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Effect of backward walking training on quadriceps strength and thigh girth among college going students in Karnataka Bangalore

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Abstract
Background: Backward walking has emerged as an important therapy. Backward walking is regulated by the same central pattern generator as forward walking. Unlike forward walking, backward walking has no heel in contact in the early stance phase and thus leads to lower compression force at the patello femoral joint and decreased force absorption at the knee joint. In addition, lower limb muscle activity during backward walking is intensified on account of the higher recruitment of motor unit. Backward walking is recently emerging exercise that helps to increase the muscle strength of lower limb. This study aims to see the effect of backward walking on quadriceps strength and thigh girth measurement.
Methods: Initially the subject was made to walk 10 steps forward and 9 steps backward and was observed for any discomfort. If no discomfort then patient is made to walk backward for 10 minutes per session barefoot. This was followed by unilateral straight leg raise. Hamstring stretching and static quadriceps exercise. This training programme was carried out for 20 minutes 3 days/week for 4 week with the total of 12 session.
Result: The result of this study showed that significant improvement in girth measure with male and female population and right side strength improvement in the male population.
Discussion: The result of this study will enhance our understanding on the therapeutic effect of backward walking training on quadriceps strength and thigh girth among college going student. The strength and thigh girth improvement seen in the quadriceps is attributed to the physiological adaptation which occurs in the skeletal muscle. Backward walking programme was given four weeks post training.
Conclusion: This study concluded that clinically backward walking can lead to improved quadriceps strength and girth.

Keywords: backward walking, quadriceps strength, thigh girth, dynamometer

Introduction

Backward walking has been introduced as a means for gait performance improvement. Backward walking is thought to share similarities with forward walking but also has its own unique features. Reverse walking may also help to improve the function of quadriceps muscle on upper thigh [1]. Reverse walking may also be done to improve gait characteristics after an injury, survey or illness [2]. Walking backward gait may be "reflect" and walking backward may improve ability to walk forwards.

In a traditional rehabilitation programme the intervention consist of conventional physiotherapy treatment. Here conventional physiotherapy treatment is a set of intervention which include heat therapy, joint mobilization, stretching and strengthening exercise for pain reduction and to improve the particular muscle activity [3].These conventional physiotherapy treatment were found to be more effective when combined with gait training. The most common gait training strategies are forward walking on the ground and on a treadmill with or without the system for supporting body weight. Backward walking has emerged as an important therapy [4-5].

Backward walking is regulated by the same central pattern generator as forward walking [6]. Unlike forward walking, Backward walking has no heel contact in the early stance phase and thus leads to lower compression force at the patella femoral joint and decreased force absorption at the knee joint [7]. In addition, lower limb muscle activity during Backward walking is intensified on account of the higher recruitment of motor unit [8]. During the loading response phase of backward walking the ground reaction force rapidly increases to support the weight of the entire body [9]. The absence of visual cues during Backward walking result in increased spatial and smaller temporal gait parameter [10]. During backward walking one has to rely more on the sense rather than the visual system (e.g.:-Auditory and sensory system) because one does not have complete view of the environment ahead Backward walking is recently emerging exercise that helps to increase the muscle strength of lower limb. When comparing forward gait to backward gait, there are many difference [11]. In forward gait, contact is initially made with the heel. The hip flexes during most of stance and reaches its maximum during double support/terminal stance.it then extends through the remainder of the phase. The knee flexes at initial contact, extend through mid-stance and finally flexes just prior to toe off. The ankle is held in dorsiflexion at initial contact, then rapidly planter flexes through loading response and dorsiflexes through the remainder of stance [12]. In backward gait, initial contact is made with the forefoot. Stance involves primarily hip flexion that begins just before contralateral heel off and continues throughout stance. The knee initially extend, remains at a constant position, the flexes again at the period of contralateral toe on, and finishes with heel off. After initial contact, there is a time of rapid dorsiflexion which ends with contralateral heel off. Then, there is a cycle of slow plantar flexion during the remainder of stance. Stance begins at the heel strike and ends at the toe off during forward walking where as it start with the contact of the toes on the floor and finishes when heel is lifted during backward walking. Therefore backward walking induces a particular modification of the biomechanical constraint and may help to get insight in to the control of human locomotion [13].

Retro-walking is considered a safe closed kinetic chain exercise. since the compressive force at the patella femoral joint are reduced [14]. Retro walking reduces quadriceps eccentric function, while the isometric and concentric quadriceps strength are preserved [15-16]. Retro- walking training program have been found to increase quadriceps strength. In addition, the cardiopulmonary demand is higher during retro walking as compared to forward walking [17-18].

This study aims to see the effect of backward walking on quadriceps strength and thigh girth measurement.

Methodology

The test was conducted in both male and female college going students between the age of 18-23years. The test was mostly performed on healthy and active participants. The subject who were participating in any exercise regularly and having any quadriceps weakness, knee injury, surgery done for lower limb joint involving ligament, meniscus in last 6 month were excluded from the test. The outcome measure used to conduct this test is micro FET2 dynamometer and inch tape.

Procedure

Initially the subject was made to walk 10 steps forward and 9 steps backward and was observed for any discomfort. if no discomfort then patient is made to walk backward for 10 minutes per session barefoot. This was followed by unilateral straight leg raise. Hamstring stretching and static quadriceps exercise.

Measurement of quadriceps muscle strength

The data was collected by conducting the survey in large and neat rooms (practical room of padmashree college) The participant will be instructed to sit at the edge of a treatment table with the knee in flexion. The FET2 dynamometer close to the ankle at a point 80% of distance between the lateral malleolus and lateral joint line of the knee. Each participants pelvis will be stabilized the edge of treatment table. The participants will perform four warm up contraction and will be asked to increase their knee extension force gradually over 3s.The participants will be instructed to produce 50% effort in the first three warm ups and a maximal contraction on the fourth warm up. After that, the participant will perform three maximum trials, and the average of the three trials will be used for the analysis.

Fig 1

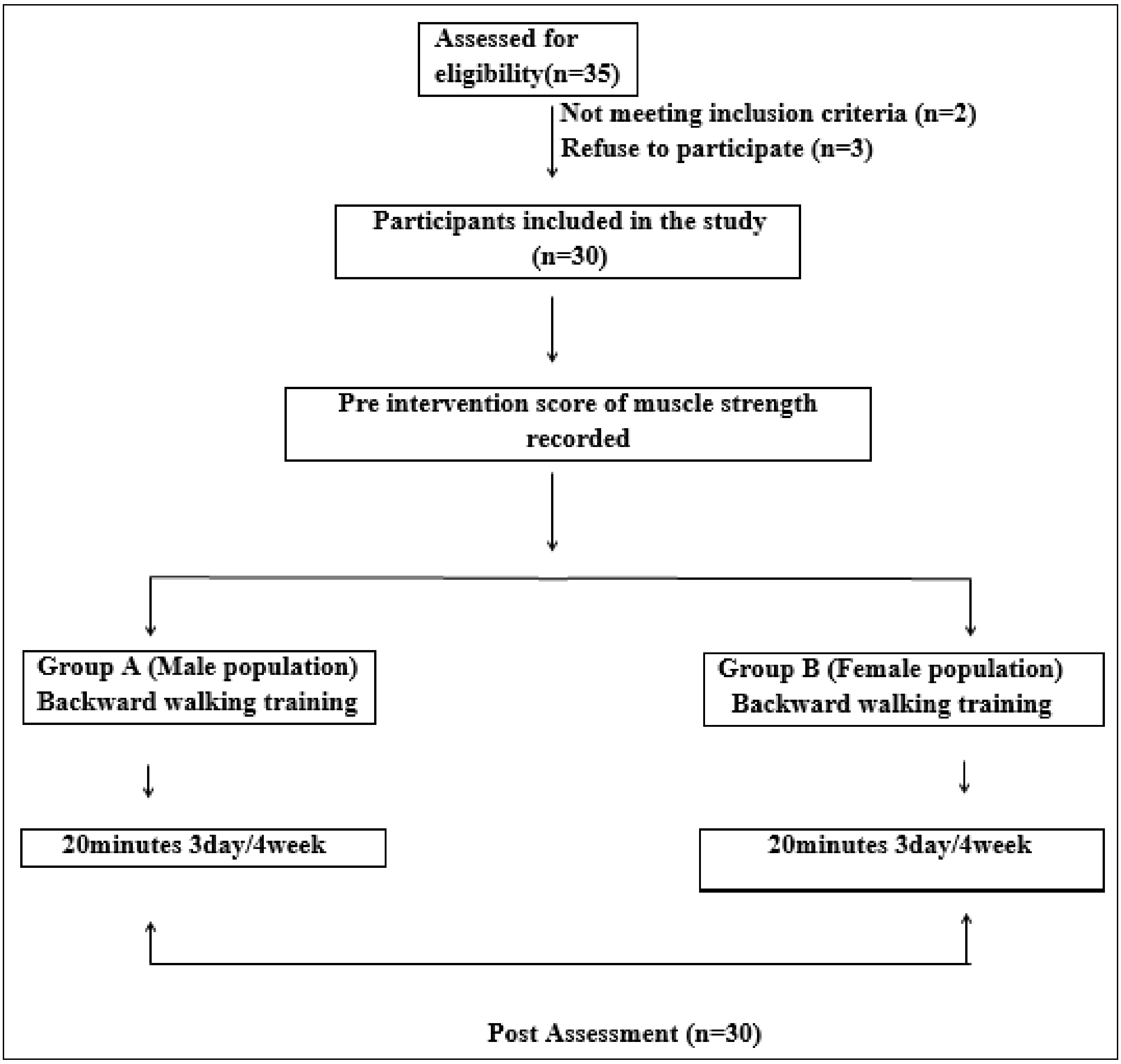

Fig 2

Results

Table 1: Description of Background variables of UG students

S. No.	Background variables	Group-A: Male (n=15)		Group –B: Female (n=15)		p-value
		Range	Mean ±SD	Range	Mean ±SD	
1	Age	19-23	20.80±1.20	20-22	21.13±0.51	t=0.983, p=0.334
2	Weight(kg)	50-88	66.06±11.00	51-68	59.26±5.03	t=2.176, p=0.038
3	Height(cm)	164-187	174.46±7.08	150-176	161.56±7.71	t=4.990, p=0.000
4	BMI	16.23-26.53	21.67±3.14	20.31-26.71	22.90±2.15	t=1.256, p=0.220

Note: Significant (p<0.05), Not significant (p>0.05); t-unpaired t-test

Table 2: Comparison of pre interventional outcome measures of UG students in between the groups

Sl. No	Outcome measures	Group-A: Male (n=15)		Group –B: Female(n=15)		p-value
		Range	Mean ±SD	Range	Mean ±SD	
1	Thigh girth right side(cm)	39-54	45.46±5.14	46-55	50.93±2.98	t=3.560,p=0.001
2	Thigh girth left side(cm)	38-53	45.09±5.05	45.5-56.0	51.03±3.23	t=3.894,p=0.001
3	Quadriceps strength right side (newtons)	12.4-20.7	15.61±2.12	12.2-19.3	15.26±2.55	t=0.411, p=0.984
4	Quadriceps strength left side (newtons)	11.1-19.5	14.68±2.54	10.7-18.6	13.13±2.26	t=1.760, p=0.089

Note: Significant (p<0.05), Not significant (p>0.05); t-unpaired t-test

Table 3: Comparison of Pre and Post Intervention outcome measures of UG students in both groups

Sl. No	Variables		Group –A: Male (n=15 Mean ±SD	p-value	Group –B: Female (n=15) Mean ±SD	p-value
1	Thigh girth right side (cm)	Pre test	45.46±5.14	t=1.264, p=0.220	50.93±2.98	t=0.269, p=0.792
		Post test	45.23±5.24		50.96±3.06	
2	Thigh girth left side(cm)	Pre test	45.09±5.05	t=0.445, p=0.663	51.03±3.23	t=459, p=0.653
		Post test	45.16±5.10		50.96±3.11	
3	Quadriceps strength right side (newtons)	Pre test	15.61±2.12	t=2.217, p=0.044	15.26±2.55	t=1.632, p=0.125
		Post test	16.58±2.21		15.76±2.53	
4	Quadriceps strength left side (newtons)	Pre test	14.68±2.54	t=1.812, p=0.092	13.13±2.26	t=1.801 p=0.093
		Post test	15.84±12.39		13.62±2.55	

Note: Significant (p<0.05), Not significant (p>0.05); t-paired t-test

Table 4: Comparison of post interventional outcome measures of UG students in between the groups

Sl. No	Outcome measures	Group-A: Male (n=15)		Group –B: Female (n=15)		p-value
		Range	Mean ±SD	Range	Mean ±SD	
1	Thigh girth right side(cm)	38-54	45.23±5.24	46-55	50.96±3.06	t=3.673, p=0.001
2	Thigh girth left side(cm)	38-54	45.16±5.10	46-55	50.96±3.11	t=3.799, p=0.001
3	Quadriceps strength right side (newtons)	13.6-21.5	16.58±2.21	12.5-19.8	15.76±2.53	t=0.936, p=0.357
4	Quadriceps strength left side (newtons)	11.6-19.7	15.84±12.39	10.6-19.7	13.62±2.55	t=1.902, p=0.067

Note: Significant (p<0.05), Not significant (p>0.05); t-unpaired t-test

Discussion

The present study was undertaken to evaluate the effectiveness of backward walking on quadriceps strength and girth. The result suggest that there was statistically significant improvement in girth measure with male and female population. And right side strength improvement in the male population. The reason of improvement in the strength and girth of quadriceps can be attributed to the backward walking training program. The strength and thigh girth improvement seen in the quadriceps is attributed to the physiological adaptation which occur in the skeletal muscle (skeletal and neural adaptation) Backward walking program which was given for 4 weeks [19-20]. post training, there is a hypertrophy of the muscle fibre Incorporated with hyperplasia. Fibre composition is changed from type 2b to type 2a.According to the size principl. low force muscle action activates only few motor unit but with the backward walking training there is a higher force requirement progressively.so there is addition of more number of motor unit to increase the muscle force due to which motor unit firing increases. synchronization and the rate of firing improves by backward walking training also there is an increase in the inhibitory function of the central nervous system because of decrease in the sensitivity of golgi tendon organ or change at the myomeural junction of motor unit [21-22].

Backward walking has different biomechanics as compared to the forward walking. The Studies shows that in the backward stance toes contact the ground first and the heel is lifted off the ground last. The foot impact on the ground in the early stance is accompanied by activity of knee extensors and ankle plantar flexors. The backward thrust is provided by the hip and knee extensors. the pattern of muscle synergies will be different as the knee flexors are reciprocally activated with knee extensors in backward walking [23-24]. Backward walking tends to decrease both swing and stance duration. The hip, knee and ankle angles are more in backward walking as compared to forward. Walking decrease in the stride length, increase the cadence as the Frequency of quadriceps firing increases [24].

Backward walking relies less on the momentum that also leads to increase in the muscle activity and practice of repeated bouts of backward walking leads to more efficient recruitment of the motor unit [24-25-26]. In backward walking, quadriceps are active in the swing phase to control the foot placement prior to touch down, also concentric activity of quadriceps needed to assist the knee extension in the stance phase thus all this result in better activity of quadriceps group of muscle. Backward walking resulted increase in the muscle activity and thus better improvement in the strength and thigh girth. This reversal of knee joint kinematics leads to changing the type of quadriceps muscle activation the early knee flexion during forward walking is controlled by the eccentric activation of the knee extensors to provide shock absorption in response to ground impact [27]. However, during backward walking the knee extension during early stance is achieved by a concentric contraction of quadriceps muscle to prevent the descent of the body's centre of gravity and propel the body backward. The conversion of eccentric quadriceps activation during forward to concentric activation during backward walking may explain the increased vastus medialis, Obliquus and vastus lateralis muscle electromyography activities found during backward walking.

Regarding the motor control mechanism, backward walking and forward walking use the same rhythm circuitry but backward walking in addition requires specialized motor circuits. The moment pattern of the ankle joint was almost identical in forward walking and time reversed backward walking. As the main thrust during midstance is provided by knee and hip extensors during backward walking this could have led to increased strength. The largest changes in muscle activation between forward and backward walking occurred in the particular thigh muscle [28]. The principal backward walking propulsion is provided by the hip and knee extensors which could have lead to increased strength and thigh girth in quadriceps muscle [29]. Also the foot impact on the ground in early stance is sustained by co-activation of several limb muscle (flexors and extensors at the hip, knee, and ankle) in forward walking gait whereas the same event is accompanied by activity in knee extensors and ankle plantar-flexors in backward gait [30]. Thus it would have lead to increase of strength and girth in quadriceps.

Conclusion

It can be concluded that there was significant improvement in right side quadriceps strength in male population and thigh girth size improvement in male and female population. backward walking training has significant improvement on quadriceps strength and girth measurement. Thus this study conclude that though clinically backward walking can lead to higher quadriceps strength and girth.

References

1. Alghadir AH, Anwer S, Sarkar B, Paul AK, Anwar D. Effect of 6-week retro or forward walking program on pain, functional disability, quadriceps muscle strength, and performance in individuals with knee osteoarthritis: a randomized controlled trial (retro-walking trial). BMC Musculoskelet Disord.2019:20(1):159. doi:10.1186/s12891-019-2537-9
2. Balasukumaran T, Olivier B, Ntsiea MV. The effectiveness of backward walking as a treatment for people with gait impairments: A systematic review and meta-analysis.
3. Gondhalekar GA, Deo MV. retrowalking as an adjunct to conventional treatment versus conventional treatment alone on pain and disability in patient with acute exacerbation of chronic knee osteoarthritis:a randomized clinical trial.North Am j med sci.,2013:5:108-112.
4. kim HH, shim jm. comparison of forward and backward walking training on gait pattern in adult. indian j. sci Technol;9 Epub ahead of print, 2016. Dol:10.17485/ijst/2016/v9i43/105030
5. Takami A, Wakayama s. Effect of partial body weight support while training acute stroke patients to walk backward on a treadmill-A controlled clinical trial using randomized allocation.j phys Ther sci.,2010:22:177.
6. Jansen k, Groote FD, Massaad f *et al*. similar muscles contribute to horizontal and vertical acceleration of center of mass in forward and backward walking:implication for neural control. j Neurophysiol.,2012:107:3385-3396.
7. joshi's, vij js, singh sk. Retrowalking:A new concept in physiotherapy and Rehabilitation.int j sci Res., 4.
8. Hide fumi Homma, Hiroto suzuki, Markoto Suzuki *et al*. Muscle activity of backward walking. Riga kuryoho, kogaku,2013:28:323-328.
9. carneiro LC, Michaelsen SM, Roesler H *et al*. vertical Reaction forces and kinematics of backward walking under water.Gait posture,2012:35:225-230.
10. Zhao H, Huo H, Zhang j. foot pressure and gait features during fitness backward walking of the elders. chinj rehabil med.,2010:25:435-438.
11. Wang J, yuan W, AnR. Effectiveness of backward walking training on spatial temporal gait characteristics: a systematic review and meta analysis Human movement science,2018:1:60:57-71.
12. Vilensky JA *et al*, A kinematic comparison of backward and forward walking in humans. Journal of Human Movement studies,19897:13:29-50.
13. Bollens B, crevecoeur f, Detrembleur c, warlopT, Lejeune TM. Variability of human gait: effect of backward walking and dual-tasking on the presence of long-Range auto correlation. Annals of biomedical engineering,2014:42(4):742-50.
14. Flynn Tw. soutas -little RW. patellofemoral joint compressive forces in forward and backward running.j orthop sports phys Ther.,1995:21(5):277-82.
15. Flynn Tw, soutas-little RW. Mechanical power and muscle action during forward and backward running.j orthop sports phys Ther.,1993:17:108-12.
16. Therkeld Aj, Horn TS, wojtowicz GM, Rooney JG, Shapiro R. kinematics, ground reaction force and muscle balance produced by backward running. j orthop sports phys Ther.,1989:11(2):56-63.
17. Flynn Tw, Connery SM, smutok MA, zeballos RJ, welsman lM. comparison of cardiopulmonary responses to forward and backward walking and running.med sci sports exerc.,1994:26:89-94.
18. Myatt G, Baxter R, Dougherty R, williams G, Halle j, stetts D *et al*. The cardiopulmonary cost of backward walking at selected speeds.j orthop sports phys Ther,1995:21:132-8.
19. Kisner c, Colby L. The knee.Therapeutic exercise foundation and technique,5th ed.jp brothers medical publisher, 2007, 546.
20. William D, Ardle MC, Frank l katch, victor L, katch. Exercise physiology energy Nutrition and Human performance.3rd ed lea and febiger:Philadelphia, 1991, 628.
21. Gerber jp, maras RL, Dibble LE. effect of early progressive eccentric exercise on muscle structure post anterior cruciate ligament Reconstruction j Bone joint and surgery,2007:89(3):559-70.

22. Gerber JP, Marcus RL, Dibble LE, Greis PE, Burks RT, LaStayo PC. Effects of early progressive eccentric exercise on muscle size and function after anterior cruciate ligament reconstruction: a 1-year follow-up study of a randomized clinical trial. Physical therapy,2009:89(1):51-9:89(1):51-59.
23. Kenji masumuto shin ichiro, Takasugi, Noboru Hotta. Muscle activity and Heart Rate response during backward walking and on dry land. physiology,2005:94:54-61.
24. Dean yoshimoto, Thomas Mohr: An EMG study of quadriceps and hamstring activity during forward and backward walking.
25. Child s, john D, Gantt, christy, Higgins. The effect of repeated bouts of backward walking on physiologic efficiency The journal of strength and conditioning Research,2002:16(3).
26. Grasso R, Blanchi L, Lacquaniti F. Motor pattern for human gait: backward versus forward locomotion J neurophysiol.,1998:80(4):1868-85.
27. Wang j, xuj, An R. Effectiveness of backward walking training on balance performance: A systematic review and meta analysis Gait and posture,2019:1:69:466-75.
28. van Deursen RW, Flynn TW, mc crory JL, morag E. Does a single control mechanism exist for both forward and backward walking? Gait and posture.1998:7(3):214-24.
29. Lee M, kim j, sonj kim. y Kinematic and kinetic analysis during forward and backward walking. Gait posture,2013:38(4):674-678.
30. Grasso R, Bianchi L, Lacquaniti f. Motor pattern for human gait. Backward versus forward locomotion. journal of neurophysiology,1998:80(4)1868-85.