prepared Normative values of spine range of motion (ROM) for the proper diagnosis of spinal impairments. They established a set of reference values for lumbar spinal flexibility in healthy Nigerians. Increasing age was associated with decreased spinal flexibility. Saha & Haldar from West Bengal compared the Health related physical fitness variables and Psychomotor ability between rural and urban school going children and observed significant differences between Rural and Urban school going children in all the Health related Physical fitness components as well as in Reaction ability under Psychomotor ability and Rural school going children was found better than Urban school going children. **Sinku from Nanded, Maharashtra** also reported differences in the cardiovascular fitness level between rural and urban collegiate students and reported better cardiovascular fitness of rural over urban students. **Kaur & Sidhu from Amritsar, Punjab** studied the prevalence of obesity and hypertension in newly diagnosed diabetic patients of Amritsar (Punjab), attending diabetic clinics. They reported that the percentage prevalence of obesity in diabetic females was higher than diabetic males while the diabetic males were more hypertensive than diabetic females. To manage the profile of the diabetic patients, proper awareness and prevention and management of obesity and hypertension is essential. **Goyal and associates from Mullana, Haryana** investigated the effect of a cervical collar use and traditional physiotherapy treatments on functional disability and grip strength in cervical radiculopathy patients. They concluded that patients of cervical radiculopathy who used cervical collar alongwith traditional physiotherapy treatment demonstrated early recovery from pain, grip strength, disability index. Kumar Ashok and coworkers studied the VO_2max and haemodynamic profiles of women national/university level boxers and reported that women boxers of their study had less mean value of VO_2max (aerobic fitness) than that reported of elite national and international boxers.

S.K. Verma

Effect of Health-Related Physical Fitness Programmes on the Cardio-Respiratory Function of Sedentary Students

Sinku, S.K.

Assistant Professor, Department of Physical Education, Swami Ramanand Teerth Marathwada University. Nanded, Maharashtra

Abstract

The purpose of the study was to examine the effects of health related physical fitness programmes that are covered in the academic programme of physical education department on the cardio respiratory functions of sedentary students. Fifteen sedentary male students studying in different colleges of the Swami Ramanand Teerth Marathwada University Nanded, Maharashtra, India volunteered to be the subjects for the study. The mean age, height and weight of these students were 20.3+2.66 years, 172.33+5.99 cm. and 69.29+4.01kg respectively. Resting heart rate, vital capacity, breath holding capacity after expiration and inspiration and respiratory rate were recorded at the begging of 2009-2010 academic year in this study on all the subjects. The health related physical fitness programme was administered for twelve weeks, 5 days a week and for 120 minutes a day. Mean scores and standard division were take and paired t-test was applied. A significant effect on resting heart rate (t=4.44, p<0.05) respiratory rate (t=4.15, p=0<.05) and vital capacity (t=4.30, p=0<.05) was observed. However no significant effects on breath holding capacity after expiration (t=0.07) & breath holding capacity after inspiration (t=0.72) was observed. In the study it was found that twelve weeks of health related physical fitness programme resulted in a significant decrease in the resting heart rate and respiratory rate with significant increase in the vital capacity. According to the results it can be concluded that diet and health related physical fitness programme in physical education department is not only beneficial to increase the cardio respiratory functions and improve physical fitness of sedentary students but also improve the cardio respiratory functions of players of various sports disciplines and general people. The study provides a platform for further research in the field of physical education.

Keywords: Health Related Physical Fitness Programme, Resting Heart Rate, Vital Capacity, Breath Holding Capacity

Introduction

The importance of physical programmes is linked to a higher quality of life as well as academic achievements. It is well documented that regular physical activity in childhood and adolescence improve strength & endurance, health build, healthy bones & muscles, hips control weights, reduce anxiety and stress increases self esteem and may improve cardio reparatory function. Physical fitness is recognized as an important component of health *(Limb et al, 1998; Twisk et al, 2002)* and it may be important for the performance of functional activities and quality of life *(Noreau and Shepherd, 1995; Stewart et al, 1994).* Low physical fitness may result in high physical strain during the performance of activities *(Bruining et al, 2007).* As a consequence, activity levels may decrease due to fatigue and discomfort, exacerbating low physical fitness.

Keeping in view the fact that student's physical fitness has important health consequences during their study, a large number of studies on physical fitness have been reported from different corners of the world. Data on the physical fitness students from *Denmark (Knutgen, 1961), England (Campbell & Pohndof, 1961), South Africa (Slon, 1966), Belgium (Hebbelink & Borms, 1969), Israel (Ruskin, 1978), Japan (Ishiko, 1978)* are available in the literature and all these reports made the health planners realize the importance of the contribution of health education & physical fitness in the development of total fitness.

Day by day the importance of young population is being declared in many platform by international organizations, politicians and scientists according to the statistics of world health organization the deficiency of physical activates of adults is approximately 17% *(Berggren, 2005, Angilley and Haggas, 2009)* in the world. In developed countries 10 to 15% of young population involve in sports *(Yitzhak, 2009)*, with a trend of decrease in the percentage in the developing and undeveloped countries. Participation in physical activities is rapidly decreasing especially in the college and university education, academic education in the universities focuses on the specialization in preferred fields. It is observed that physical education and sports lessons in Swami Ramanand Teerth Marathwada University are decreasing seekers as is trend in other institutes. Physical fitness has an important role in the education of new generation in the frame of physical and mental health and now days it is placed as a piece of education in the developed societies, education programmes. The study regarding the physical fitness programmes can be placed in a special categorize in the area of physical education, Sports sciences and medical sciences. In this contest, fitness programme applications that are covered in the study field of physical education departments have an important role. Therefore this study endows to examine the effects of health related physical fitness programmes that are covered in the academic programme of physical education department on the resting heart rate, reparatory rate, vital capacity and breath holding capacity.

Materials and Methods

Subjects: Twenty sedentary students from various colleges of Swami Ramanand Teerth Marathwada University Nanded, volunteered to participate in the health related physical fitness programmes. Exclusion criteria were the presence of chronic medical conditions such as asthma, heart disease or any other condition that would put the subjects at risk when performing the experimental tests. The subjects were free of smoking, alcohol and caffeine consumption, antioxidant supplementation and drugs during the programmes. They completed an informed consent document to participate in the study. The age, height, weight, resting heart rate, vital capacity, respiratory rate, and breath holding capacity of all subjects were measured in the laboratory of the Physical Education department. All the 20 subjects acted as the experimental group for health related physical fitness programmes with no control group.

Applied training programme

Training programme was planned for a period of 12 weeks and was administered 5 days a week and for 60 min each day. Exercises involving the use of large muscles groups that could be maintained continuously and are aerobic in nature were included in the programme. These exercises included walking, running, jogging, and climbing, jumping and cross country running. There was training programmes in the academic schedule of physical education department. The exercise session consisted of Warm - up period of 10 min., and was combined with callisthenic – type stretching, exercise and progressive aerobic activity. However cool down period was kept for 5 to 10 min.

Parameters measurements

Heart rate was measured by counting radial pulse for a min. The respiratory rate was taken by keeping palm on the stomach and counting the total number of breath for a period of 30 sec. and doubled later on to get the respiratory rate per min. Vital capacity was measured in in standing position in liters by using dry spirometer. Each subject was provided a trial before the final tests. Breath holding capacity after expiration of students was tested by an electronic watch. The subjects were instructed to stand erect with legs bended, after getting signal the students exhale air through his nostrils. The total time of air holding of the students was measured in seconds. Similarly breath holding capacity after inspiration of the student was measured by also measured by electronic watch. The subject was instructed to stand erect with legs bended after getting signal the students inhale air through his nostrils. The total time of air holing capacity after inspiration of the students was measured in seconds.

Stastical analysis: Stastical technique used for analyzing the collected data in the study was't' value.

Results & Discussion

All subjects were tested for resting heart rate, vital capacity, respiratory rate, breath holding capacity after expiration and inspiration. The collected data were analyzed by t – ratio with the level of significance set at 0.05.

The mean standard deviation and t value analyzed for each dependent variable separately.

Table 1 statistical analysis of heart rate before and after programmes.

Stages	N	Mean	SD	t-value
Before programmes test	20	76.13	8.40	4.44*
After Programmes test	20	64.66	5.42	

*** Significant at 0.05 level.**

Table 2: Statistical information of respiratory rate before and after health related fitness physical fitness programmes.

Stages	N	Means	SD	t
Before programmes test	20	19.53	3.65	4.15*
After Programmes test	20	15.13	3.65	

***Significant at 0.05 level.**

Table 3: Statistical information of before and after fitness programme with respect to vital capacity

Stages	N	Mean	S.D.	t
Before fitness programme	20	2150	431	4.54
After fitness Programme	20	2931	637	

Table 4: Analysis of breath holding capacity after inspiration before & after health- related fitness programmes.

Stages	N	Mean	SD	t
Before programmes test	20	42	28	1.02 NS
After Programmes test	20	53	39	

NS=Not significant

Table 5 analysis of breath holding capacity after expiration before and after health related fitness programmes.

Stages	N	Mean	SD	t
Before programmes test	20	69	26	0.65NS
After Programmes test	20	85	28	

NS=Not significant

The data obtained before and after health related fitness programme with respect to vital capacity were analyzed by t statistics are presented in table 3. Table 3 depicts that mean of vital capacity before fitness programme was 2150 & after fitness programme was 2931. The t statistics so that there was significant increase in vital capacity after fitness programme.

Discussion

Depending on the health related fitness programme, significant increase vital capacity after health related fitness programme, if the capacity of the player is high then more amount of oxygen could be inhaled and maximum of CO2 could be exhaled out.

This will thus purify the blood and thus give more energy to the sedentary students and more is the capacity of the sedentary students to hold breath in itself will certainly increase the cardio vascular efficiency of the students. *(Culos – Reed et al, 2006).* Finally, health related fitness programme have an important role for sedentary students to feel themselves better.

Conclusions

It is found that the health related fitness programme in the physical education schedule have beneficial effects in on the improvement of cardio vascular of sedentary students, besides this, it may be also concluded that the result the present study indicate that trainees get experience in their occupation, be happier and this is important to improve their knowledge owing to communicating mutually. In this perceptive, physical fitness make education more active and effective in physical education colleges that educate students in movement basis.

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Comparison of H-Reflex Response of Sprinters & Non-Athletes

Kumar[1], Ashok, Soodan[2], J.S., Kumar[3], Rajesh. & Kaur[4], L.

[1]Asst. Prof., Dept. of Sports Science, Punjabi University Patiala (Punjab) India, Email: akashokin@gmail.com
[2]Scientific Assistant, Department of Sports Physiology, SAI NS NIS Patiala (Punjab) India
[3]Associate Professor, Department of Physical Education, Osmania University, Hyderabad (Andhra Pradesh) India
[4]Government Medical College, Amritsar, Punjab

Abstract

The aim of this study was to investigate the effects of training type (anaerobic) on Hoffmann reflex (H- reflex) response parameters in sprinters & non-athletes. For this purpose, 10 male Sprinters (Group 1) and 10 male non-athletes (Group 2) were involved in this study in which the amplitude and latency values of H- reflex were measured with the help of an equipment called "Neuroperfect" (Medicaid Systems, India). Statistical analysis was performed by using statistical software 'SPSS,' means ± SD and student's *t* test was used. The mean age and body height of group 1 & 2 were 23.93 ± 2.65 years & 173.12±6.40 cm and 24.28 ± 2.45 years & 168.80±3.25 cm respectively. The H-reflex amplitude and latency values found in groups 1 & 2 were 3.13±0.22 mV & 22.77±2.82 ms and 6.19±0.44 mV & 26.79±1.85 ms respectively. There was no statistically significant difference between the groups with respect to latencies of H- reflex. In the test group (sprinters), the amplitude of the H-reflex was significantly smaller than the non-athlete group ($p<0.05$). The results of this study suggest that training of skeletal muscles affect the H- reflex response parameters.

Key words: Sprinters, H- reflex, Amplitude, Latency, Training

Introduction

The H-reflex is an estimate of alpha motoneuron (αMN) excitability when presynaptic inhibition *(Zehr, 2002)* and intrinsic excitability *(Capaday, 1997)* of the αMNs remain constant. This measurement can be used to assess the response of the nervous system to different neurologic conditions, *(Fisher, 1992)* musculoskeletal injuries, *(Hopkins & Palmieri, 2004)* application of therapeutic modalities, *(Krause et al, 2000)* pain, *(Leroux, 1995)* exercise training, *(Earles et al, 2002)* and performance of motor tasks *(Capaday, 1997)*. It is known that a number of factors affect the normal value of H-reflex amplitude and latency *(Simonsen and Dyhre-Poulsen, 1999)*. While age, body height and extremity length reveal direct correlation with the latency value of the H-reflex, its amplitude is associated with contraction of muscle, intensity of stimulus, vestibular stimulation, movements of head and neck, and temperature *(Oh, 1993)*. The type and training level of skeletal muscle also affects H-reflex amplitude *(Casabona et al, 1990)*. The aim of this study was to determine the effects of the type of training on H-reflex response parameters like amplitude and latency in sprinters and non trained individuals.

Materials & Methods

All subjects involved in this study were closely matched with respect to their age and height. A total of 20 male subjects were included in this study. They comprised of ten sprinters (Group 1) and ten non-athlete subjects (Group 2, control). The group 1 sprinters were engaged in specific power training program and group 2 that is untrained control group consisted of 10 healthy subjects who did not carry out any kind of sports, were not engaged in any regular training program professionally for recreational physical activity. All subjects were non smokers, non alcoholic, none had any medical problem and they were not under any prescription drugs. The H-reflex response was recorded on the right and left extremity of each subject involved in this study were measured with the help of computerized equipment called "Neuroperfect" (Medicaid Systems, India).The subject lay comfortably in the prone position on a wooden table. Their skin was degreased, conducting paste was applied before recording and stimulating electrodes were placed. The skin temperature was kept above 31 °C over the recording area. The recording electrode was positioned over the medial gastrocnemius muscle halfway between the midpoint of the popliteal fossa and upper border of the medial malleolus. The reference electrode was also positioned in the same line 5 cm distal to the active electrode, and the ground electrode was placed between the tendon and reference electrode. An approx. 15 cm thick support was placed under the ankle to ensure 90 degrees of flexion and 0.5 ms pulses of constant voltage were applied to the tibial nerve in the popliteal fossa. The time base was adjusted to 10 ms, sensitivity to 0.5-5 mV and filters to 10-500 Hz. The intensity of the stimulus was increased by 0.5 mA until maximum H-reflex amplitude and minimum motor response was obtained and then 5 maximum H-reflex responses were recorded. The maximum peak to peak amplitude and latency values were used for assessment. The reflex response with smallest distal latency was used for statistical analysis. A peak to peak interval (inter peak) was regarded as the amplitude.

Statistical analysis was performed by using statistical software 'SPSS-16 free trial version' for windows, means ± SD and student's *t* test was used. $p<0.05$ was considered to be statistically significant.

Results & Discussion

The mean age and body height of group 1 and 2 were 23.93 ± 2.65 years & 173.12±6.40 cm and 24.28 ± 2.45 years and 168.80 ± 3.25 cm (Table 1).

Table 1 Mean ± SD of age & body weight of sprinters & non-athletes

	Group 1 (Sprinters)	**Group 2** (Non-athletes)
Age (years)	23.93 ± 2.65	24.28 ± 2.45
Body Height (cm)	173.12±6.40	168.80±3.25

It was found that there was not statistical significant difference between the age and height of the sprinters and non-athlete subjects.

Table 2 Mean ± SD of H-reflex variables on the right & left side in sprinters

	H-reflex	
Variables	**Latency (ms)**	**Amplitude (mV)**
Right leg	26.80 ± 2.85	3.78 ± 0.20
Left leg	26.95 ± 2.80	3.60 ± 0.25

It was found that there was no significant difference between the latency and amplitude values on the right and left side (Tables 2 & 3) in either group; both values were pooled for statistical evaluation.

Table 3 Mean ± SD of H-reflex variables on the right & left side in non-athletes

	H-reflex	
Variables	**Latency (ms)**	**Amplitude (mV)**
Right leg	**26.09 ±1.80**	**6.21 ± 0.44**
Left leg	**27.50 ± 1.90**	**6.18 ± 0.45**

After pooling of the values on the right and left side, the mean peak amplitude and latency values of H- reflex found in group 1 and 2 were 3.13±0.22 mV & 22.77±2.82 ms and 6.19±0.44 mV & 26.79±1.85 ms, respectively. There was statistical significant difference between group 1 and 2 with respect to the H-reflex peak amplitude. The test group 1 had significantly smaller H-reflex peak amplitude value compared to the non-athlete group (p<0.001) but there was no significant difference between the groups with respect to H-reflex latency (Table 4).

Table 4 Comparison of H-reflex variables of sprinters & non-athletes

Variables	H-reflex	
	Latency, ms	Amplitude, mV
Group 1(sprinters)	22.77 ± 2.82	3.13 ± 0.22*
Group 2 (non-athletes)	26.79 ± 1.85	6.19 ± 0.44*

* (p<0.001)

It is known that physical exercises can cause structural changes in skeletal muscles as well as an increase in excitability of motor units *(Hoppeler, 1988).* But the effects of the type of exercise on these changes have not been studied in detail. The reflex tests can be used for evaluating of motor unit activities in both sedentary subjects and subjects engaged in active sports *(Perot et al, 1991).* The H-reflex is considered to reflect directly the excitability level of alpha motor neurons in the spinal cord. In H-reflex studies, stimulation is directly applied to the Ia fibers *(Oh, 1993).* The main result of our study concerned the fact that the H-reflex amplitude of trained subjects (sprinters) was significantly smaller than those of the non-athletes (non-trained) subjects. *Casabona et al, (1990)* reported that maximum H response of physically trained subjects was lower than in non-trained subjects and they suggested that this was due to the dominance of synapses between Ia motor neurons and small motor neurons in the ventral horns of the spinal cord. In attempts to characterize muscle fiber differences in trained (athletes) and non trained subjects, marked changes in motor unit morphology and functional aspects were reported *(Tesch & Karlsson, 1985).* Anaerobic exercise with fast contractions causes biochemical changes in motor units *(Hakkinen et al, 1985).* It has been shown that some of the fast contracting motor units that are resistant to fatigue are involved in the H-reflex *(Nardone and Schieppati, 1988).* The number of small motoneurons and interneurons that receive input from Ia afferents is lower in trained subjects than in sedentary subjects. This finding supports the idea that there is a close relation between morphological and functional characteristics of the neuromuscular system and that these can be affected by type and duration of training. However, it is also possible that the presynaptic inhibition is enhanced so that the output from the motor neuron pool in response to Ia afferent input will be decreased and the influence of Ia afferents will be limited. The different muscle fiber types of these subjects could also explain the difference obtained between the H-reflex responses in this study. It is believed that motor neuron excitability is not the only factor in the exercise induced changes of H-reflex parameters, since other parameters may also be involved *(Van Boxtel, 1986). Perot et al (1991)* compared the pre and post exercise H-reflex parameters and found that changes occurred in muscle stretch receptor responses. In conclusion, the results of this study point out that chronic training alters H- reflex amplitude and that the type of training is also important in these reflex changes. These changes may enhance the adaptation ability of athletes to excessive physical activity but the mechanism mediating these changes and the exact role of this modulation remains to be determined.

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Effect of PNF Technique on Gait Parameters and Functional Mobility in Hemiparetic Patients

Kumar[1], S., Kumar[2], A. & Kaur[3], J.
[1]Consultant Physiotherapist, Om Physiotherapy Clinic, Naraingarh. Distt. Ambala. Haryana.
Email: gurriphysio82@yahoo.co.in
[2]Physiotherapist, Sir Ganga Ram Hospital, New Delhi. Email: mannphysio202@yahoo.co.in[3] Lecturer, Prem
[3]Physiotherapy & Rehabilitation College, Baroli, Panipat. Haryana, Email ID: sunreet_jas83@yahoo.com

Abstract

Stroke, also known as cerebrovascular accident (CVA) is an acute neurologic injury in which the blood supply to a part of the brain is interrupted. It is reported that 1.2% of total deaths occur in India due to stroke. Stroke is the 3rd leading cause of death and the 2nd leading cause of disability. Common problems after stroke are impaired motor functions including balance and gait, sensory deficits, perceptual deficits, cognitive limitations, visual deficits, aphasia and depression. The ability to walk independently is a prerequisite for many daily activities. Many patients remain unable to walk or have difficulties with walking after stroke. A common clinical observation was that the stance phase on the affected side was considerably shorter than that of sound leg. Hemiplegics vary in their dependence on a walking aid and in amount of weight they transfer through the affected leg. The objective of the present study is to evaluate the effect of PNF techniques on the gait parameters and functional mobility in hemiplegic patients. Two group pre test- post test design. A sample of convenience of 30 subjects affected by cerebrovascular accident of ischemic injury took part in this study. They were divided into two groups i.e. an Experimental group and a Control group with 15 patients in each group. The subjects of this study were the residents of northern Haryana and the mean age of the patients was 59.30 years. Patients were assessed before commencement and after the completion of treatment sessions by a fixed battery of tests on Stride length, Gait Velocity, Cadence and Functional Mobility parameters with measuring tape, stop watch and Rivermead Mobility Index respectively. The results of this study demonstrated that the PNF technique has significant effect on gait parameters & functional mobility as compared to conventional therapy in patients with hemiplegia. The findings show that the walking speed has a significant effect on functional mobility in stroke patient.

Keywords: CVA, Stroke, PNF, Stride length, Gait Velocity, Cadence and Functional Mobility

Introduction

Stroke, also known as cerebrovascular accident (CVA) is an acute neurologic injury in which the blood supply to a part of the brain is interrupted. It is reported that 1.2% of total deaths occur in India due to stroke. Stroke is the 3rd leading cause of death and the 2nd leading cause of disability *(Aela et al, 2007).* Major risk factors are Hypertension, Heart disease and Diabetes *(O'Sullivan & Schmitz, 2001).* Apart from these, other risk factors for stroke are cigarette smoking, blood cholesterols, oral contraceptives, obesity, alcohol, social deprivation, physical inactivity, impaired ventilatory function and maternal history of stroke *(Walton, 2003).*

Several population – based surveys on stroke were conducted from different Parts in India. Recent studies showed that the age adjusted annual incidence rate was 105 per 100,000 in the urban community and 262 per 100,000 in the rural community. The ratio of cerebral infract to hemorrhage was 2.21. Hypertension was the most important risk factor. Stroke represented 1.2% of total deaths in India. Common problems after stroke are impaired motor functions including balance and gait, sensory deficits, perceptual deficits, cognitive limitations, visual deficits, aphasia and depression *(Perry, 1969).* Stroke is the leading cause of disability among adults and frequently results in impaired mobility *(Bohannon et al, 1988).* Neurological deficits that lead to loss of leg strength and impaired balance are two factors that correlate to walking ability. Many authors have shown that subjects with chronic hemiparetic stroke have profoundly diminished cardiovascular fitness, muscular atrophy in the hemiparetic extremity, and altered body composition that is related to gait deficit severity. Cerebrovascular disease is a leading cause of gait impairment, resulting in long-term disability and handicap *(Collin and Wade, 1990).*

Many patients remain unable to walk or have difficulties with walking after stroke. The ability to walk independently is a prerequisite for many daily activities *(Mehrholz et al, 2007).* It has been reported that only a small proportion can walk with sufficient ability to function effectively within the community *(Yang et al, 2007).* Hemiplegics patients have been shown to bear a greater percentage of body weight on the sound limb, than on affected side *(Agarwal et al, 2008).*

In persons with hemiplegia, posture, tone and coordinate reciprocal movements, which are required for normal gait, are usually impaired. Normal reciprocal pelvic movement is often replaced by a fixed pelvic retraction, which makes it difficult for patients to swing the affected lower extremity forward *(Wang, 1994).* Co-ordination between moving body parts is essential for functional walking and is modified, often in a subtle manner, to accommodate variation in task requirements and circumstances, such as walking speed, path curvature, and environmental clutter *(Roerdink et al, 2007).*

In physiotherapy a variety of movement therapy approaches are available for retraining motor skills in adult patients with hemiplegia. Certain approaches like Proprioceptive Neuromuscular Facilitation, Rood's, Brunnstrom, and Bobath rely on reflex and hierarchical theories of motor control, while others like Motor Relearning Programme (MRP) and system theory approaches derive clinical implications from more recent theories of motor control and motor learning as well as from the principles of neural plasticity. Proprioceptive Neuromuscular Facilitation (PNF) is one approach commonly used to improve the gait of patients with hemiplegia. Various PNF procedures have been used, depending on the affected site. Among these PNF techniques is facilitation of pelvic motion to improve control of the pelvis. Because the pelvis has been described as a "key point of control" for maintaining a gait pattern, techniques designed to affect the pelvis are widely used *(Wang, 1994).* The Rivermead Mobility Index (RMI) is a PRO instrument that measures mobility, an important aspect of daily functioning in patients after stroke, and is being used increasingly for international research in patients with stroke.

Materials and Methods:

Population and Sampling: A sample of convenience of 30 subjects affected by cerebrovascular accident of ischemic injury took part in this study. They were divided into two groups i.e. an Experimental group and a Control group with 15 patients in each group. The subjects of this study were the residents of northern Haryana and the mean age of the patients was 59.30 years.

Study design: Two group Pre-test Post-test Experimental design.

Inclusion criteria:

Patients with MCA ischemic infarction of less than 6 months post stroke duration.

Patients between 50-70 years of age and of either sex.

Patients with stage 2-4 on Brunnstrom recovery stage for hemiplegics and able to perform 6 min. walk test.

Exclusion criteria:

- i Patients with ACA and PCA tertiary involvements.
- ii Patients with severe disabling arthritis.
- iii Patients with any cardiac disease like MI.
- iv Patients with any cognitive dysfunction.
- v Patients with any movement disorders.
- vi Any other neurological deficits like Parkinson's disease.

Instrumentation:

Measuring Tape/Scale, Stop watch, Chart Walkway, Ink.

Rivermead Mobility Index – English version of RMI developed for patients who had suffered a head injury or stroke at Rivermead Rehabilitation Centre in Oxford, England was used.

Protocol Used: The subjects in both Experimental group and Control group actively participated in the study. In Experimental group all subjects received a protocol of 3 PNF techniques i.e. rhythmic initiation, slow reversal and agonistic reversal for pelvis for 30min. for 3days a week for a total duration of 4 weeks (12 sessions). Each technique was given for 10 minutes. These procedures were done to facilitate anterior elevation and posterior depression of pelvis in a side lying position. The elements of PNF, such as manual contact, stretch, resistance, and verbal cuing, were incorporated into the treatment scheme.

In control group all the subjects received the conventional stretching exercises for hip flexors, hip adductors and extensors, side lifting of pelvis physiotherapy which includes all the active and passive movements of hip joint, in sitting position, bridging exercises, resisted exercises for pelvis and weight bearing on affected leg in standing for the same time period as in experimental group i.e. 30min. for 3 days a week and for a total duration of 4 weeks (12 sessions).

Procedure

Thirty patients with hemiplegia who fulfilled the inclusion criteria were took in study. Their demographic profile and detailed medical history were collected through individual interviewing and from medical records. The stage of motor recovery of the lower extremities was determined by Brunnstrom's recovery stages. For kinesthetic evaluation, the patient's hip, knee, and ankle were tested three times. The therapist places the patient's hip in medial and lateral rotation, asking the patient whether the toes are "in" or "out". The therapist places the patient's knee in flexion or extension, asking the patient whether the lower extremity "is bent" or "straight". To test the ankle, the therapist places the patient's foot in dorsiflexion or planterflexion and asked the patient whether the foot is "up" or "down". To carry out these tests, the physical therapist always put one hand around the patient's knee and other hand around the patient's ankle. The patient must give correct response on all three trials for each region to be considered as having intact kinesthesia. All patients were divided into two groups with 15 patients in experimental group and 15 in control group.

On the first day, the volunteers were informed about the purpose, procedure, possible discomforts, risks and benefits of the study prior to obtaining an informed consent form from the subject. The subjects were asked not to participate in any other exercise form for the duration of the study and to follow the designated protocol. During the pre-assessment session footprints of all the patients were taken with the help of ink on chart paper. The ink was put on the feet of patient with the help of a piece of cloth and patients were asked to walk on the chart paper fixed on the floor. For the measurement of stride length 2 footprints of affected sides from the middle portion of each walking trial were analyzed. *Stride length:* The stride length was measured from the heel of the affected foot to the heel of the same foot when it again contacts the ground with the help of a measuring tape/scale. *Cadence:* The cadence i.e. steps per minutes were counted with the help of stop watch. *Gait velocity:* Gait velocity was studied at comfortable walking speeds. The mean of 3 repeated walking speed measurements was calculated in order to reduce measurement error. During each session, the subjects walked 10m at a comfortable pace and a digital stop watch was used for registration of time. Between the 10-m walking tests, subjects rested for about 1 minute. *Functional mobility:* The functional mobility was assessed by Rivermead Mobility Index. The same gait parameters and functional mobility were reassessed after the completion of 4 week (12 sessions) of treatment protocol for both experimental group and control groups with the help of same battery of tests.

Data Analysis and Interpretation

Data analysis was done by using SPSS version 13.0 software. Paired 't' test was used to compare the Pre and Post within the Group A & B and Unpaired 't' test was used to compare between the Group A and Group B.

Table 1: Comparison of Stride length and Cadence at Pre Vs Post Interval.

Variable		Groups A Mean±SD	Groups B Mean±SD	't' value	'P' value
Stride Length (mtr)	Pre	0.3313 ± 0.082	0.3460 ± 0.09	25.93	0.001
	Post	0.5943 ± 0.10	0.5033 ± 0.11	- 7.50	0.001
Cadence (steps/min)	Pre	30.27 ± 7.34	31.27 ± 8.70	41.16	0.001
	Post	49.87 ± 8.25	43.07 ± 9.81	26.26	0.001

Table 2: Comparison of Gait Velocity and Functional Mobility at Pre Vs Post Interval.

Variable		Groups A Mean±SD	Groups B Mean±SD	't' value	'P' value
Gait Velocity (mtr/min)	Pre	12.43 ± 3.39	13.76 ± 4.9	30.57	0.001
	Post	22.20 ± 3.27	17.27 ± 4.68	16.45	0.001
Functional Mobility	Pre	6.00 ± 0.75	6.20 ± 0.94	27.49	0.001
	Post	10.80 ± 1.14	8.47 ± 1.06	-9.93	0.001

Discussion

The results of this study demonstrated that the PNF techniques have significant effect on gait parameters as well as functional mobility as compared to conventional therapy in patients with hemiplegia. The findings show that the working speed has a significant effect on the functional mobility in stroke patient. PNF is a method of neuromuscular dysfunction treatment, primarily by means of facilitating the flow of information, mainly by stimulation of proprioceptors *(Trueblood et al, 1989).*

The results of the study done by *Wang (1994)* on twenty patients with hemiplegia of short and long duration assessed the use of PNF pelvic techniques for gait rehabilitation support the results of the present study. The results of his study showed that in subjects with hemiplegia of short duration, gait speed and cadence improved immediately after 1 session of PNF and the improvement was further enhanced by 12 treatment session in contrast, subjects with hemiplegia of long duration did not improve immediately, although the cumulative effect of the treatment was similar to that observed in the hemiplegia of short duration. The difference in the immediate effect of treatment between subjects with hemiplegia of short duration and those with hemiplegia of long duration may be due to both neural and structural changes (*Wang, 1994). Hufschmidt (1982)* assessed the mechanical properties of relaxed lower leg muscle by torque measurement during imposed constant velocity dorsiflexion - plantar flexion cycles. He observed that at lower angular velocities, the subjects' exhibited an elastic and energy consuming velocity independent resistance. In most patients with long standing spasticity, both of these were enhanced. The results support the hypothesis of secondary structural changes of muscle in spasticity.

Trueblood et al (1989) studied 20 hemiplegic patients (10 men, 10 women). Out of these nine subjects (45%) were right hemiplegic, and 11 subjects (55%) were left hemiplegic. The resisted pelvic PNF techniques were given to these patients. The results of their study revealed that the resisted PNF techniques have significant effect in the gait disturbances in hemiplegic patients *(Trueblood et al, 1989).*

Shimura and Kasai (2002) studied the effects of proprioceptive neuromuscular facilitation on the initiation of voluntary movement and motor evoked potentials in upper limb muscles. The findings of their study corroborate the presumed effects of PNF and provide insights into the neurophysiological mechanisms underlying the PNF method. Compared to the neutral position, they found that (i) the facilitation position changed the muscle discharge order enhancing the movement efficiency of the joint, (ii) the facilitation position led to a reduction in EMG-RT, the magnitude of which depended on the proximity of the muscle to the movement joint, and (iii) MEP amplitude increased and MEP latency decreased in the facilitation position as a function of the proximity of the muscle to the joint *Shimura and Kasai (2002).*

Kawahira et al (2004) studied 22 subjects with stroke and 2 brain tumor-operated subjects who were made to undergo two week facilitation sessions applied at 2-week intervals in patients with hemiplegia, who were being treated with continuous conventional rehabilitation exercise without the facilitation technique for hemiplegia. The results of their study revealed that intensive repetition of movement elicited by the facilitation technique (chiefly proprioceptive neuromuscular facilitation, stretch reflex and skin-muscle reflex) improved voluntary movement of a hemiplegic lower limb in patients with brain damage *(Kawahira et al, 2004)*. *Elzbieta (2006)* assessed gait kinematics in patients with hemiplegia after the PNF; and noticed the difference of the values of analyzed kinematic parameters of gait according to the norm. It was concluded that the therapy of PNF method enabled the partial improvement of the performed gait disabilities in the subject. Mean velocity of the patient gait improved from 0.44m/s to 0.59m/s. Similarly *Poscic et al* studied the 10 hemispastical patients after stroke and of 5 patients with spastical paraparesis of different causes who received the PNF treatment and concluded that the PNF model gave good results in rehabilitation and improvement in quality of life of such patients.

Conclusions: PNF is a very beneficial technique for improving functional independence in patients with strokes and other neurological disorders but the results of the study further prove that one can quantify the improvement especially in area like locomotion and can be used as an adjunct to the other gait training techniques for improving gait of the stroke patients.

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Reliability and Validity of Integrated Proprioception Screening Scale & Its Sensitivity in Parkinson's disease

Kaur[1], H., Narkeesh[2], A.
[1]Post graduate student of Neurological Physiotherapy, Punjabi University, Patiala-147001, Punjab, India.
[2]Associate Professor, Department of Physiotherapy, Punjabi University, Patiala-147001, Punjab, India.

Abstract

Proprioception is the awareness of the body position, orientation, movement and sensation of force. It is a sense which indicates whether the body is moving with required effort and as well as where the different parts of the body are located in relation to each other. Proprioception testing involves a combination of testing methods like kinaesthesia, joint position sense and sense of force testing. There are different scales available for assessing proprioception like Fugl-Meyer assessment sensory sub scale, Nottingham sensory assessment scale and Integrated Proprioception Screening Scale (IPSS). The proposed study was done on the subjects with age more than 60 yrs and tester, retester and inter-tester reliability and validity was measured. This study also checked the sensitivity of IPSS in Parkinson's disease patients.

Key words: Proprioception, Integrated Scale, Reliability, Validity, Sensitivity, Parkinson's disease

Introduction

Proprioception is the awareness of the body position, orientation, movement and sensation of force *(Sherrington, 1906).* It is a sense which indicates whether the body is moving with required effort and as well as where the different parts of the body are located in relation to each other *(Leibowitz et al., 2008).* The process of proprioception occurs along the afferent pathways of the sensorimotor system. The sensorimotor system covers the whole process from a sensory stimulus to muscle activation, from acquisition of a sensory stimulus and conversion of the stimulus into a neural signal, transmission of the neural signal via afferent pathways to the Central Nervous System (CNS), processing and integration of the signal by the various centres of the CNS and motor response resulting in muscle activation for the performance of various tasks and joint stabilization *(Lephart et al., 2000).*

The proprioceptive information is received from the sensory neurons located in inner ear (motion and orientation) and in the stretch receptors located in the muscles and the joints supporting ligaments. It can be conscious or sub-concious. The conscious proprioceptors are the kinesthesioceptors or joint receptors. The subconscious proprioceptors are Muscle Spindle, Gogli Tendon Organ (GTO) and Vestibular receptors. The subconscious proprioception is transmitted to cerebellum and conscious proprioception is transmitted to the cortex. Conscious proprioception is regulated by the lemniscal system that is dorsal column. This pathway begins in joint receptors and ends in cortex. The conscious proprioception enables the cortex to refine voluntary movements for skillful activities. Subconscious proprioception is mediated by the spino-thalamic tracts which begin in muscle spindle and GTO and terminates in cerebellum. It is concerned with muscle tension, muscle length and speed of movement *(McCormack and Feuchter, 2000).*

There are numerous types of afferent sensory organs (mechanoreceptors) found in the various joint structures: Ruffini endings, Pacinian corpuscles, Golgi tendon organ, free nerve endings, muscle spindles. *Johansson and Sjolander (1990)* explained that the signals from the Ruffini endings may contain information about static joint position, intra-articular pressure, and the amplitude and velocity of joint rotations. Pacinian corpuscles function as pure dynamic mechanoreceptors. GTO are active toward the end range of joint motion. Free nerve endings become active when the articular tissue is subjected to damaging mechanical deformations. Muscle spindles are oriented in parallel with the skeletal muscle fibers encoding the event of muscle stretch and the rate of passive elongation. In contrast, GTOs are aligned in series within the musculotendinous junctions encoding the stretch on the tendon generated by the total force of a given muscle during contraction

There are different scales available for assessing proprioception like Fugl-Meyer assessment sensory sub scale, Nottingham sensory assessment scale and Integrated Proprioception Screening Scale (IPSS). Fugl-Meyer assessment sensory sub scale do not support its clinical use in stroke patients. In Nottingham sensory assessment revised there is incomplete instructions for joint position sense and kinaesthesia and also error in velocity and sensory feedback is observerded when therapist is moving the patients's joint *(Gandhi, 2000).* These scales are not directly focused toward the proprioception. In the study done by *Debnath et al (2010)* reliability of Integrated Proprioception Screening scale was measured only in age between 17-25 yrs. But in this study concurrent validity of IPSS was not measured. So there is a need of study that will provide a scale with proper reliability and validity which can be used to assess the proprioception in all age groups and as a whole. The proposed study is going to check the reliability of IPSS in old age and also check concurrent validity of IPSS by relating it with Fugl-Meyer sensory subscale. It also measures the sensitivity in Parkinson's disease patients. This study will find out that whether by this scale proprioception is measured in old age also or not.

Materials & Methods:

The present study was conducted in three phases. In the phase 1 tester retester and inter-tester reliability of Integrated Proprioception Screening Scale was measured. In this 10 subjects with the age group between 60-80 yrs were selected from the area in and around Punjabi University Patiala. IPSS was applied on every subject and total scoring was done. After 5 days same scale was again applied on same subjects and then total scoring was done. Percentage of the scoring was also calculated. In this way tester retester reliability was measured. For the inter-tester reliability scale was applied twice by the researcher and two blind observers. Firstly scale was applied by researcher and blind observer 1 on the 10 subjects (60-80yrs) selected from areas in and around the Punjabi University Patiala. Total scoring was done and correlation was found between two scoring. Then second time study was conducted in All Saints Institute of Medical Sciences and Research, Ludhiana. 10 subjects with in the age group 60-80 yrs were selected. Scale was applied on each subject by the researcher and then blind observer 2 and total scoring was done and percentage was calculated. Then correlation was found between two scores.

Second phase of the study was to check the concurrent validity of IPSS by correlating it with Fugl-Meyer sensory subscale. For this 20 subjects with in the age group of 20-30 yrs were selected from Bibi Sahib Kaur Hostle, Punjabi University Patiala on the basis of inclusion and exclusion criteria. IPSS was applied on each subject by the researcher. Then Fugl-Meyer was applied on the same subjects. Correlation was found between scoring of both the scales. In the third phase sensitivity of IPSS was checked in patients of Parkinson's disease. 10 patients of Parkinson's disease above 50 yrs of age were taken from Patiala and Ludhiana. IPSS was applied on each patient and total scoring was done. Percentage of scoring was calculated. Then this scoring was compared with the scoring of normal subjects with the same age group.

Results & Discussion:

Table 1.1: Mean and SD of Age, Total Score and Percentage at different days and tester retester reliability

Variables	Mean	SD	Reliability
Age	72.80 yrs	4.34 yrs	0.995
Score Day 1	318.60	18.54	
Score Day 5	316.90	18.50	
% Day 1	86.09	5.00	0.996
% Day 5	85.60	5.01	

Table 1.1 shows the mean and SD for age, IPSS score, percentage and its tester retester reliability. The mean and SD for age is 72.80±4.34 yrs, for score at day 1 is 318.60±18.54, score at day 5 is 316.90 ±18.50 and the percentage at day 1 and day 5 is 86.09±5.00 and 85.60±5.01 respectively. Tester retester reliability of score is 0.995 and for percentage it is 0.996.

Table 1.2: Mean and SD of Age, Score, Percentage and inter-tester reliability (for researcher and Blind observer 1)

Variables	Mean	SD	Reliability
Age, yrs	69.80	5.37	
Researcher Score	318.20	13.14	0.993
Blind Observer Score	318.50	14.61	
% Researcher	86.12	3.69	0.995
% Blind Observer	86.06	3.96	

Table 1.2 shows the mean and SD for age, researcher score, blind observer 1 score, percentage researcher and percentage blind observer 1 and inter-tester reliability. The mean and SD of age is 69.80±5.37 yrs, researcher score is 318.20±13.14, blind observer score is 318.50±14.61, percentage researcher is 86.12±3.69 and percentage blind observer is 86.06±3.96. Inter-tester tester reliability for score is 0.993 and for percentage it is 0.995.

Table 1.3: Mean and SD of Age, Score and Percentage (for researcher and Blind observer 2) and inter-tester reliability

Variables	Mean	SD	Reliability
Age, yrs	70.00	5.47	
Researcher Score	313.80	16.45	0.994
Blind Observer Score	313.80	14.42	
% Researcher	84.80	4.44	0.994
% Blind Observer	84.80	3.89	

Table 1.3 shows the mean and SD for age, researcher score, blind researcher score, percentage researcher, percentage blind observer and inter-tester reliability. The mean and SD of age is 70.00±5.47yrs, researcher score is 313.80±16.45, blind observer score is 313.80±14.42, percentage researcher is 84.80±4.44 and percentage blind observer is 84.80±3.89. Inter-tester reliability

between the scoring is 0.994 and of percentage is 0.994.

Table 1.4: Mean and SD of Age, Score and Percentage (IPSS and Fugl-Meyer)

Variables	Mean	SD
Age, yrs	24.75	1.99
IPSS Score	350.20	8.12
IPSS %	94.64	2.19
FUGL-MEYER SCORE	15.70	0.73
FUGL-MEYER SCORE %	98.12	4.57

Table 1.4 shows the mean and SD for age, IPSS score, IPSS score percentage, Fugl-Meyer sensory sub scale score and its percentage. The mean and SD of age is 24.75±1.99, IPSS score is 350.20±8.12, IPSS score percentage is 94.64±2.19, Fugl-Meyer sensory sub scale score is 15.70±0.73 and Fugl- Meyer score percentage is 98.12±4.57.

Table 1.5: Test for concurrent validity (Correlation between Scores and Percentage)

Correlation	r value	P value
IPSS score Vs Fugl-Mayer Score	0.170	NS
IPSS Percentage Vs Fugl-Mayer %	0.170	NS

Table 1.5 shows the correlation between IPSS and Fugl- Mayer score and percentage. The r value of correlation between IPSS and Fugl- Mayer score is 0.170 and between percentage is 0.170 which is non-significant.

Table 1.6: Mean and SD for Age, Score and Percentage for Parkinson disease patients and Normal Subjects

Variables	Parkinson Disease		Normal Subjects		Z value
	Mean	SD	Mean	SD	
Age, yrs	68.40	6.36	72.80	4.34	-1.705
Score	279.80	17.26	318.60	18.54	-3.480
%	75.60	4.65	86.09	5.00	-3.480

Table 1.6 shows the mean and SD for Age, Score, Percentage and Z value for Parkinson disease patients and Normal Subjects. The mean and SD in Parkinson's patients for age is 68.40±6.36 yrs, score is 279.80±17.26 and for percentage it is 75.60±4.65. The mean and SD in normal patients for age is 72.80±4.34 yrs, score is 318.60±18.54 and percentage is 86.09±5.00. Z value for age is -1.705, for score is -3.480 and for percentage it is -3.480 which is highly significant. This shows that IPSS is sensitive for Parkinson's disease patients.

Discussion

Proprioception has a great role in person's well being. It is the sense whether the body is moving with required effort and where the different parts of the body were located in relation to each other. Without proper proprioceptive input person cannot control his body functions because he will not understand where his body parts are moving and also motor and sensory control both are influenced by the proprioception. So the assessment of this modality is very important. There are many assessment tools and scales available for the assessment of proprioception. Tools like computerized automated 3 dimensional motion tracking system, force plate, sway meter, kinesiometer and various other motorized devices are available and many scales like Fugl-Meyer sensory subscale, Nottingham sensory assessment scale and Integrated Proprioception Screening Scale are available. There are some limitations that these equipments cannot be used in the field of normal clinical setting. Also with these equipments and scales one cannot assess the proprioception of whole body. *Debnath et al (2010)* have formulated the Integrated Proprioception Screening Scale which consists of 11 subscales. In this study reliability of the scale was tested only in the age group of 17-25 yrs. But with the aging proprioception is deteriorating. There are many studies which concluded that with aging proprioception gets deteriorating *(Saxton et al, 2001; Kaplan et al, 1985; Pai et al, 1997; Petrella et al, 1997; Ribeiro & Oliveira, 2010; Skinner et al, 1984).* So the present study tries to explore that whether this scale is also a reliable method to assess the proprioception deficit or not.

In the present study tester retester and inter-tester reliability of the Integrated Proprioception Screening Scale was measured in the geriatric population and checked concurrent validity by relating it with Fugl-Meyer sensory subscale. This study also checked the sensitivity of this scale in Parkinson's disease patient. In the first phase of present study tester retester and inter-tester reliability of IPSS was measured. Subjects within the age group of 60-80 were included in the study. Mean and standard deviation for age was 72.80±4.34 yrs. In this study geriatric population was included because with the aging proprioception deterioration occurs. *Riberio and Oliveira (2007)* concluded that aging affect the proprioception. It was a review study in which various articles on effect of aging on proprioception were reviewed. This study reviews that with the aging there is deteriorating effect on joint proprioception. Also a survey was done by *Adamo et al, (2009)* in which researcher have taken twelve young (6 women; 6 men, mean age 22.1 ± 2 yrs) and thirty older (14 women; 16 men, mean age 76.4 ± 5.0 yrs). This survey recorded the frequency and duration of 41 physical activities pursued in a typical week over the past month and covered a broad range of tasks ranging from computer use to walking at a leisurely or fast paced rate. A metabolic equivalent value was calculated for each activity based on the amount of energy expended. For proprioceptive matching, wrist joint rotation was recorded from potentiometers mounted beneath the pivot of each manipulandum. This study concluded that proprioception is deteriorated with age and further age-related changes in proprioception, specifically upper limb position sense, are more pronounced in individuals exhibiting a sedentary lifestyle. So the present study checked whether IPSS is a reliable method for assessing the proprioception deficit.

For the tester-retester reliability, IPSS was applied on the subjects who were selected on the basis of inclusion and exclusion criteria. Mean and SD of the score on the first day was 318.60±18.54 and percentage was 86.09±5.00. Mean and SD for the score on the fifth day was 316.90±18.50 and for the percentage it was 85.60±5.01. Then from these scores tester retester reliability was calculated which was 0.995 (unbiased) for the score and 0.996 for the percentage which was highly significant. These results show that Integrated Proprioception Screening Scale is a reliable method for testing proprioception in geriatric population also. *Debnath et al (2010)* formulated IPSS and also measure its reliability in the age group of 17-25 yrs. The tester- retester reliability of the scale was 0.80 to 0.84 and it was statistically found to be significant.

Inter-tester reliability of the scale was tested two times firstly in and around Punjabi University and then in All Saints Institute of Medical Sciences and Research Ludhiana. Mean and SD of the scores and percentage of IPSS of study which was conducted in and around Punjabi University by the researcher were 318.20±13.14 and 86.12±3.69. Mean and SD of scores and percentage by the blind observer were 318.50±14.61 and 86.06±3.96. Reliability was calculated which was 0.993 for the score and 0.995 for percentage. These results show significant relationship between both which means that IPSS has high inter-tester relaibilty. From the second study which was done in All Saints Institute results were calculated in which mean and SD of scores and percentages of IPSS by the researcher were 313.80±16.45 and 84.80±4.44 respectively. Mean and SD of scores and percentage by the blind observer were 313.80±14.42 and 84.80±3.89 respectively. Reliability was calculated which was 0.994 for score and 0.994 for the percentage. These results show that IPSS is a reliable method to assess the proprioception in geriatric population. These results were supported by the study done by *Debnath et al (2010)* in which inter-tester reliability of the scale was 0.83. 0.81, 0.82 and 0.81. This described that scale is having statistically significant reliability. This study concluded that Integrated Proprioception Screening Scale is a reliable method to assess the proprioception in younger healthy population. 2nd phase of the study was to test the concurrent validity of IPSS. In this IPSS scale was correlated with Fugl-Meyer sensory subscale. 20 subjects from the Bibi Sahib Kaur hostel were selected. IPSS was applied on these subjects and then Fugl-Meyer sensory subscale was applied on same subjects. Total scoring of both the scales was correlated with each other. Mean and SD of age was 24.75±1.99 yrs. Mean and SD for IPSS score and percentage were 350.20±8.12 and 94.64±2.19 respectively. Mean and SD for Fugl-Meyer score and percentage were 15.70±0.73 and 98.12±4.57 respectively. Correlation was calculated between both the scales. Correlation between IPSS score and Fugl-Meyer was 0.17. Correlation between IPSS percentage and Fugl-Meyer percentage it was 0.170 which was non-significant. It means that there is no correlation between IPSS and Fugl-Meyer sensory subscale. Integrated Proprioception Screening Scale is a valid scale. It was proved in the study done by *Debnath et al (2010).* But Fugl-Meyer sensory subscale is not a valid scale for assessing the proprioception as a whole. *Leibowitz et al (2008)* compared the Fugl-Meyer scale with the automated approach. Apart from the advantage of producing quantitative results, the automated method seems to have superior sensitivity to deficits of proprioception compared to the traditional clinical assessment of Fugl-Meyer. This possibility is indicated by the fact that no less than 10 of the 22 patients performed faultlessly the 'up or down?' test, making not a single error in any of the 24 trials (6 per each of the tested 4 upper-limb joints), while the mean distance error revealed by the automated assessment in this subgroup of patients ranged from 4.1 – 10.0 cm. IPSS consist of many components which can assess the proprioception as a whole. So IPSS is found to be more valid than Fugl-Meyer scale. 3rd phase of study was to test the sensitivity of IPSS in the Parkinson's disease patients. Proprioception is deficit in Parkinson's disease patients. *Khudados et al (1999)* did a study in which they concluded that Parkinson's disease may produce a general impairment of proprioceptive guidance. Proprioceptive performance was analyzed using a tracking task based on knee extension and flexion movements in PD patients in the study done by *Hass et al (2007)* and conclude that spontaneous improvements in postural control are not directly connected with proprioceptive changes. Nevertheless, one also should keep in mind the general aspects and difficulties of analyzing proprioception. *Wright et al (2011)* concluded that deficits in axial kinesthesia seem to contribute to the functional impairments of posture and locomotion in PD. The administration of levodopa and dopamine agonists were associated with a modest acute suppression in central responsiveness to joint position was concluded by *Suilleabhain et al (2001).* A study was done by *Ribeiro et al (2011)* and concluded that proprioception is deficit in the patients affected from Parkinson's disease. So in the present study it was checked that whether IPSS can assess the proprioceptive deficit or not. IPSS was applied on the 10 patients with Parkinson's disease and score obtained from this was compared with the score of normal subjects of same age group. Mann-Whitney U test was applied to test the sensitivity. The mean and SD for age of Parkinson's patients came to be 68.40±6.36 yrs and for the normal subjects it was 72.80±4.34. Mean and SD of the score and percentage for the Parkinson's patients was 279.80±17.26 and 75.60±4.65 respectively and for normal subjects it was 318.60±18.54 and 86.09±5.00 respectively. Z value for the score was -3.480 and for the percentage it also came to be same which shows that there is significant difference in the scores of normal and Parkinson's disease patients. This data confirms that IPSS is sensitive for checking the Proprioception in Parkinson's patients also.

Conclusion

The present study has concluded that Integrated Proprioception Screening Scale is a reliable and valid scale to assess the proprioception in all age groups. And it can also assess the deficit in the proprioception occurred due the Parkinson's disease. It is sensitive scale to any change or deficit in proprioception. With the help of IPSS one can assess the proprioception as a whole.

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Effect of Endurance Training Of Trunk Extensor Muscles on Pain and Endurance in Patients with Sub Acute Nonspecific Low Backache

Bala, K., Gakhar, M. and Jagga V.
Prem Physiotherapy and Rehabilitation College Panipat, Haryana, India

Abstract

Objective: the study aimed to find out the effect of endurance exercises on trunk extensor muscles endurance and pain. Methods: Total 38 subjects of both genders ranging in age between 18 to 40 years suffering from subacute non specific low back pain were taken and equally divided into two groups, group A(control group) and group B (experimental group).The values of VAS and modified Biering Sorensen test were taken from each subject prior to the intervention. Then subjects of both groups received hot pack for 15 minutes and then group A received general mobility exercises including stretching and strengthening exercises of lumbar spine, and group B received 5 levels of endurance exercises for 5 times a week for consclutively 3 weeks. The values of VAS and modified Biering Sorensen test were again measured on 8th, 15th and 22nd day. Results: Comparison of baseline values of both groups showed a highly significant improvement in pain and endurance. Conclusion: Both trunk extensors endurance training and general mobility stretching strengthening exercises are equally effective in reducing pain and increasing endurance in patients with non-specific subacute low back pain.

Key words: Endurance, low back ache, Biering Sorensen test, trunk extensors

Introduction

Low back pain can be defined as any form of pain, muscle tension, or stiffness localized between the costal margins and the inferior gluteal folds, with or without radiation into the lower limbs. For the majority of cases however, no medical cause can be found for their back complaints and therefore no definitive diagnosis can be given labeled as “nonspecific” low back pain. The symptoms of nonspecific low back pain may be related to mechanical strain (e.g., manual material handlings, sports activities) and/or psychosocial stressors (e.g., complex cognitive demands, job dissatisfaction), but they can also develop spontaneously. *(Vanrhijn, et al, 2009)* Some authorities report that poor endurance of trunk extensor muscles may induce strain on passive structures of lumbar spine, leading eventually to low back pain. Evidence suggests that muscle endurance is low for people with low back pain than individuals without low back pain *(Hultman et al, 1993).* Fatigue can affect the ability of people with low back pain to respond to the demands of an unexpected load. Fatigue after repetitive loading also leads to a loss of control and precision, which may predispose an individual to developing low back pain. *(Parnianpour et al, 1988).* Therefore, trunk muscle endurance training has been recommended to elevate fatigue threshold and improve performance, thus reducing disability. The results of the study may help the physiotherapists to understand the muscular cause provoking the pain and treat it suitably with the endurance exercises or general mobility exercises.

The purpose of this study was to find out whether endurance and pain due to nonspecific sub acute low back pain are improved by the endurance training of trunk extensors.

Materials & Methods

The consent of the hospital administration and patient with prior permission was taken before starting the study. 38 subjects having symptoms of nonspecific low back ache of duration 6 weeks to 3 months, both genders ranging in age between 18-40 years were included in the study. They were randomly divided into group A (Control group) and group B (Experimental group) with 19 subjects in each group.

The subjects were excluded on the basis of having any history of spinal or lower limb surgery, prediagnosed case of spinal or pelvic fracture, pregnancy, prediagnosed case of general conditions like uncontrolled hypertension, previous myocardial infarction, respiratory disorders etc., specific low backache i.e. backache due to any nerve root compression (the radicular syndrome), trauma, infection or presence of a tumor, intervertibral disc prolapse patients having signs and symptoms of instability i.e. spondylolysis, spondylolisthesis corresponding to a symptomatic spinal level: catchimg, locking, giving way or a feeling of instability, patients having any history of congenital abnormalities ankylosing spondylitis.

All subjects initial measurement of back extensors endurance by Sorensen test, pain at rest by Visual Analogue Scale were taken on day 1 (entry level).

Group A (Control group): Subjects in the control group were given a hot pack for 15 minutes in prone lying position and general mobility exercises including stretching and strengthening exercises of lumbar spine. These subjects were asked to perform the exercises eight times. The exercise regimen therefore, was completed in 30 to 45 minutes. These exercises were performed five days a week for three weeks in the physiotherapy department.

Experimental group: First hot pack for 15 minutes was applied to the subjects. Then they were asked to perform exercise protocol five times a week for three weeks in the physiotherapy department. Exercise protocol was adapted from study by *Moffroid et al (1993)*. The exercise protocol had 5 levels;

Level 1 Bilateral shoulder lifts in prone position.

Level 2 Bilateral shoulder lifts with hands behind the head in prone position

Level 3 Bilateral shoulder lifts with both arms elevated in prone position

Level 4 Contra lateral arm and leg lift in prone position

Level 5 both the arms and leg lifts in prone position.

All the subjects started the protocol from level 1 (i.e. first test position). As soon as the subjects could hold a given position for 10 seconds and performs 25 repetitions with 3 second rest inbetween efforts. After that, they progressed to the next level. If pain was aggravated during the exercise, the subjects were asked to stop the protocol. If the pain diminished within 5 minutes after the exercise, they were asked to continue the exercise and to hold the exercise position for 5 seconds. They were progressed to 10 seconds if there was no adverse response. After 10 repetitions, the subjects were instructed to rest for 30 seconds to 1 minute. The rest interval was 1 minute for every 25 repetitions until 125 repetitions were completed.

Subjects who encountered difficulty within a particular level of exercise were asked to stop the exercise and perform the lower level exercise and then progress slowly. The aim was to encourage the subjects to exert moderate workload within pain tolerance, particularly on entry into the program. The exercise period varied from 30 to 45 minutes. Each subject received treatment protocol 5 days per week, (15 sessions). The scores were taken at the day of assessment, 8th day, 15th day and 22nd day.

Results

Results were analyzed using unpaired and paired t-test by using SPSS version 15. Comparison of baseline values of VAS for Group A gave a highly significant value of 0.001 and an overall improvement of 65.54 %, while Group B showed an overall improvement of 52.87 %.

The comparison of baseline values of endurance for group A gave a highly significant value of 0.001 and an overall improved of 62.27% while group B showed an overall improved of 52.29%.

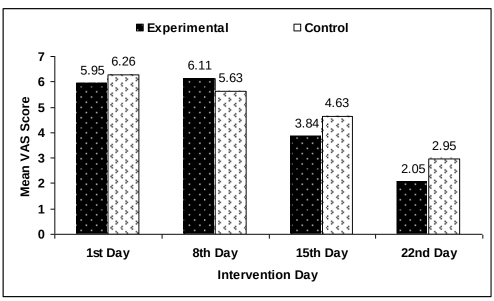

Figure 1: Comparison of mean values of VAS within experimental and the Control groups

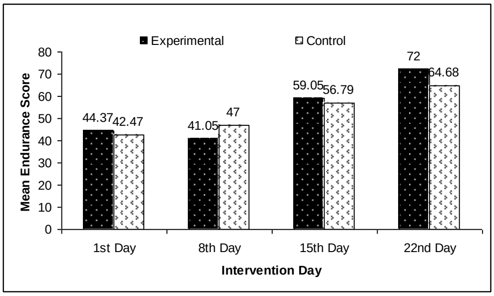

Figure 2: Comparison of mean values of Mean Endurance Score within experimental and the Control groups

Discussion

The results of this study reveals that endurance training of the trunk extensor muscles and general mobility spinal stretching and strengthening exercises both are equally effective in reducing pain and increasing endurance in subjects with nonspecific sub acute low back pain. The subjects in this study had similar baseline values of all dependent variables suggesting that both groups had homogenous distribution of patients. The participants in this study were moderately disabled by back pain that had lasted between six weeks to three months. Most of participants were females as back pain is most common among females as reported by *Stranjalis et al (2004)*. After trunk extensors endurance training and general mobility spinal stretching and strengthening exercises it was found that there was significant improvement in pain in both the groups. The reduction in pain may be due to the gain in endurance and strength of back extensor muscles following training as it has been suggested that poor endurance of trunk muscles may induce strain on the passive structures of lumbar spine, leading to low back pain. The results of the study differ from those studies in which no improvements were found following exercise intervention. The exercise program in these studies consisted of flexion and extension mobility exercises. This exercise program was different from the program of exercises used in this study. Lindström et.al and Indahl et.al found some positive effects of their exercise programs on pain and function. In these studies, exercises or activities that trained the trunk muscles were encouraged. *Staal et al (2003)* and *Koumantakis et al (2005)* also found significant reduction in low back pain severity following general mobility exercises. The results are also supported by the study done by Petersen et.al in which reduction in pain was found following strengthening exercises in patients with nonspecific low back pain. Thus, both muscle rehabilitation and simple mobilization exercises are helpful in improving function at the sub acute stage of nonspecific low back pain.

During endurance training the pain of patients is increased at 8^{th} day of treatment. This finding is different from other studies where they have taken reassessment only after 3 weeks of treatment and not after the 8^{th}, 15th, 22nd day of treatment as done in this study. The increase in pain however could be due to the acute muscle soreness which often develops during or after strenuous exercise performed to the point of muscle exhaustion.

Following the trunk extensors endurance training and general mobility exercises it was also found that there was significant improvement in endurance in patient of both group i.e. in group A and in group B after three weeks of treatment. The experimental group and the control group made comparable progress on test performance regardless of exercise. The exercise program required subjects to exercise five times a week for three weeks. This finding differs from those in previous studies done by *Chok et al (1999)* in which muscle endurance does not improved following trunk extensors endurance training. The exercise program required subjects to exercise three times a week for six weeks in Beverly *Chok et al (1999)* study. The results could be due to differences in exercise dosage and patient profile. The results of this study are similar with the findings of *Moffroid et al (1993),* and *Kahanovitz et al (1987)* which suggests that endurance training was effective for increasing isometric endurance of trunk extensors in subjects without low back pain. The results of this study are also related to the study done by *Clarke (2009)* in which trunk extensors endurance training yield better improvement in trunk extensors endurance in acute low back pain hockey players.The increase in endurance in both groups may be because of increased oxidative and metabolic capacities which allow better delivery and use of oxygen. Thus, the sub maximal exertion demanded by the exercise program in our study on subjects with sub acute low back pain was able to demonstrate an effect on the muscle endurance as measured by the Sorensen test.

Conclusion

This study compared the efficacy of trunk extensors endurance training and general exercise to decrease pain, improve endurance and to decrease functional disability in patients of nonspecific sub acute low back pain and it is concluded that both trunk extensors endurance training and general mobility stretching and strengthening exercises are equally effective in reducing pain, increasing endurance and decreasing disability in patients with nonspecific sub acute low back pain.

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Blood Lactate Response to Different Workload Patterns in Female Weight Lifters

Kumar[1], Ashok, Reena[2] & Kumar[3], Rajesh.

[1]Asst. Prof., Dept. of Sports Science, Punjabi University Patiala (Punjab) India, Email: akashokin@gmail.com

[2]M.Sc. Sports Science Student, Department of Sports Science, Punjabi University Patiala (Punjab) India

[3]Associate Professor, Department of Physical Education, Osmania University, Hyderabad (Andhra Pradesh) India

Abstract

The purpose of this study was to observe the effects of different workloads (i.e. volume patterns-3 RM, 6 RM, 9 RM) of power clean on blood lactate production in female weight lifters. A total of six weight lifters with mean age, height, weight and BMI of 20.50 ±2.88 years, 161± 6.55 cm,70±7.45Kg and 26.81±1.78 respectively volunteered to participate in this study. Each subject's blood lactate was measured at rest and after 3RM, 6RM & 9RM with the help of a digital portable lactate analyzer (Lactate Scout) and the data were analyzed using Mean ±SD, ANOVA and Scheffe. It was found that the maximum mean of relative absolute and percent increase value of blood lactate was 8.71±2.38 mmol and 370.06±109.38 % (3RM) followed by 7.45±2.02 mmol & 349.81±112.09 % (6RM) and 5.33±1.96 mmol & 33.31±81.32% (9RM).The difference in blood lactate at rest and after the execution of different work load pattern was statistical significantly ($p < .05$). It was concluded that the blood lactate response depends upon the maximum absolute load lifted by the weight lifters as compared to the volume of load lifted. In other words, we can say that in this study it was observed that blood lactate response was largely dependent on percentage of 1RM.

Key words: Lactate, Power Clean, 1RM, Olympic Style

Introduction

Typically, lactate production takes place in the presence of anaerobic energy production while lactate utilization requires oxygen *(Bridges et al., 1991).* Hence, training for improvement in lactate tolerance typically includes activities which facilitate enough stimuli for concurrent lactate production and utilization. Current training practices for improving lactate tolerance in athletes is highly influenced by aerobic activities and the combination of aerobic and resistance training *(Dudley & Fleck, 1987).*Thus, the risk of muscle loss is greater when aerobic training is used as a tool for improving lactate tolerance *(Eniseler, 2005).* This obstacle can be avoided if resistance training is modified and used as an intermittent activity to enhance concurrent lactate production and clearance, without exposing an athlete to the negative effects of excessive aerobic training. A study was conducted to evaluate the effects of high intensity resistance training on the performance of distance runners *(Hamilton et al., 2006).* The participants were divided in to two groups. In this 5-week long study, the control group performed their usual competitive-phase training while the experimental group replaced part of their training with explosive jumps and short treadmill sprints. This study observed an improvement in 1500 m speed; 800 m speed, 5 km outdoor time trial speed and lactate threshold speed without compromising baseline muscle strength. It is necessary to recite that, lactate production is higher in type II muscle fibers and during the recruitment of large to intermediate motor units *(Jones & Ehrsam, 1982)* as can occur in the

Olympic style weight lifting techniques such as the clean and jerk, power cleans and the snatch. Working at the intensity which facilitates significant lactate is important to improve lactate tolerance therefore; the use of explosive training is consistent with the training goal in question. In order to close the gap between research and application, it is important to evaluate the effects of high volume explosive training on lactate production as a prelude to the evaluation of high volume explosive training on lactate tolerance during continuous intermittent activities. Little is done to evaluate the effects of Olympic style lifts in female weightlifters. Hence, due to the lack of referring literature, this study utilized only female weightlifters as participants.

Materials & Methods

The design of this study required participants to perform different volume of power clean (3 RM, 6 RM, 9 RM) in Olympic style. Thus, trained six female weight lifters (N=6) between the ages of 17 and 25 years volunteered for this study. Olympic style lifts training session and subsequent blood lactate analysis were conducted at the Gymnasium Hall, Department of Sports, Punjabi University Patiala Campus. Participants performed one volume pattern on each day. Three total days were required for each participant to complete the study. A rest period of 48 hours was observed between the training days. Participants refrained from taking curd/lassi or whey/fermented milk in the last 2-3 hours and participating in any heavy physical activity (except activity of daily living) within 24 hours of the testing day. Blood lactate was analyzed at the beginning and at the end of every session using a digital portable lactate analyzer (Lactate Scout). The device required only 0.5 microliters (µl) whole blood. The blood was drawn from the tip of the index finger.

Statistical Analysis

Statistical analysis was performed with SPSS version 16.0 (free trial, SPSS Inc, Chicago). Repeated measure ANOVA and Scheffe Post hoc was used. In the present study, work load pattern was the independent categorical variable which had three different groups in form of three volume patterns that is 3RM, 6RM & 9RM, thus, use of the test of ANOVA to test the hypothesis of this study is justified. The alpha level of significance for the data analysis was $p<0.05$.

Results & Discussion

This study primarily focused on effects of different work loads on blood lactate response in female weight lifters. Since, exercise volume determines the degree of physiological demand, it was hypothesized that blood lactate response will increase for each increase in volume pattern or intensity of the exercise. Six healthy female weightlifters (20.50 years ±2.88) from the population of female weightlifters of Punjabi University participated in the study. The mean weight lifted for three repetitions (3RM) was 53.33 Kg ±12.11 Kg. The mean weight lifted for six repetitions (6RM) was 30.00Kg±7.74Kg. The mean weight lifted for nine repetitions (9RM) was 32.50 Kg±5.24 Kg (Table1). In addition, the total volume of each volume pattern was also calculated (Volume =Set*load*repetitions). The mean volume for volume pattern-1 (3RM) was 155.00 Kg ± 37.55Kg. The mean volume for volume pattern-2 (6RM) was 180.00Kg ± 46.47Kg. The mean volume for volume pattern-3 (9RM) was 292.50 Kg ± 47.19 Kg (Table1). According to the literature, 3RM for the resistance training exercises is estimated to be 93% of 1RM while 6RM and 9RM are at 85% and 77% respectively *(Baechle & Earle 2008)*. However, it has been suggested that the Olympic style lifts require a lower relative RM due to the relationship between force and velocity *(Newton et al., 1996; Knuttgen & Kraemer 1987)*. The mean blood lactate levels for volume pattern-1 (3RM) was 2.38±0.21mmol/l prior to exercise and 11.10± 2.34 mmol/l after the completion of one set of three repetitions. The mean blood lactate levels for volume pattern-2 (6RM) was 2.21±0.36 mmol/l prior to exercise and 9.55±1.75 mmol/l after the completion of one set of six repetitions. The mean blood lactate levels for volume pattern-3 (9RM) were 2.28±0.27mmol/l prior to the exercise and 7.61±2.07mmol/l after the completion one set of nine repetitions (Table 1).

Table 1. Descriptive Statistics of Female Weight Lifters

	Mean	Std. Deviation
Age	**20.50**	**2.88**
Height	**1.61**	**6.55**
Weight	**70.00**	**7.45**
BMI	**26.81**	**1.78**
Load 3RM,Kg	**53.33**	**12.11**
Load 6RM,Kg	**30.00**	**7.74**
Load 9RM,Kg	**32.50**	**5.24**
Load Volume 3RM, Kg	**155.00**	**37.55**
Load Volume 6RM, Kg	**180.00**	**46.47**
Load Volume 9RM, Kg	**292.50**	**47.19**
Pretest Blood Lactate of 3RM,mmol/l	**2.38**	**0.21**
Post test Blood Lactate of 3RM,mmol/l	**11.10**	**2.34**
Relative Absolute of Blood Lactate 3RM, mmol/l	**8.71**	**2.38**
Relative Percent of Blood Lactate 3RM,%	**370.06**	**109.38**
Pretest Blood Lactate of 6RM,mmol/l	**2.21**	**0.36**
Posttest Blood Lactate of 6RM,mmol/l	**9.55**	**1.75**
Relative Absolute of Blood Lactate 6RM, mmol/l	**7.45**	**2.02**
Relative Percent of Blood Lactate 6RM,%	**349.81**	**112.09**
Pretest Blood Lactate of 9RM,mmol/l	**2.28**	**0.27**
Posttest Blood Lactate of 9RM,mmol/l	**7.61**	**2.07**
Relative Absolute of Blood Lactate 9RM, mmol/l	**5.33**	**1.96**
Relative Percent of Blood Lactate 9RM,%	**233.31**	**81.32**

It was found that the maximum load lifted was 53.33±12.11 Kg (during 3RM) followed by 32.50±5.24 Kg (9RM) and 30.00±7.74 Kg (6RM). But the maximum volume of load was 292.50±47.19 Kg,(9RM);180.00±46.47Kg (6RM) and 155.00±37.55 Kg (3RM). Further, It was found that before the start of execution of different work load pattern, the mean blood lactate of female weight lifters were in a normal range that is 2.38±0.21mmol/l (3RM), 2.21±0.36 mmol/l(6RM) and 2.28±0.27mmol/l (9RM). After the successful execution of different workloads by the weightlifters, it was found that the maximum mean value of blood lactate was 11.10±2.34 mmol/l (3RM), 9.55±1.75 mmol/l (6RM) and 7.61±2.07 mmol/l (9RM).

Table 2. Mean ±SD of Blood lactate response before & after the performance of different work loads

	Blood lactate (mmol)					
Workload pattern→	**1(3RM) Load: 53.33±12.11kg**		**2(6RM) Load: 30.00±7.74 kg**		**3(9RM) Load: 32.50±5.24 kg**	
Age(years)↓	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
20 ±2	**2.38±0.21**	**11.10±2.34****	**2.21±0.36**	**9.55±1.75****	**2.28±0.27**	**7.61±2.07****

Pre- blood lactate levels prior to the beginning of exercise; Post- blood lactate levels after the completion of exercise, **significant at $p< 0.01$

Table 3 shows mean of relative absolute and percent increase in blood lactate response to different workload pattern. It was found that the maximum mean of relative absolute and percent increase value of blood lactate was 8.71±2.38 mmol/l and 370.06±109.38 % (3RM) followed by 7.45±2.02 mmol/l & 349.81±112.09 % (6RM) and 5.33±1.96 mmol/l and 33.31±81.32% (9RM).

Table 3. Mean ±SD of Relative increase in blood lactate response to different workload pattern

	Blood lactate (mmol)					
Workload pattern→	1(3RM) Load: 53.33±12.11 kg Volume: 155.00±37.55 kg		2(6RM) Load: 30.00±7.74 kg Volume: 180.00±46.47 kg		3(9RM) Load: 32.50±5.24 kg Volume: 292.50±47.19 kg	
Age(years)↓	Absolute (mmol)	Percent increase (%)	Absolute (mmol)	Percent increase (%)	Absolute (mmol)	Percent increase (%)
20 ±2	8.71±2.38	370.06±109.38	7.45±2.02	349.81±112.09	5.33±1.96	233.31±81.32

Relative Absolute & Percent increase in blood lactate levels after the completion of different work load pattern

Thus, maximum blood lactate production was observed in a 3RM workload pattern in which weightlifters had lifted maximum load (53.33±12.11 Kg). So, the blood lactate response depends upon the maximum absolute load lifted by the weight lifters as compared to the volume of load lifted. In other words, we can say that in this study it was observed that blood lactate response was largely dependent on percentage of 1RM lifted.

Table 4: Analyses of Variance of Blood lactate before & after various workloads among different groups

		Sum of Squares	Mean Square	F
Blood Lactate Pre test, mmmol	Between Groups	.08	.04	.49
	Within Groups	1.28	.08	
Blood Lactate Post test, mmol	Between Groups	36.54	18.27	4.25*
	Within Groups	64.38	4.29	
Relative Absolute Increase of Blood Lactate , mmol	Between Groups	35.06	17.53	3.84*
	Within Groups	68.41	4.56	
Relative Percent Increase of Blood Lactate , mmol	Between Groups	65365.75	32682.87	3.14*
	Within Groups	155721.47	10381.431	

*significant at $p<0.05$

The results of analysis of variance (Table 4) showed that the variance in the mean value of blood lactate pre test (F=0.49) among different workload pattern was not statistical significant. But, the variance in the mean value of blood lactate post test ($F=4.25$, $p<0.05$), relative absolute ($F=3.84$, $p<0.05$) and percent ($F=3.14$, $p<0.05$) increase in blood lactate among different workload pattern was statistical significant.

Further, the scheffe posthoc (Table 5) revealed that the difference was statistical significant at 0.05 level of blood lactate post test (3RM vs. 9RM), relative absolute (3RM vs. 9RM) and percent increase in blood lactate (3RM vs. 9RM). Results of this study shows a trend of decrease in blood lactate from volume pattern-1(3RM) to volume pattern-3 ((RM) after exercise and this may be due to that participants had done only one set of exercise instead of three sets with three repetitions. Thus, results of this study suggests that further research work should be taken with volume pattern consist of three sets with three repetitions, the results such study may more deeply and widely interpret the production of blood lactate in response to different volume pattern. In addition, when the relative increase in blood lactate was analyzed, it was observed that higher load is associated with higher lactate response as 3RM showed mean relative increase of 370.06±109.38 % as opposed to mean relative increase of 349.81±112.09 % and 233.31±81.32 in work load volume pattern 6RM and 9RM respectively (Table 2). It can be seen that there is a significant difference in relative blood lactate increase in all work load volume patterns.

Table 5. Scheffe Posthoc Multiple Comparison of Blood lactate before & after various workloads among different groups

Dependent Variable	(I) 1-3RM;2-6RM;3-9RM	(J) 1-3RM;2-6RM;3-9RM	Mean Difference (I-J)	95% Confidence Interval Lower Bound	Upper Bound
Blood Lactate Pre test, mmmol	1	2	0.16	-0.29	.62
		3	0.10	-0.35	.55
	2	3	-0.06	-0.52	.39
Blood Lactate Post test, mmol	1	2	1.55	-1.69	4.79
		3	3.48*	0.23	6.72
	2	3	1.93	-1.31	5.17
Relative Absolute Increase of Blood Lactate , mmol	1	2	1.26	-2.08	4.61
		3	3.38*	0.03	6.73
	2	3	2.11	-1.23	5.46
Relative Percent Increase of Blood Lactate , mmol	1	2	20.25	-139.39	179.89
		3	136.75*	-22.89	296.39
	2	3	116.50	-43.14	276.14

*Significant at the 0.05 level.

Discussion

A key finding of this study is the difference observed in blood lactate response to different volumes. Prior to analyzing the possible explanations for the findings, it is necessary to contemplate the study design. The work load volume of the exercise was the influential variable in measuring the lactate response. Various factors such as load, repetitions, time under tension and bar displacement among others influence the blood lactate *(Pauletto, 1986; Pauletto, 1985).* As discussed earlier, the percent load of estimated 1RM was less when associated with higher number of repetitions. Therefore, this study observed that lactate response is largely dependent on percentage of 1RM. *Robergs et al. (1991)* concluded that the rate of glycogenolysis was twofold greater during leg extension at 70% of 1RM than 50% of 1RM, possibly due to the greater involvement of Type II muscle fibers. While findings of these studies give clear indications that lactate response in resistance exercise is largely dependent on load, observations made in the present study, coupled with observations by *Gupta & Goswami (2001).* These observations are similar to the present study in which 3RM work load volume pattern with smallest number of repetitions (three) but highest amount of load percentage has yielded greatest lactate response. The literature indicates that lactate production occurs more in Type II muscle fibers and in larger muscle groups *(Robergs et al., 1991; Jones & Ehrsam, 1982). Bergeron (1991)* reported that glycolysis results in the formation of pyruvate, $NADH^+$, H^+ and ATP. While ATP is used for energy production; pyruvate, $NADH^+$ and H^+ is further processed through aerobic respiration and electron transfer chain, respectively. When the rate of energy requirement exceeds electron diffusion, pyruvate is converted to lactate. However, in intense exercise and continued energy demand, the rate of lactate production exceeds oxidation and lactate accumulates. Thus, this study confirms that lactate accumulation is closely associated with increased energy demand. It is possible that the 3RM work load volume patterns in this study overwhelmed the aerobic capacity, which may have resulted in exceedingly higher blood lactate response. Less time spent while performing higher percentage of 1RM work load (3RM) may be another determinant contributing to the elevated lactate response in volume patterns performing greater repetitions.

Conclusion

In conclusion, the results of this study indicates that blood lactate response in power clean movement is largely associated with percentage of 1RM work load volume as determined by number of repetitions and load. The power output can be another determinant of blood lactate response to power cleans; however, further study is required to support this observation. This study also concludes that, explosive movements, if performed; can impose greater demands on glycolytic capacity. Therefore, explosive activities can be used for greater improvement in energy production.

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Normative Values of Spinal Flexibility for Nigerians Using the Inclinometric Technique

Egwu, M.O., Mbada, C.E. & Olowosejeje, D.
Corresponding Author: Mbada, C.E. email: doziembada@yahoo.com
Department of Medical Rehabilitation, College of Health Sciences, Obafemi Awolowo University, Ile – Ife, Nigeria

Abstract

Normative values of spine range of motion (ROM) are essential for proper diagnosis of spinal impairments and in the monitoring of effect of treatment and patient's recovery. This study established gender and age normative data and the correlates of spinal flexibility in apparently healthy Nigerians adults. 502 volunteers whose ages ranged between 18 and 47 years participated in the study. Dual inclinometric technique was used to measure spinal flexibility in forward flexion, extension, right and left lateral flexion. Flexibility levels were defined using percentiles as poor (<25th), moderate (between 25th and 75th), good (between 75th and 95th), and very good (>95th) respectively. Data was analyzed using descriptive and inferential statistics at 0.05 alpha level. The mean value for forward flexion, extension right and left lateral flexion for all participants was 43.3+12.7, 16.7+6.81, 17.3+6.25 and 17.0+5.65. Females exhibited significantly higher extension (17.4+6.34 vs. 16.1+7.14) and right lateral flexion (18.4+6.30 vs. 16.3+6.07) ROM than their male counterparts ($p<0.05$). Age and anthropometric parameters were significant correlates of spinal flexibility ($p<0.05$). In conclusion, this study established a set of reference values for lumbar spinal flexibility in healthy Nigerians. Increasing age was associated with decreased spinal flexibility.

Key words: Spinal flexibility, dual inclinometer, normative data, Nigerians

Introduction

The nature of flexibility is complex, involving not only the range of motion of a joint or series of joints *(Anderson and Burke, 1991)* but it is affected by internal influences such as the type of joint, the elasticity of muscle tissues, tendon, ligaments, and the skin and also by external influences such as age, gender, the stage in the recovery process of a joint, time of the day *(Alter, 1996; Gummerson, 1990).* Good flexibility aids in the elasticity of the muscles *(Nelson and Kokkonen, 2007),* provides ease in movement and a wider range of motion in the joints *(Nelson and Kokkonen, 2007; Manescu, 2010),* aids with injury prevention *(Shellock and Prentice, 1985),* helps to minimize muscle soreness and improves efficiency in all physical activities *(Nelson and Kokkonen, 2007),* improves quality of life and functional independence *(Podrasky, 1983; Nelson and Kokkonen, 2007).*

Specifically, previous studies have established a relationship between flexibility of the lumbar spine and back health *(Foster and Fulton, 1991; Plowman, 1992; Stutchfield and Coleman, 2006; Battié et al, 2008).* Adequate flexibility of the lumbar spine and the surrounding soft tissues provides for a functional mechanical *advantage (Farfan, 1975),* healthy lower back *(Foster and Fulton, 1991; Plowman, 1992),* attainment of important functional skills and activities of daily living *(Podrasky,* *1983; Nelson and Kokkonen, 2007)* and unimpaired gait capability *(Podrasky et al, 1983)*. Consequent on the foregoing, spinal range of motion (ROM) measurements as been incorporated as a standard part of evaluation of patients with back pain in most clinical settings *(Rothstien, 1985; Yeoman, 2000)* and as a basis for decisions regarding disability and *compensation (Gatchel and Gardea, 1999; Gross and Battié, 2005)*. Evaluation of spinal ROM is important in patients with back problems as well as in general fitness assessments and it is also useful in monitoring therapeutic and training outcomes *(Chadwick, 1984; Mayer et al, 1984; Rothstien, 1985; Yeoman, 2000)*.

Numerous techniques have been developed to assess spinal flexibility such as visual estimation *(Youdas et al, 1991; Yeoman, 2000)*, finger-to-floor distance *(Macre and Wright, 1969)*, sit-and-reach measurements *(Christine et al, 1999; Hoeger and Hoeger, 2008)*, standard or modified Schober methods *(Macrae and Wright, 1969; Moll et al, 1971)*, subjective reports through questionnaires *(Kuornika et al, 1987)* and the use of devices such as flexicurves *(Anderson and Sweetman, 1975; Burton et al, 1989)*, protractors and *goniometers (Troup et al, 1968; Fitzgerald et al, 1983; Alaranta et al, 1994a)* and inclinometers *(Mayer et al, 1984; Gill et al, 1988; Alaranta et al, 1994b; Saur et al, 1996)*. The preference of technique of spinal ROM evaluation in routine clinical practice is often based on its reliability, validity, simplicity, cost, level of invasiveness and technicality *(Youdas et al, 1991; Yeoman, 2000)*. Establishment of reference norms for spinal flexibility requires assessment techniques with high level of validity and reliability. In light of this, the inclinometric technique has been found to be valid and *reliable (Mayer et al, 1984; Saur et al, 1996)* and has been recommended as a valuable tool in routine clinical for assessment of spinal ROM *(Mayer et al, 1984; Saur et al, 1996; Yeoman, 2000)*. It is believed that the inclinometric technique could measure and differentiate movements of the hip from those of the lumbar spine *(Mayer et al, 1984; Petra et al, 1996)* and could be learned quickly within a short period of time *(Saur et al, 1996)*. Normative values of spine range of motion (ROM) are essential for proper diagnosis of spinal impairments and in the monitoring of effect of treatment and patient's recovery *(Ensink et al, 1996; Yeoman, 2000; Al-Eisa et al, 2006)*. *Uluçam and Ciğali (2009)* summarized that factors such as medical conditions, pelvic asymmetry age, sex, race and geographical distribution are determinants of joint ROM. Dearth of normative values and dependence on criterion standard is a limitation in the assessment of back functions performance *(Hoeger and Hoeger, 2007)*. Therefore, it is expedient that every population should have their age-and-gender specific spinal ROM values. There appears to be a dearth of studies on normative values of spinal flexibility in apparently healthy Nigerians. This study was designed to established gender and age normative data and the correlates of spinal flexibility in apparently healthy Nigerians adults using the dual inclinometric technique.

Materials and Methods

Five hundred and two consenting apparently healthy individuals whose ages ranged between 18 to 47 years participated in this study. The participants comprised of students and staff of

Obafemi Awolowo University (OAU), Ile-Ife, Nigeria and other individuals from Ile-Ife community. The participants were screened via interview to ensure that they satisfied the eligibility criteria for the study. Exclusion criteria were a positive history of LBP within 1 year to the time of the study; any obvious spinal deformity or neurological disease such as post-polio syndrome; any history or cardiovascular diseases such as hypertension, stroke, or other cardiac disorders; participation in high-intensity regular exercise or elite sports at a competitive level. The ethical approval for the study was obtained from the Obafemi Awolowo University Teaching Hospitals Complex Institutional Review Committee. The study was conducted at the Exercise Laboratory of the Department of Medical Rehabilitation, OAU, Ile-Ife, Nigeria.

Measurements

Anthropometric measurements included height, weight, body mass index (BMI), limb length (LL) and trunk length (TL). Height was measured to the nearest 0.1cm with a height meter calibrated from 0-200cm. The subject stood barefooted on the platform of the scale looking straight ahead while the horizontal bar attached to the height meter was adjusted to touch the vertex of the head. Weight was measured nearest to the 0.5Kg on a bathroom weighing scale calibrated from 0-120kg with the subject in minimal clothing, barefoot and standing in an erect posture looking straight ahead. LL was measured by taking the distance between the anterior superior iliac spine and the sole of the foot with the participant in an erect position. TL was measured by taking the distance from the anterior superior iliac spine to the acromion process with the participant in an erect position.

Procedure

Dual inclinometric technique was used to assess spinal ROM in flexion, extension, right and left lateral flexion. The assessment procedure for spinal ROM was explained and demonstrated to each consecutive participant at inclusion. Prior to the test, the participants were required to warm up with back stretches and a 5-minute walk at self-determined pace around the research venue. Measurements were carried out with the universal inclinometer based on guidelines provided in the *American Medical Association (AMA) Guides (1993)*. The mean of three consecutive movements was used in the final analysis to determine spinal ROM.

Forward Flexion and Extension Measurement

The upper edge of the sacrum (S1 vertebra) and the lower edge of the T12 vertebra were palpated in the participants in a standing position. The middle of the platform of the first inclinometer was put on the sagittal plane of the spinous process of T12, and the second inclinometer was set on the sagittal plane of the spinous process of S1 and Lumbar Range of Motion (LROM) was determined in degrees using the technique described by *Loebl (1967)*. In the neutral position, the participants were asked to stand erect with their hands hanging without any effort toward the ground. From this position, the participants were then asked to flex forward as far as possible with their knees straight. The readings on the two inclinometers were then taken. The reading on the first inclinometer was the total lumbar flexion and that on the second inclinometer was the sacral flexion. To get the true LROM, the readings of the lower inclinometer was subtracted from those of the upper inclinometer. The flexion protocol was repeated for extension having the participants extend back for full extension instead of flexing forward. The readings were taken three times and the mean of the three values was used as the lumbar ROM *(AMA, 1993; Yeoman 2000).*

Lateral Flexion Measurement

The inclinometers were placed on the frontal planes of the both the S1 and T12 vertebrae so that the bases of the inclinometers line up with the lines drawn at this planes. The two inclinometers were held upside down and not pressed against the back, so that the gravity dependent pendulum swung freely. The participants were then asked to stand erect against a wall with nose nearly touching the wall. This position kept the participants from bending forward during lateral flexion measurements. The participants were asked to laterally flex to the right by running their right hands down the lateral thigh towards the right knee. The readings were then taken from the two inclinometers. The difference between the T12 and the S1 inclinometers gave the true right lateral flexion value. The right lateral flexion procedure was repeated for left lateral flexion having the participants bend to the left instead of bending to the right. The readings were taken three times and the mean of the three values was used as the lumbar range of motion *(AMA, 1993; Yeoman 2000). Data analysis* Data were summarized using descriptive statistics of mean and standard deviation. Independent t-test was used to compare the general characteristics and spinal flexibility values between male and female participants. Analysis of Variance (ANOVA) was used to compare general characteristics and spinal flexibility values across different age groups. Pearson product moment correlation analysis was used to determine the relationship between spinal flexibility and each of age, height, weight, BMI, LL and TL. Alpha level was set at 0.05. SPSS 16.0 version software was used for data analysis.

Results & Discussion

Table 1: Physical characteristics of the subjects.

Variables	**Male**	**Female**	**t-cal**	**p-value**	**All participant**
	N=267	**N=235**			
X +S.D		**X + S.D**		**X +S.D**	
Age (yrs)	**23.1+3.73**	**22.2+3.41**	**2.515**	**0.012***	**22.7+3.60`**
Weight (kg)	**67.2+10.0**	**60.3+10.0**	**7.69**	**0.001***	**64.0+10.5**
Height (m)	**.74+0.08**	**1.65+0.07**	**12.519**	**0.001***	**1.70+0.09**
BMI (kg/m2)	**22.2+2.82**	**22.1+3.57**	**0.422**	**0.673**	**22.1+3.19**
LL	**1.02+0.07**	**0.98+0.06**	**7.262**	**0.001***	**1.00+0.07**
TL	**0.72+0.06**	**0.67+0.05**	**8.989**	**0.001***	**0.70+0.06**

Key: BMI = Body Mass Index; LL= Limb Length; TL= Trunk Length

Table 1 shows the physical characteristics of all participants. The mean age of the participants was 22.7+3.60 years. The result shows that LL and TL of the male participants were significantly higher than that of their female counterparts ($p<0.05$). The participants were classified into four age groups as (<20yrs, 20-25 yrs, 26-30 yrs and >30yrs respectively) and their characteristics were compared as presented in table 2. The result indicated that there were significant differences ($p<0.05$) in all the general characteristics across the different age groups except for height (p=0.303).

Table 2: One-way ANOVA and post-hoc LSD comparison of general characteristics of all participants by age distribution (N=502)

Variables	<20yrs N=45	20-25yrs N=388	26-30yrs N=56	>30yrs N=30	F-ratio	p-value
	$X \pm SD$	$X \pm SD$	$X \pm SD$	$X \pm SD$		
Age	18.6+0.50^a	22.0+1.56^b	27.1+1.23^c	38.0+5.85^d	581.285	0.001*
Weight	62.1+12.7^a	62.9+10.0^a	69.3+8.04^b	69.3+8.04^b	18.637	0.001*
Height	1.68+0.11	1.69+0.08	1.71+0.08	1.70+0.10	1.218	0.303
BMI	21.9+3.70^a	21.8+2.83^a	23.6+3.18^b	28.0+4.37^c	22.812	0.001*
LL	0.98+0.07^a	1.01+0.06^b	1.01+0.07^b	0.92+0.16^c	7.809	0.001*
TL	0.70+0.05^a	0.69+0.05^a	0.71+0.07^a	0.78+0.07^b	12.089	0.001*

Superscripts $^{a, b, c, d}$ – for a particular variable, mode means with different superscript are not significantly (p>0.05) different. Mode means with same superscript are significantly (p<0.05) different

Table 3: Spinal flexibility of all the participants (N=502)

Variables	Male N=267	Female N=235	t-cal	p-value	All participant
	X $\pm$S.D	X $\pm$ S.D			X $\pm$ S.D
FF	43.3$\pm$12.1^0	43.3$\pm$13.4^0	0.014	0.989	43.3$\pm$12.7^0
EXT	16.1$\pm$7.14^0	17.4$\pm$6.34^0	-2.261	0.024*	16.7$\pm$6.81^0
RF	16.3$\pm$6.07^0	18.4$\pm$6.30^0	-3.666	0.001*	17.3$\pm$6.25^0
LF	17.0$\pm$5.48^0	17.1$\pm$5.85^0	-0.26	0.795	17.0$\pm$5.65^0

Key: FF = Forward Flexion; EXT = Extension; RLF = right lateral flexion; LLF = Left Lateral Flexion; (°) = Degree

The spinal flexibility value of all participants is presented in table 3. From the result, significant differences were also observed in right lateral flexion (p=0.001) and extension (p=0.024) between male and female participants.

Table 4: One-Way ANOVA and post-hoc LSD Comparison of spinal flexibility of all participants by age distribution

Variables	$\leq$ 20yrs N=45	20-25yrs N=388	26-30yrs N=56	$\geq$30yrs N=13	F-ratio	p-value
	X$\pm$S.D	X$\pm$S.D	X$\pm$S.D	X$\pm$S.D		
FF	42.9$\pm$11.4^0	43.2$\pm$12.6^0	44.3$\pm$15.0^0	43.4$\pm$9.62^0	0.153	0.928
EXT	18.5$\pm$8.47^{0a}	16.9$\pm$6.59^{0b}	15.3$\pm$6.68^{0b}	12.3$\pm$4.85^{0c}	3.739	0.011
RF	15.6$\pm$5.85^{0a}	17.6$\pm$6.47^{0b}	17.1$\pm$4.75^{0b}	13.3$\pm$4.65^{0c}	3.271	0.021
LF	17.06$\pm$5.88^{0a}	17.3$\pm$5.74^{0a}	16.4$\pm$4.64^{0a}	13.4$\pm$1.41^{0b}	2.318	0.075

KEY: FF = FORWARD FLEXION; EXT = EXTENSION; RLF = RIGHT LATERAL FLEXION; LLF = LEFT LATERAL FLEXION; (°) = DEGREE

Superscripts ^{a,b,c} – for a particular variable, mode means with different superscript are not significantly (p>0.05) different. Mode means with same superscript are significantly (p<0.05) different

Table 4 shows the comparison of spinal flexibility of all participants by age distribution. Extension (p=0.011) and right lateral flexion (p=0.021) significantly decreased with increasing age. Forward flexion was comparable across the different age groups (p=0.928). However, left lateral flexion decreased with increasing age but was not statistically significant (p=0.075). The mean, standard deviation, range and 25th, 50th, 75th and 95th percentile scores were determined for four gender/ age categories for spinal flexibility of all participants as presented in tables 5 and 6. Flexibility levels were defined using percentiles as poor (<25th), moderate (between 25th and 75th), good (between 75th and 95th), and very good (>95th) respectively.

Table 5: Mean score and percentile data of spinal flexibility in forward flexion and extension (values are in degrees)

Variable	Age group	Sex	N	X±S.D	min	25th	median	75th	95th	max
					Percentile					
Forward Flexion	≤20	M	22	44.2±9.55	24	36.25	46.67	51.17	58.67	58.67
	≤20	F	23	41.7±1.30	18	29.67	48	52.33	57.53	58
	20-25	M	198	42.6+1.23	14	35.5	43.33	49.75	61.88	78.67
	20-25	F	190	43.7+1.28	15.33	34.17	45.67	53.42	64.15	71.33
	26-30	M	40	46.3+1.22	25.33	38.42	49.17	54.85	63.33	69.33
	26-30	F	16	39.4+2.02	8.33	26.75	37	58.58	68.33	68.33
	> 30	M	7	41.8+1.16	25	30	40.67	51.33	56	56
	> 30	F	6	45.2+7.42	36.67	39.92	42.33	54	55	55
	18- 47	M	267	43.3+1.21	14	36	43.67	51	62.67	78.67
	18- 47	F	235	43.3+1.34	8.33	33.33	45.33	53.67	64.07	71.33
		(M&F)	502	43.3+1.27	8.33	35	44	52.33	63.33	78.67
Extension	<20	M	22	18.6+9.87	6.33	10	17.5	24.08	44.15	45
	<20	F	23	18.4+7.11	9.33	13.67	18.33	21.33	40.33	43.33
	20-25	M	198	15.9+6.85	4.67	11	15	20.17	29.67	42
	20-25	F	190	17.8+6.18	5.33	13.33	16.67	21.67	30.15	71.33
	26-30	M	40	15.7+7.07	8	11.42	12.67	18.16	33.4	40
	26-30	F	16	14.5+5.73	7	10.41	13.67	18.42	25.67	25.67
	>30	M	7	14.2+4.97	6	10	14	19	19.67	19.67
	>30	F	6	10.1+4.01	5.67	6.67	9.33	14.5	15	15
	18- 47	M	267	16.1+7.14	4.67	11	15	20	29.67	45
	18- 47	F	235	17.4+6.34	5.33	13.33	16.33	21.33	30	43.33
		(M&F)	502	16.7+6.81	4.67	11.67	15.67	21	30	45

Table 6: Mean score and percentile data of spinal flexibility in forward flexion and extension (values are in degrees)

Variable	Age group	Sex	N	X±S.D	min	25th	median	75th	95th
						Percentile			
Right Spinal Flexion	<20	M	22	14.3+5.72	6.33	9.17	14	19.33	24.87
	<20	F	23	16.8+5.84	7	12	17.33	19.67	28.53
	20-25	M	198	16.6+6.43	5	12.33	15.67	21	28.33
	20-25	F	190	18.7+6.34	6.33	13.92	19	23.08	29.82
	26-30	M	40	16.6+3.98	8	13.33	16.5	19.58	22.98
	26-30	F	16	18.3+6.27	11	13.08	16.83	23.25	30
	> 30	M	7	14.0+5.64	9.67	10	11.67	17.33	25.33
	> 30	F	6	12.4+3.46	8.67	9.67	11.67	15.3	18.3
	18- 47	M	267	16.3+6.07	5	12.33	15.5	20.75	26.67
	18- 47	F	235	18.4+6.30	6.33	13.33	18.33	23.33	29.4
		(M&F)	502	17.3+6.25	5	12.67	17	21.33	28.33
Left Flexion	<20	M	22	16.2+5.47	8	11.83	16	20.16	27.8
	<20	F	23	17.9+6.25	7.33	13	17.67	23.33	31.6
	20-25	M	198	17.5+5.56	2	13.92	18.17	21.08	25.68
	20-25	F	190	17.0+5.93	4	12.33	17.5	21	25.6
	26-30	M	40	15.7+4.58	5	13.08	16	18.58	24.55
	26-30	F	16	17.9+4.55	11.67	13.33	18.5	22.67	24.33
	> 30	M	7	12.1+4.55	11.7	13.33	18.5	22.7	24.33
	> 30	F	6	14.9+5.20	10	11.75	14	16.75	24.33
	18- 47	M	267	17.0+5.48	2	13.25	17	20.67	25
	18- 47	F	235	17.1+5.85	4	12.67	17.33	21	25.27
		(M&F)	502	17.0+5.65	2	13	17.33	20.83	25

The correlates of spinal flexibility were determined among the participants. Significant correlations were found between age and left flexion ($r=-0.144$; $p=0.001$), age and extension ($r=-0.169$; $p=0.001$), weight and forward flexion($r=0.088$, $p=0.050$), height and extension ($r=-0.114$, $p=0.011$) and trunk length and extension ($r=-0.109$; $p=0.014$) respectively.

Table 7: Correlation of age and general characteristics with spinal flexibility of all participants

	AGE	WT	HT	LL	TL	BMI	FF	EXT	RF
AGE	-								
WT	0.330*	-							
	0.001								
HT	0.089*	0.529*	-						
	0.046	0.001							
LL	-0.106*	0.350*	0.768*	-					
	0.017	0.001	0.001						
TL	0.272*	0.385*	0.593*	0.016	-				
	0.001	0.001	0.001	0.178					
BMI	0.329*	0.773	-0.122*	-0.165	0.061	-			
	0.001	0.001	0.006	0.001	0.715				
FF	0.034	0.088*	-0.016	-0.023	0.004	0.119	-		
	0.442	0.05	0.721	0.602	0.922	0.008			
EXT	-0.169*	-0.073	-0.114*	-0.054	-0.109*	-0.017	0.205	-	
	0.001	0.104	0.011	0.226	0.014	0.707	0.001		
RF	-0.078	-0.067	-0.065	-0.035	-0.057	-0.04	0.158*	0.220*	-
	0.079	0.136	0.146	0.433	0.2	0.371	0.001	0.001	
LF	-0.144*	-0.007	-0.064	0.014	-0.117*	0.029	0.048	0.255*	0.230*
	0.001	0.868	0.155	0.749	0.009	0.516	0.288	0.001	0.001

Key: Wt- weight; TL- trunk length; Ht- height; LL- limb length; FF- forward flexion; Ext- extension, RLF- right lateral flexion; LLF- left lateral flexion

Discussion

This study established gender and age normative data and the correlates of spinal flexibility in apparently healthy Nigerians adults using the dual inclinometric technique. Participants in this study were young adults with the mean age of 22.7+3.60 years and the 20-25yrs age bracket. The male participants had significantly higher TL and LL than their female counterparts. Literature is replete on the gender dependent differences in body segment proportions between male and female *(Cooper et al, 1992; Marras et al, 1987; 2001; Xu et al, 1999; Sizer and James, 2008; Norton et al, 2004; Brown et al, 2002).* Contrary to the finding of this study, females generally have been reported to have longer trunk and shorter legs than men *(Tichauer, 1978; Marras et al, 2001)* and these differences can significantly impact on variables such as spine loading *(Marras et al, 2001)* and mechanical efficiency in physical performance assessments *(Decker et al, 2003).* In addition, variation in body segment length have been found to be significantly correlated with range of motion test result especially toe-touch flexibility *(Alter, 1996).* Literature reveals that variation in body morphology and geometry are related to physical performance *(Jaric et al, 2005; Nevill et al, 1992; Winter and Nevill, 1995; Nevill et al, 2005)* which differs among racial groups *(Alter, 1996; Sumiski et al, 2002).* Body morphology and geometry have been found to vary according to race and geographical population *(Tanner et al, 1982; Lohman et al, 1988; Ruff, 2002; Wagner and Heyward, 2007).* Consequently, population-specific health related physical performance norms are recommended *(Ross et al, 1987; Hoffman, 2006; Catley and Tomkinson, 2012).*

The mean value for forward flexion, extension, right and left lateral flexion for all participants in this study was 43.3$\pm$12.7, 16.7$\pm$6.81, 17.3$\pm$6.25 and 17.0$\pm$5.65 respectively. *Magee (1992)* submitted that the archetypal lumbar spine should be able to flex forward 40 to 60^0, with extension normally limited to 20 to 35^0, while left and right lateral flexion should be approximately 15 to 20^0. The result of this study revealed that the mean extension ($17.4+6.34^0$) and right lateral flexion ($18.4+6.30^0$) of female participants were significantly higher than that of their male counterparts. These results corroborates with previous studies that suggest that females are more flexible than males *(Haley et al, 1986; Alter, 1996; Knudson et al, 2000).* In addition to structural differences, males appear to have greater stiffness and decreased segmental motion in the lumbar spine compared to females *(Brown et al, 2002). Moll et al (1972)* also confirmed that lateral flexion is greater in females than in male while *Haley et al (1986)* stated that girls had greater lumbar spine mobility than boys in side bending. Furthermore, this study's result showed that there was no significant difference in forward flexion between male and female participants. This is corroborated by *Mellin and Poussa (1992)* who found no significant differences in forward flexion of the lumbar spine between male and female. Although conclusive evidence is lacking, several factors, including anatomical and physiological differences, may account for the difference in flexibility between the sexes. Other factors could be smaller muscle mass, joint geometry, and gender-specific collagenous muscle structure *(McHugh et al. 1992).*

Flexibility is one of the major components of health-related and performance-related physical fitness, and is defined as the maximum physiological passive range of motion of a given joint movement *(Araújo, 2008).* Spinal flexibility values in normal individuals have been documented by previous investigators among various populations using the dual inclinometric technique *(Mayer et al, 1984; Keeley et al, 1986; Gill et al, 1988; Alaranta et al, 1994b; Saur et al, 1996). Alaranta et al (1994b)* established normative data for spinal flexibility among white and blue workers aged 35 to 54 year using the dual inclinometric technique. *Trudelle-Jackson et al (1976)* established normative data of lumbar flexion and extension for women of different age and racial groups. *Troke et al (2001)* established comprehensive normative data base of lumbar spine ranges of motion using a portable modified spine motion analyzer. *Konndratek et al (2007)* provided the basic normative values for lumbar range of motion in children. These normative data contribute to a better knowledge of the flexibility behavior with age and gender and will be useful for professionals who assess flexibility in their professional practice *(Araújo, 2008).* For the purpose of constructing gender and age reference value tables for spinal flexibility among all the participants, forward flexion scores less than 35^0 was regarded as poor, scores between $35\text{-}52^0$ was regarded as moderate; scores between 52- 63^0 was regarded as good scores and greater than 63^0as very good. Extension scores less than 12^0 was regarded as poor, scores between $12\text{-}21^0$ was regarded as moderate; scores between 21- 30^0 was regarded as good scores and greater than 30^0as very good. Right lateral flexion scores less than 13^0 was regarded as poor, scores between $13\text{-}21^0$ was regarded as moderate; scores between 21-28^0 was regarded as good scores and greater than 28^0as very good; while left lateral flexion scores less than 13^0 was regarded as poor, scores between 13-21^0 was regarded as moderate; scores between 21- 25^0 was regarded as good scores and greater than 25^{0}as very good.

This study investigated the correlation between spinal flexibility and individual factors. From the result, there was a significant inverse relationship between age and each of spinal extension and left flexion. This result is consistent with previous reports that flexibility decreases with advancing *age (Alaranta et al, 1994b; Dvorak et al, 1995; Sullivan et al, 1994; Troke et al, 2001). Alter (1996)* submitted that the inverse relationship between age and flexibility is due to the age-related physiological changes in the connective tissues. These changes causes an increased in the amount of calcium deposits, adhesions, and cross-links in the body, an increase in the level of fragmentation and dehydration, changes in the chemical structure of the tissues, loss of suppleness due to the replacement of muscle fibers with fatty, and collagenous fibers *(Alter, 1996)*. Furthermore, certain anthropometric measures were found to be significantly related to flexibility in this study. A direct significant relationship was observed between weight and forward flexion, and between trunk length and extension. Previous studies have reported variable results on the anthropometric correlates of spinal flexibility. However, *Battié et al (1987)* concluded that age, sex, and other physical attributes of an individual are important variables that must be taken into account in determining what is normal, excessive, or diminished spinal flexibility.

Clinical Implication of findings

The normative spinal flexibility values derived in this study could be useful in assessing impairment in the function of the back muscles in both healthy and patient populations. These values can be used to compare a patient's score at intake or as an outcome measure in clinical practice. The reference norm values for spinal flexibility could be used in rehabilitation to estimate the level of spinal flexibility improvement in a patient at intake and also serve as outcome measure of improvement. Clinicians who treat low-back pain can use established baseline data on low back flexibility among normal subjects as a means to recognize decreased spinal flexibility as one of the impairments resulting from low-back pain or as an outcome measure to help evaluate residual disability.

Conclusion

This study established a set of normal values for lumbar spinal flexibility in healthy Nigerians. Increasing age was associated with decreasing spinal flexibility without gender bias. Females were found to have a significantly higher extension and right lateral flexion range of motion than males. Age and anthropometric parameters were significant correlates of spinal flexibility.

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Comparison of Health Related Physical Fitness Variables And Psychomotor Ability between Rural and Urban School Going Children

Saha[1], G.C. & Haldar[2], S.

[1]Assistant Professor and AFC 'C' licensed Coach, Post Graduate Govt. Institute for Physical Education, Banipur, 743233, West Bengal State University, West Bengal, India, e-mail: callmegopal@gmail.com
[2]Research scholar, Dept.of Phy. Edu, University of kalyani, Dist- Nadia, West Bengal, India, email: shantanu.halder93@gmail.com

Abstract

The purpose of the study was to compare the Health related physical fitness variables and psychomotor ability between rural and urban school going children. One thousand students age ranging from 17 to 30 years were selected as subjects for the study of which five hundred were Tribal and the remaining five hundred were Non-tribal School going from different schools of North 24 Parganas District, West Bengal. The subjects were tested in their respective school ground for continuously five days. The criterion measures included under Health related physical fitness directly related to improvement of health are 1) Sit and Reach test to measure lower back flexibility and was, 2) Body Fat Monitor, an electronic device manufactured by Omron model no. HBF 306 to measure Body fat percentage, 3) Aerobic /cardiovascular function was measured by the 1.5 mile run test, 4) Abdominal muscular strength and endurance was used measured by Partial Curl Ups and 5) Upper body muscular strength and endurance was measured by Right Angle Push-Ups.To measure the Psychomotor ability, reaction ability was considered and was measured by Nelson Hand Reaction Test. For the purpose of Comparison of Health related physical fitness variables and Psychomotor ability between Rural And Urban School going children, Student's 't' ratio statistical technique was used (SPSS Version 18) to analyse the data. The level of significance was set at $p<0.05$ level. The results showed significant differences between Rural and Urban school going children in all the Health related Physical fitness components as well as in Reaction ability under psychomotor ability and rural school going children was found better than urban school going children.

Key words: Health related physical fitness, reaction ability, Rural, Urban

Introduction

The sedentary lifestyle presents a major public health challenge that must be met in order to prevent obesity and thus enhance health and well-being *(Bize et al, 2007)*. For substantial health benefits, current guidelines for adults recommend at least 2.5 hours of moderate-intensity or 1.25 hours of vigorous-intensity aerobic physical activity per week. Futher, moderate- or high-intensity muscle strengthening activities for all major muscle groups two or more days a week provide additional health benefits *(http://www.health.gov/PAguidelines, 2009)*.

Over the past four decades, there has been an increase in the prevalence of overweight and physical fitness deterioration in adult across all genders, ages and racial/ethnic groups *(Ichinohe et al, 2004)*. The negative effects of degraded physical fitness on both the individual and society are serious and multi-dimensional. It can precipitate many risk factors to health including coronary heart disease, certain forms of cancer, diabetes, hypertension, stroke, gall bladder diseases, osteoarthritis, respiratory problems, gout and its associated increases in all cause mortality *(Cataldo, 1999).*

Further Psychomotor Ability deals with physical and motor development. It is the main goal of physical educators. In the psychomotor domain opportunities are presented to develop balance, eye-hand coordination, agility, flexibility, strength, reaction ability and other components of the domain. Reaction time is the interval between the onset of a signal (stimulus) and the initiation of a movement response *(Magill, 1998).* Development of the psychomotor domain can be important for the individual's health and well-being, as well as for that of the community. Fitness activities in the school setting have important individual, societal, and economic implications.

The reaction times of high performance sprinters have been reported to be shorter than those of low performance sprinters. Reaction time can be improved to a certain extent by warm-up and exercise. Exercise induces arousal that supports alertness to external environmental stimuli in highly trained athletes *(Mouelhi et al, 2006).*

Majority of the Indian population live in rural areas, mainly depending on agriculture for their livelihood, and carry out more physical activities when compared to the urban population who are accustomed to sedentary life style. Healthy body is necessary for increasing the working capacity and maintaining health related physical fitness of an individual to perform his daily tasks vigorously and alertly, with left over energy to enjoy leisure time activities. It also helps to withstand stress and carry on, in circumstances where a physically unfit person could not continue.

In India various tribal communities are in different stages of development, but they are still backward in comparison to those who are so-called civilized people or belong to urban communities. These tribal's are aborigines of our country. They have been studied from a number of angles. The active life with a lot of physical activities to earn their daily bread and butter is contributory to their physical development. The genetical potentiality in performing vigorous physical activities can be useful to excel in certain sports and games.

Therefore it is worthwhile to compare the health related physical fitness variables and psychomotor ability of rural and urban school going children who may be selected at an early age and might be systematically nurtured for full manifestation of sports potentialities through scientific sports training for enhancing performance and upliftment of overall fitness and therefore the present study was undertaken.

Materials and Methods

One thousand students age ranging from 17 to 30 years were selected as subjects for the study of which 500 hundred were Tribal and the remaining five hundred were Non-tribal School going from different schools of North 24 Parganas District, West Bengal. The subjects were tested in their respective school grounds for continuously five days. Health related fitness includes the five major components of fitness directly related to improvement of health.

Test component-1: The sit and reach test was used to measure lower back flexibility and was recorded in nearest centimeters.

Test component-2: Body Fat Monitor, an electronic device manufactured by Omron model no. HBF 306 was used to measure body fat percentage and was recorded in percentage.

Test component - 3: Aerobic /cardiovascular function was used measured by the 1.5 mile run test and was recorded to nearest minutes and seconds.

Test component-4: Abdominal muscular strength and endurance was measured by Partial Curl Ups and was recorded in numbers.

Test component-5: Upper body muscular strength and endurance was measured by Right Angle Push-Ups and was recorded in numbers.

To measure the Psychomotor Ability, reaction ability was considered and was measured by Nelson Hand Reaction Test and was recorded to nearest seconds.

The entire tests were demonstrated and explained to the subject by the researcher himself. After that, subjects were asked to give the test and the data were recorded. In the present study simple random experimental group design was used to compare Health related physical fitness variables and psychomotor ability between rural and urban schoolgoing children.

Statistical procedure

The gathered data were duly analyzed through statistical procedure. For the purpose of comparison of Health related physical fitness variables and psychomotor ability between rural and urban schoolgoing children, student's 't' ratio statistical technique was used (SPSS Version 18). The level of significance was set at $p<0.05$ level.

Results & Discussion

Table 1 enlists the comparison of health related fitness and psychomotor ability measures between rural and urban school going children. Statistically significant differences are revealed in the health related fitness and psychomotor ability measures between rural and urban school going children. Rural schoolgoing children were found to possess greater health related physical fitness and quick reaction ability than their urban school going counterparts.

Table-1: Significance Of Difference Of Mean Of Health Related Physical Fitness Variables And Psychomotor Ability Of School Going Children

Groups	Mean	S.D.	Mean Diff.	S.E. DIFF	't' ratio
One mile race (Rural)	**9.165**	**0.792**	**0.21**	**0.05**	**4.27***
One mile race (Urban)	**9.377**	**0.777**			
Body Fat Percentage (Rural)	**18.961**	**4.811**	**1.64**	**0.30**	**5.43***
Body Fat Percentage (Urban)	**20.601**	**4.744**			
Push Ups (Rural)	**20.396**	**7.442**	**1.40**	**0.41**	**3.41***
Push Ups (Urban)	**18.994**	**5.419**			
Sit Ups (Rural)	**23.730**	**5.397**	**1.51**	**0.31**	**4.82***
Sit Ups (Urban)	**22.218**	**4.484**			
Sit and Reach Test (Rural)	**33.728**	**3.966**	**1.49**	**0.231**	**6.46***
Sit and Reach Test (Urban)	**32.234**	**3.319**			
Reaction Ability (Rural)	**0.235**	**0.031**	**0.014**	**0.002**	**6.61***
Reaction Ability (Urban)	**0.249**	**0.035**			

*** Significant at 0.05 level of significance.**

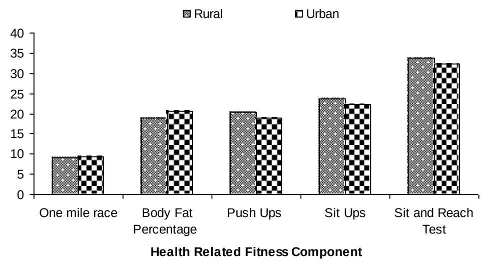

Figure 3: Comparison of Means of Health Related Physical Fitness Variables And Psychomotor Ability Of School Going Children

It is usually noticed that lifestyle of the Rural people is based on hard physical works than that of urban people which makes the tribals more hardy, speedy, agile, flexible and laborious and probably due to such reasons they assumed high functional ability in their daily life activities, which rather assists them to be more fit physically and mentally than that of the non-tribals. Moreover the tribal people mostly live in villages or small towns where because of their lower socio-economic status they usually engage themselves in hard working and laborious type of activities which also assists them to develop their health related physical fitness.

Regular practice of systematized physical activities in childhood and adolescence may strongly favor the development or maintenance of suitable levels of health related physical fitness, decreasing hence the risk of incidence of several chronic-degenerative dysfunctions in early ages. Reflexes are at their best in a person's teens and twenties. Exercise also relates to this, as reflexes can be maintained at older ages through regular exercise and constant alertness. The direct correlation between fine motor skills and reaction time causes reaction time to worsen with age.

Some of the factors which have been found to influence reaction time are the sense organ involved, the intensity of the stimulus, the preparatory set, general muscular tension, motivation, practice, the response required, fatigue and one's general state of health *(Johnson and Nelson, 2007)*. Reaction time and speed have been used in the evaluation of the motor skills of humans for a considerable time. Although reaction time is a measure of performance, researchers generally use it to evaluate motor skills *(Magill, 1998).*

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Cardiovascular Fitness among Sedenatry Students

Sinku, S.
Assistant Professor, Department of Physical Education, Swami Ramanad Teerth Marathwada University, Nanded Maharashtra, India

Abstract

The primary objective of the study is to find out the cardiovascular fitness level between rural and urban collegiate students and to determine the level of fitness level among rural and urban students. Eighty Rural and Eighty Urban collegiate sedentary students from various colleges of Swami Ramanand Teerth Marathwada University Nanded, voluntary to participate in the health related physical fitness programmes. Exclusion criteria were the presence of chronic medical conditions such as asthma, injuries, heart disease or any other condition that would put the subjects at risk when performing the Health tests. The subjects were free of smoking, alcohol and caffeine consumption, antioxidant supplementation and drugs during the programmes. The age, height, weight, and cardiovascular fitness, of all subjects were measured in physical education department laboratory and Field. Cardiovascular fitness was assessed using 12 minute run test. Participants were ruined for 12minutes, and the total distance covered is recorded. Walking was allowed. BMI was calculated by Quetelet equation. The result reveals a statistically significant difference of body mass (t=3.45<, .05) between rural and urban collegiate students. However the result reveals a statistically significant difference of cardiovascular fitness (t=49.61, p<.05) was found between rural and urban collegiate students. The results of present study showed that cardiovascular fitness performance was better in rural students.

Key words: cardiovascular fitness, Urban, Rural, Students

Introduction

Sedentary life style is a seriously growing health problem. Epidemiological study has shown that sedentary life style will contribute to the early onset and progression of life style disease such as cardiovascular disease, hypertension, diabetes and obesity *(Hulens et al, 2002).* Majority of Indian population live in rural areas, mainly depending on agriculture for their livelihood, and carry out more physical activities when compared to urban population who are accustomed to sedentary life style. Healthy body is necessary for increasing the working capacity and maintaining physical fitness of any individual to perform his daily tasks vigorously and alertly, with left over energy to enjoy leisure time activities. It also helps to withstand stress and carry on, in circumstances where a physically unfit person could not continue *(Patil et al, 2012).* The importance of cardiovascular fitness to health for all individuals has been well documented. Physical fitness is a required element for all the activities in our life. Cardiovascular fitness of an individual is mainly dependent on lifestyle related factors such as daily physical activity levels. It was believed that the low cardiovascular fitness level of an individual is associated with higher mortality rate. *(Jourkhesh et al, 2012).* For Cardiovascular fitness, the activity components included are not only for muscular development and endurance training. The lungs, heart, and circulatory system are also the focal points in health and fitness. The reason for this is to improve stamina, immune system, and maintain good body composition. Cardiovascular fitness reduces the risk of cardiovascular diseases and other diseases like hypertension, Diabetes obesity, and may cure respiratory problems like asthma (*Amusa & Goon, 2011)*.

Cardiovascular fitness of our citizens is a vital prerequisite to a country's realization of its full potentials a nation *(Lamb et al, 1988).* Cardiovascular fitness recognized as an important component of health and it may be important for the performance of functional activities and quality of life *(Maria et al, 2003)*. Low cardiovascular fitness may result in high physical strain during the study period (*Pongprapai et al, 1994)*. The primary objective of the study is to find out the cardiovascular fitness level between rural and urban collegiate students and to determine the level of fitness level among rural and urban students.

Material and Methods

Target Population and Study Area:

Eighty Rural and Eighty Urban collegiate sedentary students from various colleges of Swami Ramanand Teerth Marathwada University Nanded, voluntary to participate in the health related physical fitness programmes. Exclusion criteria were the presence of chronic medical conditions such as asthma, injuries, heart disease or any other condition that would put the subjects at risk when performing the Health tests. The subjects were free of smoking, alcohol and caffeine consumption, antioxidant supplementation and drugs during the programmes. The age, height, weight, and cardiovascular fitness, of all subjects were measured in physical education department laboratory and Field.

Assessment of Cardiovascular Fitness Tests

12 minute Run

Cardiovascular fitness was assessed using 12 minute run test. Place markers at set intervals around the track to aid in measuring the completed distance. Participants were ruined for 12minutes, and the total distance covered is recorded. Walking was allowed. BMI was calculated by Quetelet equation

Statistical analysis

The Statistical Package for the Social Sciences (SPSS; version 18.0) was used for the data analysis. Independent t tests were used to assess overall differences between Rural and Urban students.The level of significant set up at 0.01 level of confidence.

Results

Comprised and indentified of cardiovascular fitness between rural and urban sedentary students. The data have been systematically analyzed in the form of Mean Scores, Standard Deviations and t-ratios. The results of the study comprised of cardiovascular fitness between rural and urban sedentary students are shown in tables are as given below

Table 1 Morphological Characteristic of Rural and Urban Students

S.No.	Parameters	Rural		Urban	
1	Age	22.34	4.98	21.87	3.54
2	Height	170	24.78	169.05	22.52
3	Weight	65.44	11.21	69.80	13.87

Table 1 illustrates the age, height and weight of rural and urban sedentary collegiate students.

Table -2: Statistical Comparison of Body Mass Index among rural and urban collegiate students

Variable	Test	Number	Mean	S.D.	T-ratio
Body Mass Index	Rural	80	20.12	5.32	3.45*
	Urban	80	23.78	7.88	

**** Significant at 0.01 level***

Table-2 compares the mean scores, standard deviation and t-ratio of body mass index between rural and urban sedentary collegiate students. With regards to body mass index in rural and urban collegiate students they have obtained mean value were 20.12 and 23.78 respectively, the result reveals a statistically significant difference of body mass index (t=3.45, 0<.05) was found between rural and urban collegiate students; Urban collegiate students was found to got more obese as compare than rural collegiate students.

Table- 3: Statistical Evaluation of Cardiovascular Fitness through 12 meter run & walk test among rural and urban collegiate students

Variable	Test	Number	Mean (Mts.)	S.D.	T-ratio
12 Meter Run	**Rural**	**80**	**1945.65**	**27.72**	**49.61***
	Urban	**80**	**1740.25**	**24.60**	

Table -3 illustrates that mean scores, standard deviation and t-ratio of 12minutes run and walk between rural and urban sedentary collegiate students. With regards to 12 minutes run and walk in rural and urban collegiate students they have obtained mean value were 1357.5 and 13.40 respectively, the result reveals a statistically significant difference of cardiovascular fitness (t=49.61, p<.05) was found between rural and urban collegiate students.

Discussion of findings

The results of present study showed that cardiovascular fitness performance was better in rural students, This may be due to mechanization, automation and computerization have minimised the opportunities for vigorous physical activities to cause physical exertion in urban population. The relatively grater right cardiovascular fitness of rural students were Probably due to rural students engaged in vigour physical activity like agriculture and Animal husbandry. The results of this study suggest that urban students have lower levels of cardiovascular fitness as compared with rural students. Our findings are in agreement with other study that has examined cardiovascular fitness levels in African-American adults. According to observations of the Amsterdam Growth and Heath Longitudinal Study, physical activity levels affect cardiovascular capacity during puberty and later in life. Thus, we assumed that physical activity levels of our study participants were similar as earlier in their life and consequently their Cardiovascular capacity resulted from long term engagement in a given physical activity pattern. In addition, future research examining cardiovascular fitness levels should assess what percentage of rural and urban students played university sports and whether participation in such activities influenced their cardiovascular fitness levels. The research has provided early information to help the students understand their physical fitness. It will motivate them to be involved in sports. The information can be applied as criteria in selecting or choosing athletes. It is also a source to assist physical education teachers, sports directors, physical educationist and sports trainer to be proactive and change their perspective in order to improve the cardiovascular fitness. According to the results of this study, it is suggested that the Physical education must be a compulsory subject for college students of Maharashtra therefore student is needed to at least take up a course on physical education for each year so that their cardiovascular fitness is maintained.

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Prevalence of Obesity and Hypertension in Newly Diagnosed Type 2 Diabetes Mellitus (T2dm) Patients Of Amritsar

Kaur[1], N. and Sidhu[2], S.
[1]Dept. of human Genetics, Guru Nanak Dev University, Amritsar, Punjab.
email:hazranirmaljitkaur4u@gmail.com
[2]Profeessor, Dept. of Human Genetics, Guru Nanak Dev University, Amritsar, Punjab.
email- shardasidhu@hotmail.com

Abstract

The present study was conducted to observe the prevalence of obesity and hypertension in newly diagnosed diabetic patients of Amritsar (Punjab), attending diabetic clinics. A total sample of 300 newly diagnosed diabetic patients including 162 males and 138 females were studied to acess the prevalence of obesity and hypertension. The prevalence of obesity in diabetic males and females was 58.02% and 73.91% according to BMI, 88.27% and 91.3% according to WC, while 98.14% and 96.3% according to WHR and 85.18% and 90.59% according to WSR, respectively. The prevalence of hypertension was 88.2 % and 84.7% in diabetic males and females, respectively. From the result, it was observed that the percentage prevalence of obesity and hypertension was quite high in diabetic patients of Amritsar. The prevalence of abdominal obesity was higher than general obesity. The percentage prevalence of obesity in diabetic females was higher than diabetic males while the diabetic males were more hypertensive than diabetic females. To manage the profile of the diabetic patients, proper awareness and prevention and management of obesity and hypertension is essential.

Keywords: **Obesity, Diabetes, Hypertension, Amritsar, T2DM patients.**

Introduction

Diabetes is a chronic non-communicable disease having serious health, economic and social consequences. The World Health Organisation has recently acknowledged that India is the diabetic capital of the world. According to *Patel et al (2011)*, the overall number of people with diabetes in India (based on *the ICMR – INDIAB* study) is estimated to be 62.4 million and this was also confirmed by the 5th edition of the Diabetes Atlas, which gave a figure of 61.3 million people with diabetes in India in the age group of 20 – 79 years. In India the prevalence of diabetes is growing rapidly in both urban and rural areas *(Pradeepa et al, 2012).* The increasing prevalence of diabetes is associated with increased rate of overweight and obesity. It has been found by *Sharma and Jain (2009)*, that prevalence of diabetes increases by a factor of 2-3 folds in obese individuals, 5-fold in moderately obese and 10-fold in severe obese persons. It has been estimated by *Hossain et al (2007)* that 90% of type 2 diabetes mellitus (T2DM) patients are attributable to excess body weight. *Arner et al (2010)* reported that newly diagnosed T2DM patients are more overweight than non-diabetic patients and they further reported that obesity plays an important role in pathogenesis of T2DM. *Klein et al (1996)* reported that 50% of the subjects with T2DM have hypertension can be directly attributed to obesity. Obesity is considered a major risk factor for T2DM and hypertension by *Mugharbel et al (2003) and Waghmare et al (2012)*. Obesity has reached epidemic propotions globally with more than 1 billion adults overweight – atleast 300 million of them clinically obese *(Al-Johari, 2011)*. Clinical evidence suggests that association of diabetes with central obesity is stronger than the general obesity. Waist circumference (WC) and Waist-Hip-Ratio (WHR) has been used for measures of central obesity and BMI as a measure of general obesity. Studies by *Mukherjee et al (2008)* and *Daousi et al (2006)* indicate that central obesity is shown to be a strong risk factor for T2DM. With rapidly increasing prevalence of diabetes in India, it is of paramount importance to determine the prevalence of obesity and hypertension in these patients and treat it at the earliest by implementing suitable lifestyle measures. Thus, it becomes imperative to examine the prevalence of obesity and hypertension in patients with T2DM attending diabetes clinics.

Material and methods:

The present hospital-based study was done in Amritsar on the newly diagnosed T2DM patients (diagnosed within the last 6 months). The patients were recruited from two hospitals (Dr. A.S. Multani clinic and Guru Nanak Dev Hospital) of Amritsar. The study was done on a total of 300 newly confirmed diabetic patients including 162 males and 138 females. Diagnosis of T2DM was based on reports of doctors on the criteria established by WHO (1999) i.e. fasting blood glucose ≥110 mg/dl. The present study was approved by ethical committee of Guru Nanak Dev University, Amritsar. An informed consent was obtained from all the subjects after explaining the objectives of the study. During the data collection, personal interview was held with each subject using pretested questionnaire. For determining obesity four anthropometric measurements (Body weight, Body height, Waist circumference, and Hip circumference) were taken on each subject using standard methodology given by *Weiner and Lourie (1981)*. From weight and height measurements BMI was calculated and general obesity was assessed by using following BMI criteria of WHO (2000):

BMI	CATEGORY
<18.5 kg/m2	Underweight
18.5-22.9 kg/m2	Normal
23-24.9 kg/m2	Overweight
≥25 kg/m2	Obese

The prevalence of abdominal obesity was assessed with the help of WC, WHR, WSR using following criteria:

Category	Normal		Obese	
	Male	Female	Male	Female
WC, cm *Snehalatha et al, (2003)*	<90	<80	≥90	≥80
WHR cm *Snehalatha et al, (2003)*	<0.88	<0.81	≥0.88	≥0.81
WSR, cm *Hsieh and Muto (2004)*	<0.5	<0.5	≥0.5	≥0.5

Blood pressure of each subject was recorded in a sitting position by ascultatory method on the right arm using a mercury sphygmomanometer (Diamond Deluxe Blood Pressure apparatus, Pune, India). Before taking the measurement, the subject was seated at rest at least 10 minutes prior to measurements. Three blood pressure readings were recorded at more than one weak intervals and average of three readings taken into account for determination of blood pressure reading. Hypertension was assessed using following "JNC VII" (2003) criteria:

	SBP (mm/Hg)	DBP (mm/Hg)
Normal	<120	<80
Pre-hypertensive	120-139	80-89
Hypertensive	≥140	≥90

The whole data was entered into computer using MS-Excel program. The data was analyzed using Statistical Software for Social Sciences for Windows version 16.0 (SPSS Inc., Chicago, IL). The students 't'- test and 'chi' square tests were used to find out the statistical significance of the results.

Results & Discussion

Table 1: Anthropometric and Physiological variables of newly diagnosed diabetic patients.

Variables	Males		Females		't' values
	Mean	SD	Mean	SD	
Age(yrs.)	52.06	16.63	54.04	15.77	1.050
Weight (kg)	79.54	10.54	72.35	12.41	5.359**
Height(cm)	175.0	6.141	160.0	6.462	20.254**
WC (cm)	93.60	7.917	93.30	11.20	0.266
HC (cm)	99.63	8.02	100.0	11.57	0.496
BMI (kg/m2)	25.81	3.04	28.0	4.4	5.038**
WHR	0.94	0.05	0.92	0.06	1.866
WSR	0.53	0.04	0.57	0.07	6.086**
SBP (mm/Hg)	139.0	9.85	138.0	12.25	0.877
DBP (mm/Hg)	96.23	9.87	94.85	10.49	1.166
PP (mm/Hg)	43.67	7.24	43.98	8.98	0.328
MAP(mm/Hg)	125.0	9.24	109.0	10.43	13.77**

** Significant at p<0.05, ** Significant at p<0.01*

Table 1 depicts the characteristics of the studied newly diagnosed T2DM subjects. Diabetic females were slightly older than males. Males had significantly higher weight and height values as compared to that of females while females had slightly higher values of BMI and WSR as compared to males.

Table 2: Percentage prevalence of obesity in newly diagnosed diabetic males.

	Variables	Under weight	Normal	Over weight	Obese %
Males					
Generalised obesity	BMI (kg/m^2)	0.61% (1)	14.81% (24)	26.54% (43)	58.02% (94)
	WC(cm)	-	11.72% (19)	-	88.27% (143)
Abdominal obesity	WHR	-	1.85% (3)	-	98.14% (159)
	WSR	-	14.82% (24)	-	85.18% (138)
Females					
Generalised obesity	BMI (kg/m^2)	0 (0)	11.59% (16)	14.49% (20)	73.91% (102)
	WC(cm)	-	8.69% (12)	-	91.3% (126)
Abdominal obesity	WHR	-	3.62% (5)	-	96.3% (133)
	WSR	-	9.42% (13)	-	90.59% (125)

According to *WHO (2000)*, criteria of BMI it was apparent from the Table 2 that the prevalence of obesity among newly diagnosed diabetic males and females was 58.02% and 73.91%, respectively. The prevalence of abdominal obesity according to WC in newly diagnosed diabetic males and females was 88.27% and 91.3%, while according to WHR was 98.14% and 96.3% and according to WSR was 85.18% and 90.5%, respectively. In case of males, only 11.27%, 14.82% and 14.81% subjects were normal according to WC, WSR and BMI, respectively, while in case of females, 8.69%, 9.42% and 11.59% were normal according to WC, WSR and BMI, respectively. It was quite interesting to note that only 1.85% diabetic males and 3.62% diabetic females were normal according to WHR.

Table 3: Percentage prevalence of hypertension in newly diagnosed diabetic patients.

Category	Normotensive	Pre-hypertensive	Hypertensive
Males (n=162)	0 (0)	11.7% (19)	88.2% (143)
Females (n=138)	1.4% (2)	13.76% (19)	84.7% (117)
Total (n=300)	0.66% (2)	9.66% (38)	86.6% (260)

Figures in parenthesis indicates number of subject

Table 3 shows the prevalence of hypertension in diabetic patients. In the present study 86.6% of the diabetic patients were hypertensive according to "JNC VII" criteria (males: 88.2%, females: 84.7%). While 9.66% were in pre-hypertensive (males: 11.7%, females: 13.76%) category and only 0.66% were normotensive. The difference between the percentage prevalence of hypertension in diabetic males and females was statistically non-significant.

Discussion

Diabetes Mellitus is a major public health problem which has become the leading cause of mortality and morbidity worldwide. Its prevalence is rising in the developing countries especially in India, in response to increasing prosperity and sedentary lifestyles. To the best of our knowledge, no similar study on prevalence of obesity and hypertension in newly diagnosed T2DM patients attending diabetic clinics was conducted in Amritsar (Punjab). BMI is the most widely used diagnostic tool to identify prevalence of obesity in epidemiological studies. The mean value of BMI of the diabetic females among the newly diagnosed diabetic patients was significantly higher than diabetic males (Table 1). In the present study, the prevalence of obesity (BMI ≥25) was 65.33% and the prevalence of obesity (according to BMI) was more in females than in males. On the other hand, the abdominal obesity according to WC, WHR and WSR was present in 89.66%, 97.33% and 87.66% (Table 2). Results of the present study clearly depicted that majority of the diabetic patients were abdominally obese. Table 4 shows the comparative prevalence of obesity (according to BMI) in diabetic patients of various parts of India. This table shows that the prevalence of obesity was slightly higher in T2DM patients of Amritsar was slightly higher than the other parts of India. However, the prevalence of obesity reported in these studies was not strictly comparable because of the variation in criteria used, variation in age and socioeconomic status of the subjects.

Table 4: Percentage prevalence of overweight and obesity in diabetic Indian patients.

Place and Area	Obesity criteria (BMI) kg/m2	(n)	% Prevalence Men	Women	Total
Andhra Pradesh Dudekhula et al. (2012)	≥ 25	140	50	47.5	-
Ahmedabad Patel et al (2011a)	≥ 25	709	-	-	62
Manipal Kamath et al. (2011)	≥ 25	446	40.9	58.8	48.4
Gujarat Patel et al (2011b)	≥ 25	622	-	-	68
Bikaner Sankhla et al (2011)	≥ 25	171	-	-	56.72
South Asia Pandya et al (2011)	>25 Modified ATP III And NCEP	350	Urban-71 Rural -49	Urban-88 Rural-80	70
Udaipur Sharma and Jain(2009	≥ 25	60	-	-	46.66
North india	>25	241	-	-	45.22
Chennai					
Kanchipuram	≥ 25	124	-	-	54.3
Panruti		95	-	-	48.5
South India		33	-	-	33.0
Ramachandran et al (2008)		252	-	-	48.1

86.6% of newly diagnosed T2DM patients were hypertensive while 9.66% were pre-hypertensive and only 0.66%

were normotensive (Table 3). This is apparent from present results that majority of T2DM patients were hypertensive. Table 5, depicts the comparative prevalence of hypertension in some diabetic patients of India. It is evident from this table that the prevalence of hypertension among diabetic patients varies from 33% to 70%. This proves that, the prevalence of hypertension was quite higher among diabetic patients of Amritsar than other studies conducted in India which may be due to the difference in the dietary habits and lifestyle changes. This proves that prevalence of figures of obesity and hypertension among newly diagnosed T2DM are alarming so, these patients need counseling for lifestyle modification, which mainly include physical activity and nutrition education.

Table 5: Percentage prevalence of hypertension in some Indian diabetic patients

Place and Area	n	Criteria	% Prevalence		
Jodhpur *Purvi Purohit, (2012)*	180	≥130/80	40.2	39.8	-
Andhra Pradesh *Dudekula et al (2012)*	140	≥140/80	-	-	61
Ahmedabad *Patel et al (2011a)*	709	>130/80	-	-	45.1
Gujarat *Patel et al (2011b)*	622	>130/80	-	-	47
Chennai *Ramachandran et al (2008)*	141				61.8
Kanchipuram	104				53.1
Panruti	56	≥130/85			56.0
South India	301				57.4

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Functional Disability & Grip Strength of Cervical Radiculopathy Patients before & after Cervical Collar Use & Traditional Physiotherapy Treatment

Goyal[1], M., Kumar[2], Ashok & Sethi[3], R.
[1]Asst. Professor & Head, MM Institute of Physiotherapy & Rehabilitation, MM University, Mullana, Haryana, India. E-mail: manu_goyal1902@yahoo.co.in
[2]Asst. Professor, Department of Sports Science, Punjabi University Patiala, Punjab, India
[3]MPT Student, MM Institute of Physiotherapy & Rehabilitation, MM University, Mullana, Haryana, India

Abstract

The purpose of the study was to observe the effect of a cervical collar use and traditional physiotherapy treatments on functional disability and grip strength in cervical radiculopathy patients. A total of 30 patients (male =16; female=14) were selected as subjects and they were further divided into 2 groups. Each group comprising of 15 subjects (male=8; female=7).The results of the present study suggest that there was an improvement in the mean values of Numeric Pain Rating Scale, Grip Strength and Neck Disability Index scores after treatment in both groups. But it was found that an improvement was statistical significant more in an experimental group than non-experimental group. It was concluded that if the patients of cervical radiculopathy used cervical collar alongwith traditional physiotherapy treatment then there was early recovery from pain, grip strength, disability index in them.

Keywords: Cervical radiculopathy, Functional disability, Grip strength, Pain

Introduction

Dillin et al, (1986) described cervical radiculopathy as a common disorder characterized by neck pain radiating to the arm and fingers corresponding to the dermatome involved. The condition may result in neck pain however the primary symptoms reported in this population are often upper-extremity pain, numbness, and weakness, which often result in significant functional limitations and disability *(Benini, 1987).* Cervical radiculopathy typically manifests as pain radiating from the neck into the distribution of the affected root. The exact location and pattern of pain may vary widely and a classic dermatomal distribution of pain is not always present. Associated sensory, motor, and reflex disturbances may or may not be present. Because acute cervical radiculopathy generally has a self-limited clinical course, non surgical treatment is the appropriate initial approach for most patients. Surgical treatment may be considered when nonsurgical treatment fails and in the patient with a significant neurologic deficit *(Bush et al, 1997). Heckmann et al, (1999)* reported that an annual incidence of cervical radiculopathy was approximately 83 per 100,000 and there was an increased prevalence of in the fifth decade of life (203 per 100,000). Treatment strategies for patients with cervical radiculopathy range from conservative management to surgery *(Sampath et al, 1999).* More than 50% of patients with neck pain are referred to physical therapists and this population comprises approximately 25% of all patients seeking outpatient physical therapy for musculoskeletal conditions *(Borghouts et al, 1999).*

Generally orthopaedicians prescribe cervical collar for treatment of cervical radiculopathy. In the present study, the effect of cervical collar use and traditional physiotherapy treatments as cervical traction and exercises. Soft collar are the least restrictive, allowing the closest to normal range of motion. As many as 76% of the patients report reduced pain with their use *(Naylor & Mulley, 1991).* Although the collar may be of symptomatic benefit, there is no evidence on long term outcome *(Spitzer & SkOvron, 1995).* Many physicians cite anecdotal evidence of their clinical utility and soft collars are often prescribed by convention for patients complaining of pain.

Materials & Method

The 30 patients of cervical radiculopathy both male and female in the age range of 30 to 35 years were selected as subjects after obtaining their consent based on inclusion and exclusion criteria of the study. The subjects were further divided into two groups: Group-A (n=15) and Group-B (n =15). Each group was further comprising of eight male and seven female subjects.

Treatment Protocol: The subjects of *Group-A* underwent a use of cervical collar plus traditional physiotherapy treatment comprising of MHP, stretching exercise, manual traction and isometric exercise. The subjects of Group-A used the cervical collar in day time for 4-weeks. On the other hand, the subjects of Group-B underwent only traditional physiotherapy treatment comprising of MHP, stretching exercise, manual traction and isometric exercises only. The training frequency of MHP, stretching exercise, manual traction and isometric exercise for both groups was 3 times per week, training volume per session was 3 sets of 10 repetitions for 4 weeks. The rest between repetition and sets was 30 seconds and 60 seconds respectively. The subjects were seated by facing the therapist and treatment began with moist heat pack in supine position for 15 minutes and exercise was followed. The stretching exercises comprising of neck flexion. The isometric exercises comprising of forward, backward and side-to-side pressures exerted against the hands of the subject. The manual traction was given to the subjects in a supine position by placing right hand on the chin of the subject and left hand on the occipital then the distraction force was applied for 15 seconds. The scores of NPRS (Numeric Pain Rating Scale), NDI (Neck Disability Index) and Grip strength of each subject of Group-A and Group-B were recorded before and after 4-weeks.

Statistics

The data was analyzed using statistical computer software 'SPSS10 free trial version'. The mean, standard deviation and t-test was used. The level of significance was $p<0.05$.

Results & Discussion

The mean age and BMI of the subjects of Group -A and Group-B was 31.93±5.17 years, 32.53±4.17 years, 23.74±2.43 Kg/m^2 and 23.76±3.43 Kg/m^2 respectively. It was found that the difference in the mean values of age and BMI between Group -A and Group-B was not statistical significant (Table 1).

Table 1.Comparison of Age & BMI

	Group A	Group B	t-value
Age(years)	31.93±5.17	32.53±4.17	0.35
BMI(Kg/m^2)	23.74±2.43	23.76±3.43	0.01

*significant $p<0.05$

Table 2 shows the comparison of scores of Numeric Pain Rating Scale (NPRS), Grip strength and Neck Disability Index (NDI) among Group-A and Group-B before and after four weeks.

It was found that before the start of four week treatment programme to the subjects of Group-A and Group-B there was no statistical difference in the scores of NPRS, Grip Strength and NDI.

After four week there was statistical significant difference in the scores of NPRS, Grip Strength and NDI in both the groups but a greater improvement was observed in Group-A as compared to Group-B (Table 2).

Table 2: Comparison of Scores of NPRS, Grip Strength & NDI among different groups

		Group A	Group B	t-value
NPRS	before	6.80±0.77	6.73±0.70	0.24
	After 4 week	4.00±1.69	5.33±0.81	2.75*
Grip strength	before	10.60±2.24	11.07±2.96	0.48
	after 4 week	29.80±6.66	13.07±3.19	8.75*
NDI	before	22.07±4.23	23.53±3.60	1.02
	after 4 week	5.07±2.21	21.47±4.30	13.10*

*significant $p<0.05$; NDI- Neck Disability Index; NPRS- Numeric Pain Rating Scale

Further, it was found that in Group-A there was a statistically significant improvement in the scores of NPRS, Grip Strength & NDI after four weeks (Table 3).

Table 3. Paired t-test of NPRS, Grip Strength & NDI of Group A

	before	after 4th week	t-value
NPRS	6.80±0.77	4.00±1.69	8.57*
Grip strength	10.60±2.23	29.80±6.66	13.19*
NDI	22.07±13.13	5.07±2.21	13.13*

*significant $p<0.05$; NDI- Neck Disability Index; NPRS- Numeric Pain Rating Scale

Similarly, in Group-B there was a statistical significant improvement in the scores of NPRS, Grip Strength & NDI after four weeks (Table 4).

Table 4: Paired t-test of NPRS, Grip Strength &NDI of Group B

	before	after 4th week	t-value
NPRS	6.73±0.70	5.33±0.81	4.83*
Grip strength	11.07±6.66	13.07±3.19	3.74*
NDI	23.53±3.60	21.47±4.30	4.37*

*significant $p<0.05$; NDI- Neck Disability Index; NPRS- Numeric Pain Rating Scale

Discussion

The results of the present study shows that subjects in both the groups had significant decrease in pain, increase in grip strength and improvement in neck disability index. However, out of the two groups, the Group-A receiving cervical collar as a supplement to traditional physiotherapy treatment had a higher percentage of change in pain intensity, grip strength and neck disability index as compared to Group-B using traditional physiotherapy treatment alone (i.e. manual traction, eccentric strengthening, stretching exercises). Therefore the null hypothesis is rejected. There are many studies *(Persson et al, 1997; Garvey & Eismont, 1991)* done on cervical collar with conventional physiotherapy in isolation, which shows their effectiveness but the results obtained from this study are novel that proves the combined effect of cervical collar and conventional treatment in cervical radiculopathy patients. Both the groups in present study had equal number of subjects and there was no significant difference found with respect to their gender distribution, age and body mass index. A number of studies has examined the effects of cervical collar for cervical radiculopathy, *Dillin et al, (1986)* reported that the patient of cervical radiculopathy who used cervical collar had reduced arm and neck pain within three weeks as compared to traditional physiotherapy treatment which had taken six weeks to reduce arm and neck pain, further interventions after this period was not likely to be of benefit in most patients. *Carlsson & Carlsson (1997)* also reported that in that treatment of patient with long lasting cervical radicular pain, cervical collar was effective in long term. *Naylor & Mulley (1991)* reported that patients of cervical radiculopathy who had taken standardized physiotherapy with semi hard collar use and doing home exercise for six weeks resulted in a significant reduction in arm and neck pain compared with the patients who had a wait and see policy. Thus, the results of the studies reported in literature support the result of the present study that is by the use of cervical collar alongwith traditional physiotherapy treatment reduced the time period of treatment that is there was early recovery from pain, grip strength, disability index in the management of cervical radiculopathy patients. But little evidence exists in the literature on the mechanisms of cervical collar use and physiotherapy in giving pain relief to the patients. The collar may reduces forminal compression and associated root inflammation by immobilizing the neck which might explain the larger reduction of arm pain compared with neck pain and neck disability as found in the present study.

Conclusion

It was concluded that if the patients of cervical radiculopathy use the cervical collar alongwith traditional physiotherapy treatment can reduce the time period of their treatment that is there was early recovery from pain, grip strength, disability index in them.

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VO_2max & Haemodynamic Profile of Woman Boxers

Kumar[1], Ashok, Manisha[2] & Kumar[3], Rajesh.

[1]Asst. Prof., Dept. of Sports Science, Punjabi University Patiala (Punjab) India, Email: akashokin@gmail.com
[2]M.Sc. Sports Science Student, Department of Sports Science, Punjabi University Patiala (Punjab) India
[3]Associate Professor, Department of Physical Education, Osmania University, Hyderabad (Andhra Pradesh) India

Abstract

Woman boxers of national and interuniversity level participation of Punjabi University Patiala volunteered to participate in this study and their age ranged 18 to 23 years. The standard procedure was used to observe VO_2max and haemodynamic variables. The mean age, height, weight and BMI of woman boxers were 20.18±1.66 years, 162.04±5.45 cms. 60.18±10.21 Kg and 23.25±3.31 respectively. The resting VO_2 max, Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Pulse Pressure, Mean Arterial Pressure, Rate Pressure Product, Stroke Volume and Cardiac Output was 44.45±3.26 $ml.kg^{-1}.min^{-1}$, 67.00±5.15 beats/minute, 114.91±5.24 mmHg, 77.27±5.53 mmHg, 37.64±1.96 mmHg, 89.55±5.39 mmHg, 76.85±9.15 $beats.min^{-1}.mmHg$, 54.93±4.34 ml/beat and 3.60±0.23 L/minute respectively. It was concluded from the results that women boxers of this study have less mean value of VO_2max (aerobic fitness) and haemodynamic variables than reported of elite national and international boxers.

Key words: PP, MAP, RPP, SV, CO

Introduction

In the field of combat sports several works on taekwondo, karate kumite, nunchaku exercise, and judo have been reported *(Beneke et al, 2004; Toskovic et al, 2002).* Boxing is an intermittent sport characterized by short duration, high intensity bursts of activity. It requires significant anaerobic fitness, and operates within a well-developed aerobic system. Boxing is estimated to be 70-80% anaerobic and 20-30% aerobic *(Ghosh et al, 1995).* The study of VO_2max and haemodynamic variables can be informative in regard to the physiological status of the athletes and can also help in preparing a well defined training schedule on a physiological basis. Despite the sport's popularity, little is known about the VO_2max and haemodynamic variables like heart rate, blood pressure, pulse pressure, mean arterial pressure, rate product pressure, cardiac output, stroke volume, and maximal oxygen consumption. Moreover, very few studies were conducted on VO_2max and haemodynamic profile of Punjabi woman boxers in India *(Chatterjee et al, 2005).* Hence, the present study was undertaken with the aim of studying the VO_2max and haemodynamic profiles of Punjabi women boxers.

Materials & Methods

Eleven woman boxers of national and interuniversity level participation of Punjabi University Patiala volunteered to participate in this study and their age ranged 18 to 23 years. The VO_2max (aerobic fitness) of each subject was estimated by taking subject's resting heart rate for 20 seconds and enter the number of beats that counted, along with subject's age, into the equation $VO_2max = 15.3 \times (MHR/RHR)$; where, MHR = Maximum heart rate (beats/minute) = 208 - (0.7 x Age); RHR = Resting heart rate (beats/minute) = 20 second heart rate x 3 (Uth et al., 2004). Blood pressure was recorded using a standardized protocol, according to the World Health Organization recommendations, pulse pressure- difference between the Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP), Mean arterial pressure = Diastolic pressure + 1/3 (Systolic - Diastolic pressure) (Andy et al.,1985),Rate-Pressure Product ($beats.min^{-1}.mmHg$) = HR x SBP /100 (Nagpal et al., 2007), Stroke Volume (ml/beat) = 91.0 + 0.54 PP - 0.57 DP - 0.61 age (Starr et al.,1954) and Cardiac Output (ml/min) = Heart Rate (beats/min) X Stroke Volume (ml/beat) (Jackson et al., 1995).

Statistical Analysis

Statistical analysis was performed with SPSS version 16.0 (free trial, SPSS Inc, Chicago). Results were expressed as Mean ± Standard Deviation. The level of significance for the data analysis was $p < 0.05$.

Results & Discussion

The mean age, height, weight and BMI of woman boxers were 20.18±1.66 years, 162.04±5.45 cms., 60.18±10.21 Kg and 23.25±3.31 respectively. The mean VO_2 max, Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Pulse Pressure, Mean Arterial Pressure, Rate Pressure Product, Stroke Volume and Cardiac Output of women boxers at resting was 44.45±3.26 $ml.kg^{-1}.min^{-1}$, 67.00±5.15 beats/minute, 114.91±5.24 mmHg, 77.27±5.53 mmHg, 37.64±1.96 mmHg, 89.55±5.39 mmHg, 76.85±9.15 $beats.min^{-1}.mmHg$, 54.93±4.34 ml/beat and 3.60±0.23 L/minute respectively (Table 1).

Table 1: Mean ±SD of VO_2max & Haemodynamic Variables of Woman Boxers

Variables	Resting
Age (years)	20.18±1.66
Height (cms)	162.04±5.45
Weight (Kg)	60.18±10.21
BMI	23.25±3.31
VO_2 max ($ml.kg^{-1}.min^{-1}$)	44.45±3.26
Heart Rate (beats/minute)	67.00±5.15
Systolic Blood Pressure (mmHg)	114.91±5.24
Diastolic Blood Pressure (mmHg)	77.27±5.53
Pulse Pressure (mmHg)	37.64±1.96
Mean Arterial Pressure (mmHg)	89.55±5.39
Rate Pressure Product ($beats.min^{-1}.mmHg$)	76.85±9.15
Stroke Volume (ml/beat)	54.93±4.34
Cardiac Output (L/minute)	3.60±0.23

Discussion

One of the challenges confronting coaches and combat fighters is to understand the physiological factors contributing to the success or failure of an athlete. Testing of these aerobic fitness components can provide an insight to the combat fighter's current physical capability. Also, assessment of the combat fighter's current level of aerobic fitness reveals strengths and relative weaknesses that can become the basis for the development of an optimal training program *(Mirzaei et al, 2009).* The results of the measurements in this study were relatively similar to the values reported in the literature for other combative sports. It is important to note that the results of aerobic fitness components will differ depending upon the relationship of the athletes training schedule and competitive schedule *(Roemmich et al, 1997).* Maximum oxygen uptake is considered to be a valid indicator of the function of respiratory, cardiovascular and muscular systems working together *(Impellizzeri &*

Marcora, 2007). Aerobic capacity is necessary to prevent fatigue during training/or competition in martial arts *(Imamuraet al, 1998).* There are no VO_2max *measurements* found for university level women boxers. Studies performed on untrained subjects have shown that a good VO_2max is above 40 ml/kg/min; a measure reported above 50 ml/kg/min is considered excellent *(Impellizzeri & Marcora, 2007).* In relationship to sport, endurance specific athletes such as cyclists have been shown to have a VO_2max values on the order of 75 ml/kg/min *(Saltin & Astrand, 1967).* Martial art athletes generally exhibit greater cardiorespiratory endurance than untrained individuals, but not as great as athletes who focus on cardiorespiratory endurance as their primary fitness component for success in their sport, such as cyclists. In regard to martial art disciplines, a study of highly trained competitive black belt karate practitioners were found to have a VO_2max of 57.5 ml/kg/min while the lesser skilled competitive white belt karate practitioners were found to have a VO_2max of 57.2 ml/kg/min *(Imamura et al, 1998).* By contrast, VO_2max values of 63.8 ml/kg/min were found in 60 England International boxers *(Smith, 2006). Crisafulli et al (2009)* reported that maximum oxygen uptake for martial art athletes may be as low as 48.5 ml/kg/min and as high as 63.2 ml/kg/min depending upon the specific type of training discipline. *Adams et al (1997)* reported that average VO2max of boxers was 57.6 ml/kg/min for running on treadmill and 54.9 ml/kg/min for pedaling on cycle ergometer and 49 ml/kg/min on step test method. These results correspond to a 4.7% difference, which is practically equivalent to the 5-15% previously mentioned *(Hermansen & Saltin, 1969; Chase et al, 1966; Astrand & Saltin, 1961).* Indian women boxers have an average VO_2max of 48.6 ml/kg/min as obtained in the pre-test. VO_2max (ml/kg/min) of international elite athletes of a few sports reported in the literature *(Astrand & Rodhal, 1986)* are as follows - in boxing male 65 ml/kg/min, fencing male and female 59 ml/kg/min and 43 ml/kg/min , wrestling male 57 ml/kg/min. In a recent study, VO_2max of elite Italian male boxers was 57.5 ± 4.7 ml/kg/min *(Guidetti et al, 2002).* Indian male boxers of the pooled weight category showed a VO_2max value of 58.32 ml/kg/min *(Majumdar, 1989)* which was 16.6% higher than the Indian female boxers. It can be said that the obtained value of relative resting VO_2max (44.45±3.26 $ml.kg^{-1}.min^{-1}$**)** in our study is highly comparable with that of the male boxers.It should be noted here that, in a recent study *(Guidetti et al, 2002)* high positive correlation was found between VO_2max and boxing performance ranking. Resting heart rate averages 60 to 80 beats/min in healthy adults *(Wilmore & Costill, 2005).* In the present study the mean resting heart rate was 67.00±5.15 beats/minute**.** Thus, the resting heart rate of woman boxers of this study was in the normal range. Earlier reports support the reduction in resting heart rate as aerobic training brings about both functional and dimensional changes in the cardio-vascular system *(Fox et al., 1973).* In untrained individuals stroke volume at rest stroke volume averages 50-70ml/beat. In elite athletes resting stroke volume averages 90-110ml/beat increasing *(Wilmore & Costill, 2005).* Thus, the resting stroke volume of woman boxers of this study was in the normal range. At rest the cardiac output is about 5L/min *(McArdle et al, 2000)* but in this study resting cardiac output was 3.60±0.23 L/min which is not in the normal range. At rest, a typical systolic blood pressure in a healthy individual ranges from 110-140mmHg and 60-90mmHg for diastolic blood pressure *(Wilmore & Costill, 2005)* and the mean systolic and diastolic blood pressure of the woman wrestlers of this study also falls in the normal range.

Conclusion

It was concluded from the results of this study that university level Punjabi women boxers have less mean value of VO_2max and haemodynamic variables than national/international level women boxers. As in other sports, where skills play a decisive role, the physiological data cannot be the sole predictor of competitive success. On the other hand, we must note that these physiological variables are necessary conditions for success in high levels of boxing competition. The norms play a decisive role in talent selection. A norm of desired level for physiological status of the women boxers may be formulated after sufficient data.

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