Title: Impact of Lumbar Core Strength on the Balance in Community Dwelling Elderly

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Abstract: Background: Aging is an inevitable biological process contributes changes in systems like musculoskeletal, neurological, somatosensory, vestibular etc. Also, possesses increasing the risks of falls. The core strength and balance are components which are often affected & are not much investigated. Thus, we aim to assess correlation of lumbar core muscle strength and static and dynamic balance in elderly individuals
Methods: 30 subjects (15 males, 15 females) above 65 years with independent ambulation, recruited by random sampling from the community. Lumbar core strength and static balance and dynamic balance were measured
Results: Statistical analysis was done using Spearman's correlation co-efficiency test with $p<0.05$.A moderate negative correlation ($r=-0.4$) was obtained between the lumbar core muscle strength and timed up and go test ($p=0.01$). There was no significant correlation seen between lumbar core strength and static balance.
Conclusion: Dynamic balance is dependent on lumbar core strength which reduces gradually with aging in elderly

Keywords: Aging, core strength, elderly individuals, falls, balance, TUG.

INTRODUCTION

Aging is an inevitable process affecting various systems and tissues of our body. The active aging is also knownas the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age. (World Health Organization)The term coined as optimal aging which was defined as "the capacity to function across many domains—physical, functional, cognitive, emotional, social, and spiritual—to one's satisfaction and in spite of one's medical conditions".[1]

The aging process results in a number of functional, neurological, musculoskeletaldeteriorations.[2]A general decline in overall physiological ability is observed with a gradual increase in age[3]along with an increased risk of fall. This may also lead to sustain an injury.[4,5]Thefrequency of falls isseen high after 65 years of age resulting in severe loss of function.[6] Various factors can be attributed to increased risk of falls like muscular weakness, balanceimpairments, impaired neuromuscular control, somatosensoryissues, and environmental issues etc.[7]

Balance isthetask of maintaining person's center of gravity (COG) over base of support (BOS) in upright posture.[8]Balancein standing or during ambulation preventsor minimizes risk of falls. Static balance is defined as status of body in which all forces acting on body are aligned.[9]The COG of a body moves along or is close to medial border of supporting foot, rather than passing through its base. The integration of posture and voluntary movements in order to maintain dynamic relationship between body's COG and BOS more vital. This isapparent during dynamic activities where balance is critical. Dynamic balance is the sumof the forces on bodyinfluencing it to move in a controlled manner.

One more potent component which plays a very important role when the balance is discussed, is the Lumbar core strength. The lumbar core or lumbar corset is the deep corset model of stability,which is formed by four synergists; transverses abdominis,multifidus,diaphragm and pelvic floor muscles which provide stability for distal mobility.[10] Core muscle weakness and imbalances have a major contribution to postural mal-alignment. The co-contraction of the lumbar core muscles produces force to stabilize the lumbar spine and pelvis.[10] Force production abilities reducing with aging are faster than the reduction in muscle mass; attributed to neural alterations leading to muscle weakness, leading to imbalance.[11, 12, 13]

The real importance of maintaining an appropriate balance is understood when we come cross doing functional activities in daily routine. This incorporates single as well as bipedal stance. Single leg stance is the ability to balance on one leg measured as the time before placing the opposite leg on the ground.[14] Stance stability forms one of the four locomotorfunctions,[15] which essentially is also one of the three major tasks; i.e., single limb support, involved in the eight phases of gait.[16]Thus, providing a stable single legged

stance is thought to be integral part for progression into a stable gait, thereby playing a major role in prevention of falls. But there is not much evidence to suggest that core muscles strength has an effect on this single leg stance.

Therefore, this study aimed to correlate lumbar core muscle strength and static as well as dynamic balance in elderly individuals to find out the influence of these components on each other.

MATERIALS AND METHOD

Thirty healthy and independently ambulating elderly subjects (aged 65-80 years; 15 men and 15 women) were recruited in this co-relational study, after taking their informed consent from the local urban communities. Participants incapable of independent ambulation (including use of assistive device/s) or with any disease affecting their physical activity level (i.e., lower limb injury, musculoskeletal disease and neurological disorders) and those undergone any abdominal, back and knee surgeries were excluded. The study was approved by the Institutional Ethical Committee.

The lumbar core muscles strength was assessed by the supine test using Sphygmomanometer[17, 18]. Subjectswas asked to assume crook lying position with their feet flat on the plinth and arms to the side. They were taught to achieve the neutral spine position and to activate the core muscles by gently drawing in the belly button up, hollowing the abdominal muscles. Procedure was shown to subject and 3 trials were taken. The pressure of the cuff was inflated to 40mmHg (baseline value). Then the subject was asked to perform the maneuver without holding the breath for 10 seconds. During the maneuver following things were observed for: Increase in pressure, subtle posterior pelvic tilt, flattening of the lumbar spine without flaring of ribs, bulging of the abdominal wall and increased pressure through feet.

Static balance was assessed by measuring the single leg stance time. Dominance of legwas ascertained by imaginary ball kicking test.[18] Subjects were asked to stand bare feet on floor with hands on their waist. They were then instructed to stand over their dominant leg.[18] The time was noted with a stopwatch till the time subject was able to maintain balance without moving the support leg, touching the ground with the elevated leg or grabbing a support. Three readings were taken and best timing was noted.

Dynamic balance was assessed by Timed up and go test. The subject started in a seated position. The subject stood up upon therapist's command walked 3 meters, turned around, walked back to the chair and sat down.The time stopped when the patient was seated. Use of walking aids was allowed. Three trials were given and average was taken.[19,20]

Statistical analysis was done by Correlating the values using Spearman's correlation co-efficiency test with $p \leq 0.05$ on SPSS version 16.

RESULTS

The study was done to find out if there is correlation in core strength and static as well as dynamic balance. The demographic data was described in (0Table no.1.

It was obtained that there is no correlation between core strength and Single leg stance test for right limb (SLST_R) (Table no. 2) and that of for left limb (SLST_L) (Table no. 3)

It was also obtained that there is moderately negative correlation between core strength and Timed up and go test (TUG) [Dynamic balance] (Table no. 4)

DISCUSSION

The study was conducted to investigate the correlation between lumbar core strength and static as well as dynamic balance in community dwelling older adults. All the recruited subjects were evaluated for lumbar core strength by sphygmomanometer and single leg stance testfor static balance and TUG for dynamic balance.After performing statistical analysis, it was found negative correlation between lumbar core strength and Dynamic balance. Statistical test for correlation of lumbar core strength with static balance came non-significant.

The statistically significant and similar findings about lumbar core strength and balance are stated in a pilot study done by Kahle N, Tevald MA[21] on 'Core Muscle Strengthening and Improvement of Balance Performance in Community-Dwelling Older Adults. It was stated that the balance is an integrated function of neuromuscular system. Along with which sensory(vision), vestibular and proprioceptive systems form parts. Core muscles give stability for maintaining erect posture. Also change in body position deviates center of gravity(COG) and challenges the attained balance. To regain it and to anticipate the change in COG, core muscles work to give postural stability. As age progresses, the decline in muscle strength, also causes decline in functional abilities and activities of daily living (ADL) compromising the quality of life to some extent.

Another study done by Petroski JS, Cuneo M, Dial R, Pawley AK, Hill Jon 'Core strengthening and balance in geriatric population' stated that weakness of skeletal muscles like rectus abdominis, transverses abdominis and external obliques causes decline in functional activities including balance as well as ADLs. It was found that aging is associated with loss in muscle strength. It was also seen that the improvement in the strength of core muscles help to maintain balance in daily activities.[22,23,24,25]

The study done byÖzmen T, Gafuroğlu Ü, Aliyeva A, Elverici E on 'Relationship between core stability and dynamic balance in women withpost-menopausal osteoporosis' stated that reduce muscle mass and strength as age increases leads to decline in balance especially in dynamic balance. And also, there is increase in postural instability with reduced lumbar muscle strength. Although, they could not overcome confounding factors like levels of estrogen and vitamin D. They suggested that there may be effect of these factors on results they obtained.[26]

Improvements in balance, functional ability, and leg functioning in frail elderly people have been noted by giving standing, static balance exercises conducted independently without safety supervision.[27]The frail elderly are basically individuals above 65 years and depending on their level of activities, often under institutional care[28]There is also a weak evidence that some types of exercise (gait, balance, co-ordination and functional tasks; strengthening exercise; 3D exercise and multiple exercise types) are moderately effective. It could be because physiological changes which are inevitable with aging also may be because of different in lifestyle and the energy demands pose in later life.

Core instability strength training program is said to mitigate age-related deficits in measures of trunk muscle strength, spinal mobility, dynamic balance and functional mobility in older adults.[29,30]Also considering lower limb muscle strength would have played arole in single leg stance time and balance maintenance.

Thus, it can be concluded from the study that there is moderate negative correlation between lumbar core strength and dynamic balance. Static balance and lumbar core strength could not show any significant correlation, Present study also showedthat ddynamic balance is dependent on lumbar core strength which reduces gradually with an advancing age in the elderly individuals. By involving a good lumbar core muscle strengthening program in the rehabilitation of the elderly, the risk of falls can be minimized. Also, it can be used to improve balance in elderly individuals havingneurological problems that lead to balance deficits.

DISCLOSURE STATEMENT

"No potential conflicts of interest."

REFERENCES

1. Brummel-Smith K. Optimal aging, part I: demographics and definitions. Ann of Long Term Care. 2007;15(11):26.
2. 2.Granacher U, Gollhofer A, Hortobágyi T, Kressig RW, MuehlbauerT.The importance of trunk muscle strength for balance, functional performance, and fall prevention in seniors: a systematic review.Sports Med. 2013 Jul; 43(7):627-41.
3. Schwartz RS. Sarcopenia and physical performance in old age: introduction. Muscle & Nerve Suppl. 1997;20(S5):10-2.
4. Campbell AJ, Spears GF, Borrie MJ. Examination by logistic regression modeling the variables which increase the relative risk of elderly women falling compared to elderly men. J ClinEpidemiol 1990; 43:1415-1420
5. Rubenstein LZ, Josephson KR. The epidemiology of falls and syncopeClinGeriatr Med 2002 May;18(2):141-58
6. Guideline for the prevention of falls in older persons. J Am GeriatrSoc, 2002, 49:664-672.
7. Guccione AA, Avers D, Wong R. Geriatric physical therapy-ebook. Elsevier Health Sciences; 2011 Mar 7.
8. 8.Winter DA. Human balance and posture control during standing and walking. Gait & posture. 1995 Dec 1;3(4):193-214.
9. O'Sullivan SB, Schmitz TJ, Fulk G. Physical rehabilitation. FA Davis; 2019 Jan 25.
10. Richardson C, Hodges P, Hides J. Therapeutic exercise for lumbopelvic stabilization. Edinburgh: Churchill Livingstone; 2004 May..
11. 11.Bilodeau M, Henderson TK, Nolta BE, Pursley PJ, Sandfort GL. Effect of aging on fatigue characteristics of elbow flexor muscles during sustained submaximal contraction. Appl Physio 2001 Dec 1;91(6):2654-64.
12. Macaluso A, Nimmo MA, Foster JE, Cockburn M, McMillan NC, De Vito G. Contractile muscle volume and agonist-antagonist co activation account for differences in torque between young and older women. Muscle nerve. 2002 Jun;25(6):858-63..
13. Morse CI, Thom JM, Davis MG, Fox KR, Birch KM, NariciMV. Reduced plantarflexor specific torque in the elderly is associated with a lower activation capacity. Eur J ApplPhysiolEuropean journal of applied physiology. 2004 Jun 1;92(1-2):219-26.
14. 14Jonsson E, Seiger Å, Hirschfeld H. One-leg stance in healthy young and elderly adults: a measure of postural steadiness?. Clinic biomech2004 Aug 1;19(7):688-94.
15. Perry J, Davids JR. Gait analysis: normal and pathological function. Journal of Pediatric Orthopaedics. 1992 Nov 1;12(6):815.
16. Rose J, Gamble JG, editors: Human walking, 3rd edn, Philadelphia, PA, Lippincott Williams & Wilkins, 2006.
17. 17.Kisner C, Colby LA, Borstad J. Therapeutic exercise: foundations and techniques. Fa Davis; 2017 Oct 18.
18. 18.Apurv SP, Supriya KA, Ankita TA, Savita RA, Ashok S, Parag S. Effect of Induced Muscular Fatigue on Balance and Core Strength in Normal Individuals. Ind J PhysOccupTher 2014 Jul 1;8(3):182.
19. 19.Podsiadlo D, Richardson S. The timed 'Up & Go': a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39:142–148
20. 20.Isles RC, Choy NL, Steer M, Nitz JC. Normal values of balance tests in women aged 20–80. J Am Geriatr Soc. 2004;52:1367–1372
21. Kahle N, Tevald MA. Core muscle strengthening's improvement of balance performance in community-dwelling older adults: A pilot study. J Aging Phys Act 2014 Jan;22(1):65-73.
22. Petrofsky JS, Cuneo M, Dial R, Pawley AK, Hill J. Core strengthening and balance in the geriatric population. J App R Clin and ExpTher. 2005 Nov 1;5(3):423
23. 23.Jacobson BH, Thompson B, Wallace T, Brown L, Rial C. Independent static balance training contributes to increased stability and functional capacity in community-dwelling elderly people: a randomized controlled trial. Clinic Rehabil 2011 Jun;25(6):549-56.
24. 24.Granacher U, Lacroix A, Muehlbauer T, Roettger K, Gollhofer A. Effects of core instability strength training on trunk muscle strength, spinal mobility, dynamic balance and functional mobility in older adults. Gerontology. 2013;59(2):105-13
25. 25.Howe TE, Rochester L, Neil F, Skelton DA, Ballinger C.Exercise for improving balance in older people.Cochrane Database Syst Rev. 2007; (4):CD004963.
26. 26.Özmen T, Gafuroğlu Ü, Aliyeva A, Elverici E. Relationship between core stability and dynamic balance in women with postmenopausal osteoporosis. Turk J Phys Med Rehab 2018;64(x):i-vii
27. Jacobson BH, Thompson B, Wallace T, Brown L, Rial C. Independent static balance training contributes to increased stability and functional capacity in community-dwelling elderly people: a randomized controlled trial. ClinRehabil2011 Jun;25(6):549-56.
28. 28.Lally F, Crome P.Understanding frailty. Post grad Med J. 2007 Jan; 83(975): 16–20
29. 29.Granacher U, Gollhofer A, Hortobaqyi T, Kressig RW, Muehlbauer T The importance of trunk muscle strength for balance, functional performance, and fall prevention in seniors: a systematic review. Sports Med 2013 Jul;43(7):627-41.
30. Granacher U, Zahner L, Gollhofer A. Strength, power, and postural control in seniors: Considerations for functional adaptations and for fall prevention. Eur J Sport Sci. 2008;8(6):325–40.
31. Table 1: Demographic data

Total no. of subjects (n)	30
Males: Females	15:15
Age (years) (SD)	70.06 (3.8)

The table no.1 shows demographic data of the sample population.

Table no. 2Correlation between Core strength and Single leg stance test for right limb (SLST_R)

Component	Score	Correlation coefficient r	p value
Core strength	2.5	0.283	0.06
SLST_R	4.6		

It interprets that it has weak and statistically non-significant correlation between core and static balance of right lower extremity

Table no. 3Correlation between Core strength and Single leg stance test for left limb (SLST_L)

Component	Score	Correlation coefficient r	p value
Core strength	2.5	0.146	0.03
SLST_L	4.96		

It interprets that it has weak and statistically non-significant correlation between core and static balance of left lower extremity

Table no.4Correlation between Core strength and Timed up and go test (TUG)

Component	Score	Correlation coefficient r	p value
Core strength	2.5	-0.4	0.00
TUG	14.72		

It interprets that it has moderate and statistically significant correlation between core and dynamic balance