



Influence of trunk extensor muscle fatigue on postural stability in healthy young adults

Shriya Sharma¹, Khadija Dhrolia*² and Shaheen Sheikh³

¹Intern, Dr. Ulhas Patil College of Physiotherapy, Jalgaon-45001, Maharashtra, India.

²Associate Professor, Dr. Ulhas Patil College of Physiotherapy, Jalgaon-45001, Maharashtra, India.

³Asswastant Professor, Dr. Ulhas Patil College of Physiotherapy, Jalgaon-45001, Maharashtra, India.

*Corresponding Author: Khadija Dhrolia

Email id: khadijadhrolia@gmail.com

ABSTRACT

Background and aims

Previous researches have shown that the localized fatigue of trunk extensor muscle would significantly reduce static and dynamic postural stability, which would lead to loss of balance. Thwas was a major concern for certain occupation, neuromuscular conditions and geriatric population, so the study was carried out to determine influence of trunk extensor muscle fatigue on postural stability in healthy young adults.

Methods and Results

70 healthy young individuals of Age group 20 -25 yrs were asked to perform one leg standing test and functional reach test before and after a session of dynamic trunk extension until exhaustion and the difference in test scores was documented and analysed. It was found that Trunk extensor muscle fatigue significantly reduces static and dynamic postural stability in both OLST and FRT scores.

Conclusion

There was an influence of trunk extensor muscle fatigue on postural stability in healthy young adults.

Keywords: Postural stability, Fatigue, Trunk extensor, Healthy adults, One leg standing test, Functional reach test.

INTRODUCTION

Muscle is a soft tissue that contains protein filament of actin and myosin that slide past one another producing a contraction that changes both length and shape of cell.

Types of muscles

1. Cardiac muscle- are located in the walls of heart and are under voluntary control.

2. Smooth muscle- are located in walls of hollow vvasceral organ, except heart and are under involuntary control.
3. Skeletal muscle – occur in a muscle which are attached to skeleton, and are under involuntary control.

Anatomical classification of muscle

1. Unipennate- here fasciculi are attached obliquely to its tendon. e.g Extensor digitorum longus.

2. Bipennate- here fasciculi are set on both sides of central tendon. e.g Rectus femoris.
3. Multipennate- here oblique fibres insert on several tendon. e.g Deltoid.

Physiological classification of muscle

Type 1/ slow twitch/ red fibres

- They fatigue slowly.
- Work on oxidative mechanism, are aerobic muscles.
- Also called tonic or postural muscles.
- They are used in endurance work.

Type 2a/ fast twitch/ red fibres

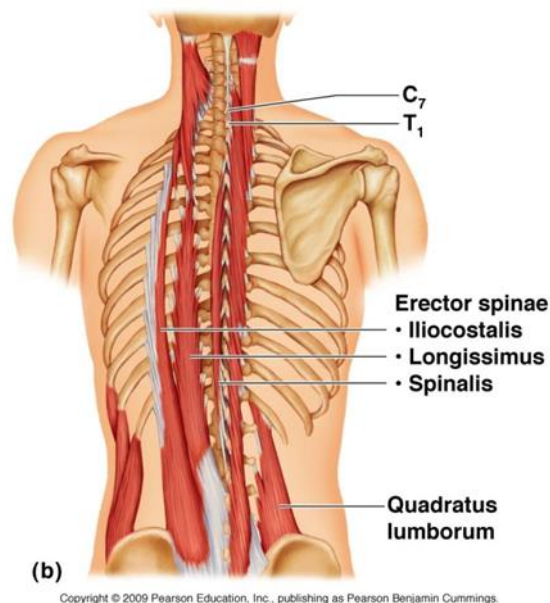
- Fatigue rate was moderate.
- Work on glycolytic metabolism, are anaerobic muscles.

Type 2b/fast twitch/white fibres

- Fatigue at fast rate.
- Work on glycolytic metabolism are anaerobic muscles.
- Also known as mobility or phasic, muscles.

Trunk extensor muscles

- Rectus Abdominus.
- External Obliques.
- Internal Obliques
- Transversus Abdominus.
- Quadratus Lumborum.
- Erector Spinae.-
Iliocostalis, Longissimus, Spinalis
- Splenius.
- Multifidus



The sustained maintenance of erect bipedal stance was unique to humans. The erect standing posture allows persons to use their upper extremities for the performance of large and small motor tasks.

POSTURAL STABILITY simply means balance, was an ability to maintain line of gravity of body within BOS with minimal sway.

For a weight-bearing joint to be stable, or in equilibrium, the gravity line of the mass must fall exactly through the axis of rotation, or there must be a force to counteract the moment caused by gravity. In the body, the counterforce was provided by either muscle or inert structures. In addition, the

standing posture usually involves a slight anterior/posterior swaying of the body of about 4 centimeters (cm), so muscles are necessary to control the sway and maintain equilibrium. An increased sway was indicator of decreased sensorimotor control.

POSTURAL CONTROL is defined as the ability to maintain upright stance, which is accomplished through intergration of internal and external forces and environmental factors

It is a dynamic activity with the neurosensory system contributing to postural control such as visual, proprioception and vestibular systems. Also

individual factors such as age, sex and fatigue affects postural control. [42]

“Postural control, which can be either static or dynamic, refers to a person’s ability to maintain stability of the body and body segments in response to forces that threaten to disturb the body’s equilibrium. According to Horak and associates, the ability to maintain stability in the erect standing posture was a skill that the central nervous system (CNS) learns, using information from passive biomechanical elements, sensory systems, and muscles. The CNS interprets and organizes inputs from the various structures and systems and selects responses on the basis of past experience and the goal of the response. Reactive (compensatory) responses occur as reactions to external forces that displace the body’s center of mass (CoM). Proactive (anticipatory) responses occur in anticipation of internally generated destabilizing forces” [44]

In numerous studies in young adults, it was seen that postural control was altered, characterized by increase in COP (center of pressure) sway displacement and/or COP sway velocity across several tasks (eg. unipedal stance, bipedal stance, eye open, eye closed) following fatigue of ankle (Vuillerme et al 2001) knee (Gribble and Hertel 2004) hip (Gribble and Hertel 2004), back (Davidson 2004) and neck (Gosselin 2004) muscle groups. [4, 31, 33]

None of the authors have reported any falls during their studies, so, we can say that postural control may not be altered enough after fatigue to lead to fall, but it could decrease ability to perform a second task while standing and/or respond to sudden perturbation.

Fatigue

Fatigue was a state during which a person was unable to carry out a sustained activity any longer after performing it repeatedly for sometime.

Various definitions of fatigue have been framed. One of the oldest definitions of fatigue framed by **Mosso in 1904** states that “The first was the diminution of the muscular force. The second was fatigue as a sensation. That was to say, we have a physical fact which can be measured and compared, and a psychic fact which eludes measurement.”

Other definitions have been framed by various authors which are stated below, **Fitts and Holloszy (1978)** A reversible state of force depression,

including a lower rate of rise of force and a slower relaxation.

- **Bigland-Ritchie et al. (1986)**-Loss of maximal force-generating capacity.
- **Vøllestad (1997)** Any exercise-induced reduction in the maximal capacity to generate force or power output.
- **Allen and Westerblad (2001)** Intensive activity of muscles causes a decline in performance, known as fatigue.
- **Vuillerme (2001)** - inability to produce and expected force.
- **Saladin (2012)** – it was the progressive weakness and contractility that results from use of muscles which was a loss of force in muscular contraction.
- The amount of force that muscle can produce depends on; size of muscle, number of muscle fibres, type of fibres and number of fibres per motor unit.

Types of fatigue

LOCAL FATIGUE - fatiguing of particular muscle or muscle group.

- Central fatigue: the sites of central fatigue are the central nervous system including the motor cortex of brain, spinal cord, anterior horn cell, and the cardio respiratory organs such as heart, lungs, etc. Fatigue occurs when transmission of impulses and energy requirements was slowed down at these sites.
- Peripheral fatigue: the sites of peripheral fatigue are the neuromuscular junction, the local vasculature and the skeletal muscle itself. Here there will be a disruption in the coupling-contraction mechanism, a deficit in energy production mechanisms or the disruption of impulse transmission at the NMJ.

GENERAL FATIGUE - fatiguing of more than one muscle. The whole body performs sluggishly and demands a period of rest.

Therefore, it was evident that fatigue has significant negative impact on postural control. Fatigue was measured by Maximal Voluntary Contraction of group of muscles or % of MVC; but currently best way to measure fatigue was Rate of Perceived Exertion. When MVC was reduced to 25-30%, local fatigue affects postural control.

Need of study

Previous researches show that the localized fatigue of trunk extensor muscles significantly reduce static and dynamic postural stability, so the study was carried out to determine influence of trunk extensor muscle fatigue on postural stability in healthy young adults.

Aim

To study the influence of trunk extensor muscle fatigue on postural stability in healthy young adults.

Objectives

1. To determine influence of trunk extensor muscle fatigue on postural stability in healthy young adults using clinical measures.
2. To know the time period for which effect on postural stability by trunk extensor muscle fatigue persists.

MATERIALS AND METHODS

The study design was an experimental study design with a sample size of 70 persons. Convenient sampling technique was used. The study was carried out at a tertiary care hospital in a duration of six months. Inclusion criteria was- healthy young

individuals aged 20-25 years and both males and females were included in the study. Exclusion criteria was individuals suffering from low back pain, individuals having any musculoskeletal, cardiorespiratory or neurological conditions and individuals with vestibular impairments. Two outcome measures were used to assess the static balance one leg standing test and functional reach test.

The Functional Reach Test (FRT) was developed by Duncan et al to provide a quick screen of balance problems in older adults. [19-20] It was the maximal distance one can reach forward beyond arm's length while maintaining a fixed BOS in the standing position. It was performed with the dominant hand to the side of wall with 90 degree shoulder flexion with closed fist. The subject was asked to reach forward without taking a step. An initial measurement was made of the position of the 3rd metacarpal along the yardstick. For forward reach, the patient was instructed to lean as far forward as possible without losing balance or taking a step. A second measurement was taken also using the 3rd metacarpal for reference. This measurement was then subtracted from the initial measurement. Three readings taken in inches and best was selected. [21]

FUNCTIONAL REACH TEST



One leg standing was performed on a firm surface with the subject standing on the dominant leg and the other leg flexed at the knee, with both hands crossed across the chest, with eyes closed, time noted in

seconds. Time of one leg standing was recorded in seconds using a stopwatch. Test was terminated when the subject used his arms (i.e., uncrossed arms), used the raised foot (moved it toward or

away from the standing limb or touched the floor), moved the weight-bearing foot to maintain balance (i.e., rotated foot on the ground), or opened eyes.

Three attempts were given and the best was selected. [20]

One leg standing test



Dynamic trunk extension until maximum exhaustion



For the performance of dynamic trunk extension until exhaustion, the subject was made to lie prone

on bench in horizontal plane with upper body unsupported and lower body supported, and both

hands were across the chest. The subject was asked to perform continuous trunk extension until maximum exhaustion and a metronome device was used to check if the subjects were performing extension at consistent rate. The subject was asked to stop when he/she felt discomfort or pain.

For recovery time the FRT and OLST were performed every three minutes until the scores reached that of non fatigue condition.

Both the tests are performed in all three conditions (No fatigue, Fatigue, Recovery)

DATA ANALYSIS AND INTERPRETATIONS

Table 1: means of age, BMI and recovery time

Variables	Mean	±S.D
Age	21.50	±1.43
BMI	21.08	±3.64
Recovery Time	77.23	±45.01

Table No.2 shows mean of one leg standing test in all three conditions (No fatigue, Fatigue, Recovery).

ONE LEG STANDING TEST (in sec)

	Frequency	Mean	S.D.	t value	P value
No Fatigue	70	3.50	±1.23	15.68	0.00
Fatigue	70	1.84	±0.75		
	Frequency	Mean	S.D.	t value	P value
Fatigue	70	1.84	±0.75	20.56	0.00
Recovery	70	3.91	±1.25		
	Frequency	Mean	S.D.	t value	P value
No Fatigue	70	3.50	±1.23	6.23	0.30

Table No.3 shows mean of functional reach test in all three conditions (No fatigue, Fatigue, Recovery)

FUNCTIONAL REACH TEST (in inches)

	Frequency	Mean	S.D.	t value	P value
No Fatigue	70	12.59	±3.00	4.48	0.00
Fatigue	70	11.92	±2.48		
	Frequency	Mean	S.D.	t value	P value
Fatigue	70	11.92	±2.48	2.31	0.02
Recovery	70	12.41	±2.83		
	Frequency	Mean	S.D.	t value	P value
No Fatigue	70	12.59	±3.00	0.86	0.39
Recovery	70	12.41	±2.83		

p value less than 0.05 shows significant difference between conditions.

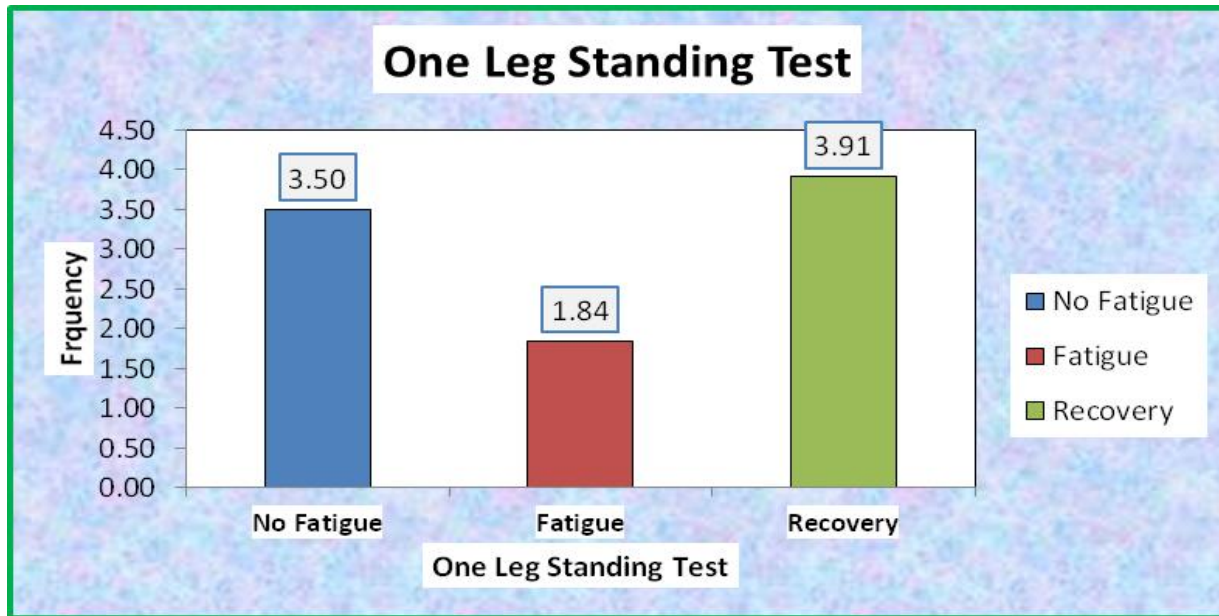


Figure 3 shows graphical representation of mean of one leg standing test in all three conditions (No fatigue , Fatigue, Recovery)

Here OLST showed decrease from No fatigue to fatigue condition

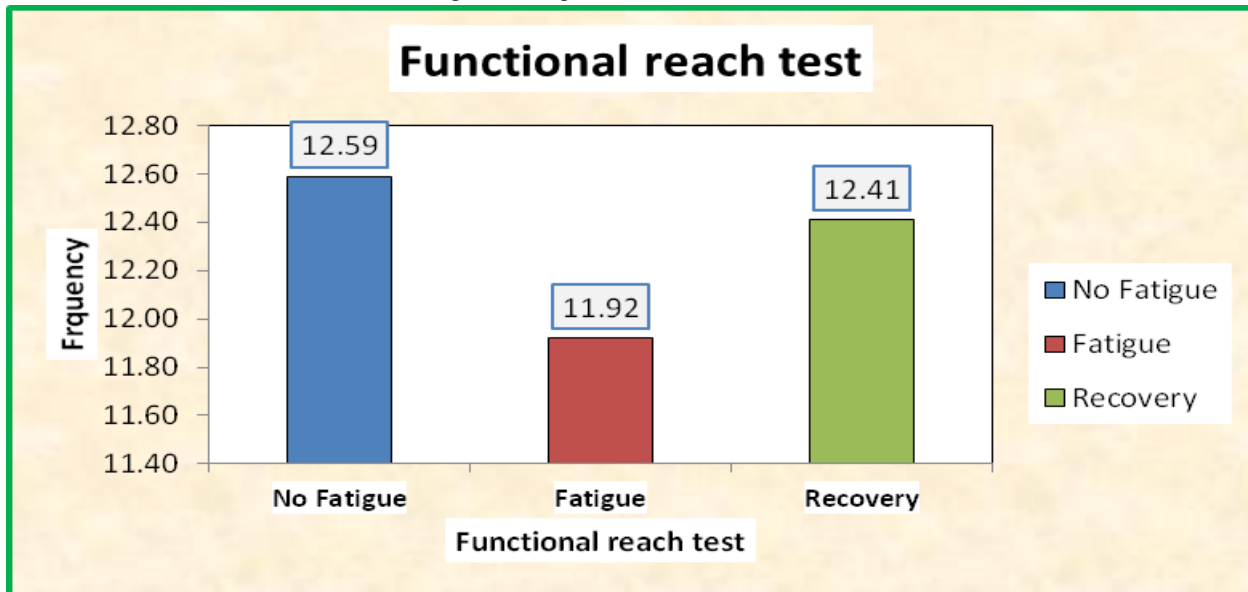


Figure 4 shows graphical representation of mean of functional test in all three conditions (No fatigue, Fatigue, Recovery)

Here FRT showed decrease from No fatigue to fatigue condition, hence there is decrease in postural stability.

RESULTS

Table no.1 shows mean of Age i.e 21.50 ± 1.43 , BMI i.e 21.08 ± 3.64 , Recovery time i.e 77.23 ± 45.01

Table no.2 shows significant difference between No fatigue and Fatigue condition with p value 0.00 and also there is no significant difference between

No fatigue and recovery condition with p value 0.30; hence postural stability was hampered due to fatiguing of muscle. The figure 3 shows the graphical representation of the same.

Table no.3 shows significant difference between No fatigue and fatigue condition with p value 0.00 and also there is no significant difference between No fatigue and recovery condition with p value 0.39; hence postural stability hampered due to

fatiguing of muscle. The figure 4 shows the graphical representation of the same.

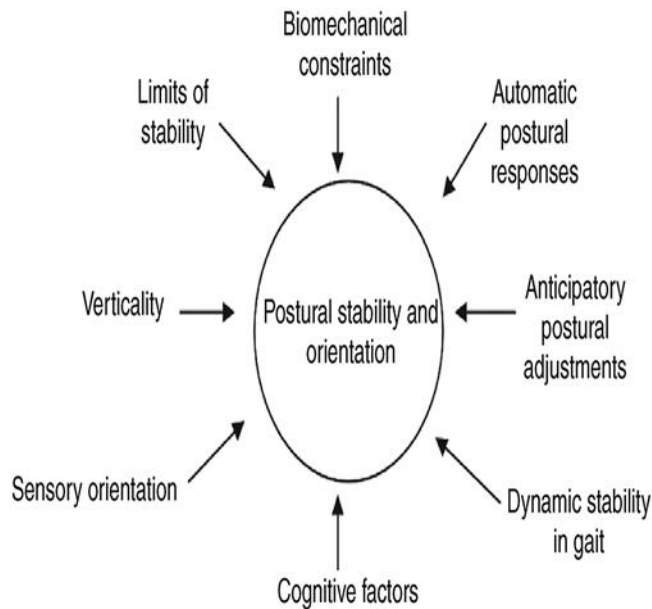
DISCUSSION

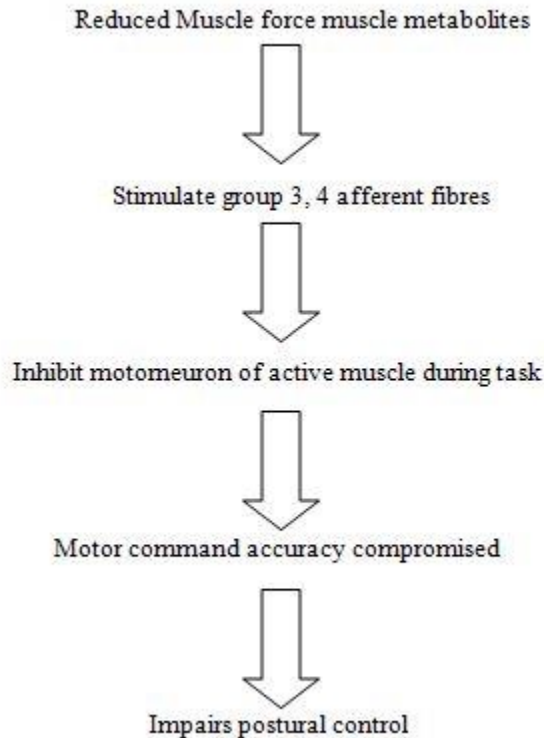
The present study was carried out to investigate influence of trunk extensor muscle fatigue on postural stability in healthy young adults, and the results obtained suggest that the applied fatigue protocol affects static and dynamic postural stability as indicated by reduction in OLST and FRT scores from No fatigue to Fatigue condition.

Taylor JL, et al in 2000 suggested that fatigue is a reduction of maximal muscle force or power that occurs with exercise and is accompanied by changes at multiple levels in the motor pathway and also by changes in the discharge patterns of muscle afferents. Changes in afferent firing can lead to altered perceptions and can also act on the efferent pathway. Changes in the motor pathway include slowing of motor unit firing rates during sustained maximal voluntary contractions (MVCs). [17] Schieppati M, et al in 2003 performed a similar study in which a fatiguing task of neck extensors was performed following which an

increase sway of subjects compared to controls was observed. The sway returned to normal after recovery. [30]

The effects of muscle fatigue on postural control depend upon muscle group involved in task and applied fatigue protocol. Trunk extensors are physiologically postural muscles being rich in type 1 muscle fibers [22-24]. Erector spinae and multifidi are found to be tonically active in quite standing and erector spinae contract eccentrically to control trunk flexion from standing position and also when head or upper limb is moved forward. It has been suggested from studies that muscular strength and sensory detection are two important factor in fatigue protocol [11-13, 25, 26]. In fatigue condition, there is decline in muscle force output compromising ability of musculoskeletal system to adjust the body posture. Previous studies have shown that a decline bigger than 30% of maximum isometric force after a fatigue protocol is enough to compromise postural control [10]. Similarly, muscle metabolites produce during task until exhaustion contribute to postural control impairment. [17]





One leg standing is associated with decreased inherent stability, because of adjustment of COG over short narrow BOS. In one leg standing, due to reduced somatosensory information and decreased inherent stability results in more dependence on visual and proprioceptive input from other postural muscles of body. In this study OLST, was performed under eye closed condition, thus vision was removed from contributing to task of postural control. As subjects stood on firm surface and head was aligned upright, vestibular was not affected by neuromuscular fatigue. Considering more dependence on proprioceptive inputs from these muscle during one leg stance, compare to role of trunk musculature strength, there is decrease in static stability during OLST observed in study, therefore diminished proprioceptive feedback from fatigue trunk extensors. In this study FRT was used as a measure of dynamic stability.

Bisson, E.J., et al in 2010 performed a study which showed increased sway in CoP after ankle fatigue. [45] José Alberto dos Santos Rocha, et al found that the applied fatigue protocol was not able to modify the postural control, as well as the capacity of integrating sensorial information in the absence of vision, of young healthy subjects. Their results indicate that proprioceptive information remains reliable after the used fatigue protocol,

allowing subjects to keep a satisfactory straight posture. But the protocol used was different. Recent studies show that muscle fatigue results in decrease in level of muscle excitation and early onset of APAs (anticipatory postural adjustment). Early APA's counteract fatigue, induce decrease in force producing capability of muscle that contribute to postural stability. It reduces the impact that fatigue has on body during various dynamic perturbations. It is documented that fatigue in extensor muscles of trunk reduces trunk's local dynamic stability [39, 40]. It is seen in previous studies that 50% or more decrease in MVC resulted in balance deterioration. Fatigue protocol produces desired fatigue in all subjects as indicated by rating of 10.53 ± 2.47 on RPE scale. The time period for which trunk extensor muscle fatigue persists in both OLST and FRT is 77.23 ± 45.01 i.e 1 min 17sec.

CONCLUSIONS

Trunk extensor muscle fatigue significantly reduces static and dynamic postural stability in both OLST and FRT. So, alternate hypothesis is accepted in our study as there is influence of trunk extensor muscle fatigue on postural stability in healthy young adults.

REFERENCE

- [1]. Movement, posture and equilibrium: interaction and coordination. *ProgNeurobiol* 38, 1992, 35-56.
- [2]. Adlerton A, Moritz U Does calf-muscle fatigue affect standing balance? *Scand J Med Sci Sports* 6, 1996, 211-215.
- [3]. Adlerton AK, Moritz U, Moe-Nilssen R Forceplate and accelerometer measures for evaluating the effect of muscle fatigue on postural control during one-legged stance. *Physiother Res Int* 8, 2003, 187-199
- [4]. Davidson B, Madigan M, Nussbaum M Effects of lumbar extensor fatigue and fatigue rate on postural sway. *Eur J ApplPhysiol* 93, 2004, 183-189.
- [5]. Davidson B, Madigan M, Nussbaum M, Wojcik L Effects of localized muscle fatigue on recovery from a postural perturbation without stepping. *Gait Posture* 29, 2009, 552–557.
- [6]. Helbostad J, Sturnieks D, Menant J, Delbaere K, Lord S, et al. Consequences of lower extremity and trunk muscle fatigue on balance and functional tasks in older people: A systematic literature review. *BMC Geriatr* 10, 2010, 56.
- [7]. Kahlaee A, Bahrpeyma F, Esteki A The effect of fatigue and instability on postural control parameters in standing posture in healthy adults and patients with chronic low back pain. *Zahedan J Res Med Sci* 14, 2012, 17-22
- [8]. Lin D, Nussbaum M, Seol H, Singh N, Madigan M, et al. Acute effects of localized muscle fatigue on postural control and patterns of recovery during upright stance: influence of fatigue location and age. *Eur J ApplPhysiol* 106, 2009, 425-434.
- [9]. Parreira R, Amorim C, Gil A, Teixeira D, Bilodeau MM Effect of trunk extensor fatigue on the postural balance of elderly and young adults during unipodal task. *Eur J ApplPhysiol* 113, 2013, 1989-1996.
- [10]. Pline K, Madigan M, Nussbaum M Influence of fatigue time and level on increases in postural sway. *Ergonomics* 49, 2006, 1639-164.
- [11]. Vuillerme N, Anziani B, Rougier P Trunk extensor muscles fatigue affects undisturbed postural control in young healthy adults. *Clinical Biomechanics* 22, 2007, 489-494.
- [12]. Vuillerme N, Pinsault N Re-weighting of somatosensory inputs from the foot and the ankle for controlling posture during quiet standing following trunk extensor muscles fatigue. *Exp Brain Res* 183, 2007, 323-327.
- [13]. Vuillerme N, Pinsault N, Chenu O, Fleury A, Payan Y, et al. Postural destabilization induced by trunk extensor muscles fatigue is suppressed by use of a plantar pressure-based electro-tactile biofeedback. *Eur J Applied Physiol* 104, 2008, 119-125.
- [14]. Vuillerme N, Pinsault N Vestibular and neck somatosensory weighting changes with trunk extensor muscle fatigue during quiet standing. *Exp Brain Res* 202, 2009, 253-259.
- [15]. Wilson E, Madigan M, Davidson B, Nussbaum M Lumbar extensor fatigue changes postural recovery strategy. *Gait & Posture* 23, 2006, 348-354.
- [16]. Schmidt RA A schema theory of discrete motor skill learning. *Psychol Rev* 82, 1975, 225-260.
- [17]. Taylor JL, Butler JE, Gandevia SC Changes in muscle afferents, motoneurons and motor drive during muscle fatigue. *Eur J Appl Physiol.* 83, 2000, 106-115.
- [18]. Mezaour M, Yiou E, Le-Bozec S Effect of lower limb muscle fatigue on anticipatory postural adjustments associated with bilateral-forward reach in the unipedal dominant and non-dominant stance. *Eur J ApplPhysiol* 110, 2010, 1187-1197.
- [19]. Delgado G, Coghlin C, Earle K, Holek A, O'Hare K Trunk Extensor Muscle Fatigue Does Not Affect Postural Control During Upright Static Stance in Young-Adults and Middle-Aged Adults. *WURJ: Health Natural Sci* 2, 2011, 1-7.
- [20]. Bohannon R, Larkin P, Cook A, Gear J, Singer J Decrease in timed balance test scores with aging. *Physical Therapy.* 64, 1984, 1067-1070.
- [21]. Duncan P, Weiner D Functional reach: A new clinical measure of balance. *J Gerontol* 45, M192-197.
- [22]. Borg G (1974) Perceived exertion. *Exer Sports Sci Rev* 2, 1990, 131-153.
- [23]. MacDonalda D, Moseleyb L, Hodgesa P The lumbar multifidus: Does the evidence support clinical beliefs? *Manual Ther* 11, 2006, 254-263.
- [24]. Moseley GL, Hodges PW, Gandevia SC Deep and superficial fibers of the lumbar multifidus muscle are

- differentially active during voluntary arm movements. *Spine* 27, 2002, E29-E36.
- [25]. Taimela S, Kankaanpää M, Luoto S The effect of lumbar fatigue on the ability to sense a change in lumbar position. A controlled study. *Spine* 24, 1999, 1322-1327.
- [26]. Radebold A, Cholewicki J, Polzhofer G, Greene H Impaired postural control of the lumbar spine is associated with delayed muscle response times in patients with chronic idiopathic low back pain. *Spine* 26, 2001, 724-730.
- [27]. Allum J, Bloem B, Carpenter M, Hulliger M, Hadders-Algra M Proprioceptive control of posture: A review of new concepts. *Gait and Posture* 8, 1998, 214-242.
- [28]. Bloem B, Allum J, Carpenter MG, Honegger F Is lower leg proprioception essential for triggering human automatic postural responses? *Exper Brain Res* 3, 2000, 375-391.
- [29]. Riemann B, Myers J, Lephart S Comparison of the ankle, knee, hip, and trunk corrective action shown during single-leg stance on firm, foam, and multi-axial surfaces. *Arch Phys Med Rehabil* 84, 2003, 90-95.
- [30]. Schieppati M, Nardone A, Schmid M Neck muscle fatigue affects postural control in man. *Neuroscience* 121, 2003, 277-285.
- [31]. Gosselin G, Rassoulain H, Brown I Effects of neck extensor muscles fatigue on balance. *ClinBiomech* 19, 2004, 473-479.
- [32]. Liang Z, Clark R, Bryant A, Quek J, Pua Y Neck musculature fatigue affects specific frequency bands of postural dynamics during quiet standing. *Gait posture* 39, 2013, 397-403.
- [33]. Vuillerme N, Nougier V, Teasdale N Effects of lower limbs muscular fatigue on anticipatory postural adjustments during arm motions in humans. *J Sports Med Phys Fitness* 42, 2002, 289-294.
- [34]. Mezaour M, Yiou E, Le Bozec S Effect of lower limb muscle fatigue on anticipatory postural adjustments associated with bilateral-forward reach in the unipedal dominant and non-dominant stance. *Eur J ApplPhysiol* 110, 2010, 1187-1197.
- [35]. Allison G, Henry S The influence of fatigue on trunk muscle responses to sudden arm movements, a pilot study. *ClinBiomech* 17, 2002, 414-417.
- [36]. Strang A, Berg W Fatigue-induced adaptive changes of anticipatory postural adjustments. *Exp Brain Res* 178, 2007, 49-61.
- [37]. Strang A, Berg W, Hieronymus M Fatigue-induced early onset of anticipatory postural adjustments in non-fatigued muscles: Support for a centrally mediated adaptation. *Exp Brain Res* 197, 2009, 245-254.
- [38]. Yiou E, Caderby T, Hussein T Adaptability of anticipatory postural adjustments associated with voluntary movement. *World J Orthop* 3, 2012, 75-86.
- [39]. Granata K, Gottipati P Fatigue influences the dynamic stability of the torso. *Ergonomics* 51, 2008, 1258-1271.
- [40]. Ritchie B, Woods J Changes in muscle contractile properties and neural control during human muscular fatigue. *Muscle Nerve* 7, 1984, 691-699.
- [41]. Sogaard K, Gandevia SC, Todd G, Petersen NT, Taylor JL The effect of sustained low-intensity contractions on supraspinal fatigue in human elbow flexor muscles. *J Physiol.* 573, 2006, 511-523.
- [42]. Yaggie JA, McGregor SJ Effects of isokinetic ankle fatigue on the maintenance of balance and postural limits. *Arch Phys Med Rehabil* 83, 2002, 224-228.
- [43]. Nardone A, Tarantola J, Galante M, Schieppati M Time course of stabilometric changes after a strenuous treadmill exercise. *Arch Phys Med Rehabil* 79, 1998, 920-924.
- [44]. Pamela Levangie , Cynthia Norkin, *Joint Structure & Function*, Fourth Edition.
- [45]. Bisson, E.J., Chopra, S., Azzi, E., Morgan, A. & Bilodeau, M. Acute effects of fatigue of the plantarflexor muscles on different postural tasks. *Gait & Posture*, 32(4), 2010, 482-486.

How to cite this article: Shriya Sharma, Khadija Dhrolia and Shaheen Sheikh. Influence of trunk extensor muscle fatigue on postural stability in healthy young adults. *Int J of Allied Med Sci and Clin Res* 2019; 7(2): 396-406.

Source of Support: Nil. **Conflict of Interest:** None declared.