Vol II - Issue 3 July-Aug-Sept 23 eISSN: 2583 – 4304

Indian Journal of Physiotherapy and Rehabilitation Science

Published by
Association of Health and Wellness Providers (AHWP)

https://ijptrs.com

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp1-5 EISSN 2583-4304

URL:https://www.ijptrs.com/view-issue/98/Fulltext

DOI:https://ijptrs.com/public/images/content/17vignesh%2008.pdf

Effects of Tendon Neuroplasticity Training among Badminton Players with Lateral Epicondylitis – A Quasi Experimental Study

Manoj Abraham [1], Hariharasudan[1], Vignesh N[2], Sakthi Aiswarya M[3], Sivaramakrishnan K[3], Kaleeswaran A[3]

1,2,3 K.G college of Physiotherapy, Affiliated to The Tamil Nādu Dr. M.G.R Medical University, Chennai, Tamil Nādu, India.

Corresponding Author's Email: nvignesh194@gmail.com

Submission: 23rd may 2023

Revised: 10th June 2023

Publish: 3rd July 2023

Abstract

Background: Lateral epicondylitis, also known as "tennis elbow" is an overuse tendinopathy of the common extensor origin at the elbow due to repetitive movements of the wrist and forearm. The repeated motions and stress to the tissue results in injury of the tendons at the lateral epicondyle of the humerus. A normal Tendon is exposed to optimised load, which causes adaptation. An inappropriate load to the tendon or an unloaded tendon leads to stress shielding where normal loading or excessive loading provokes Tendinopathy.Tendon Neuroplasticity training involves strength training and external pacing, which helps in developing good motor control and sufficient muscle capacity to perform a task.

Materials and Method: In this study 24 Badminton players with tennis elbow were selected and divided into two groups Group A with 12 players underwent Conventional therapy and strengthening exercise and Group B with 12 players underwent Tendon Neuroplasticity training along with conventional physiotherapy for 4 weeks.

Results: The Statistical Analysis showed a significant reduction of Pain after Tendon Neuroplasticity Training (NPRS: $p < 0.05$;) and improvement in Hand Grip (Hand held dynamometer: $p<0.05$;)

Conclusion: The study is concluded that Tendon neuroplasticity training along with conventional therapy reduces Pain and improves Hand grip strength

Keywords: Lateral Epicondylitis, tendon neuroplasticity training, pain, grip strength

Table of content

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp1-5 EISSN 2583-4304

INTRODUCTION

Lateral Epicondylitis (LE), otherwise "Tennis Elbow", generally overuse syndrome in the elbow (Cutts S et al., 2019). It affects approximately 4-7 per 1000 individuals. LE is an overuse injury which may results in hyaline degeneration at the common extensor origin. Overuse of the muscles and tendons of the forearm and elbow together with repetitive contractions adjoin too much strain on the extensor tendons which cause deformation in tendon structure that leads to pain in the lateral epicondyle. Predominantly, the pain is located anterior and distal from the lateral epicondyle (Pienimäki T, et al.,2002). Tendons have the ability to modify depending on which loads they are subjected to, Modification can occur not only at a structural level but also occur at a cortical level (Ahmad Z.,2013), which introduced a tendon rehabilitation protocol to address motor control deficits seen in patients with tendinopathy. Tendon neuroplastic training (TNT) refers to the combination of isometric or isotonic strength training secondary with an externally-paced audio or visual cue. Patients perform a strength training task that loads the affected tendon (Rio E et al.,2016).

HYPOTHESES:

Null Hypothesis (Ho1): There is no significant improvement in Pain with Tendon Neuroplasticity Training.

Null Hypothesis (Ho2): There is no significant improvement in Handgrip Strength with Tendon Neuroplasticity Training.

Null Hypothesis (Ho3): There is no significant improvement in Pain and handgrip with Tendon Neuroplasticity Training.

Alternate Hypothesis (Ha1): There is significant improvement in Pain and Handgrip Strength with Tendon Neuroplasticity Training.

Alternate Hypothesis (Ha2): There is significant improvement in Handgrip Strength with Tendon Neuroplasticity Training.

Alternate Hypothesis (Ha3): There is significant improvement in Pain and Handgrip Strength with Tendon Neuroplasticity Training.

MATERIALS AND METHOD

Study design: Quasi Experimental design

Procedure: Participants 24 badminton players at the beginner's stage (less than one year) were selected. All the players were selected with Lateral epicondylitis in under cultural stage and had Cozens test positive, were selected and divided into two groups Group A with 12 players undergoing Tendon Neuroplasticity training along with conventional physiotherapy and Group B with 12 players underwent conventional physiotherapy for 4 weeks. In this study only male players were selected.

Exercise Program

The exercise program was given for 4 weeks.

Conventional therapy and strengthening exercise

1) Patient in a high chair sitting with arm abducted forearm pronated resting above a pillow on a table.

2) Ultrasound was given under Pulsed mode for 8 minutes and ice pack for 10 minutes

Conventional therapy and Tendon Neuroplasticity Training

This training was done by providing an auditory cue through a metronome and the patient performs wrist extension with the

IJPTRS Vol 2(3) July-August-September 2023 pp1-5 EISSN 2583-4304

Thera loop and progressed to Dumbbell for 3 sets and 10 repetitions.

Statistical Tool: Paired and unpaired t test

RESULTS

The sample comprised of a total 24 badminton players with Lateral epicondylitis. The assessments were taken for 1) Pain by using NPRS, 2) Hand Grip by using hand-held Dynamometer. The Data analysis was done using data 't'test and unpaired 't'test and SPSS software v 22.0. The Statistical Analysis showed a significant reduction of pain after Tendon Neuroplasticity Training (NPRS: $p < 0.05$;) and improvement in Hand Grip (Hand held dynamometer: $p<0.05$;). The unpaired 't'test post test value are described in the table below.

Outcome measures	Mean Value		Calculated t-value	Table t-value	p-value
	Group A	Group B			
NPRS	2.00	1.67	12.53	1.717	P < 0.05 is significant

Table 1: Post test values for pain

Outcome measures	Mean Value		Calculated t-value	Table t-value	p-value
	Group A	Group B			
Hand grip strength	70.00	80.83	3.0262	1.717	P < 0.05 is significant

Table 2: Post test values for Hand grip strength

DISCUSSION

Tendinopathy can be resistant to treatment and frequently recurs, implying that current treatment approaches are suboptimal. Rehabilitation programs that have been successful in terms of pain reduction and return to sport outcomes generally include strength training (Rio E etal., 2016). Tendon neuroplastic training is a strength training technique that address the central nervous system involvement of tendinopathies. Combining resistance exercise with metronome- based training can potentially enhance the tensile capacity of the tendon and reduce motor control deficits (Cutts S etal., 2019).

The studies shows that ultrasound provides reduction in pain over one to three months. Ultrasound should be done two or three times per week with a duration of four to six weeks (Rio E etal., 2016). Physical examination tests' individual accuracy has been under- researched but available evidence suggests that the Cozen's test reported high perceptivity and concluded that the Cozen's test can be used to rule out side epicondylitis during a physical examination, and that the grip strength difference between elbow flexion and extension has good individual values for determining the presence and absence of side epicondylitis (Karanasios. S etal., 2022). A resisted wrist extension was performed to target the extensor carpi radialis brevis, as this accounts for 90 of side elbow tendinopathies (Bhabra, G et al., 2016). Externally paced resistance training, similar as with the use of a metronome, is able of inducing ipsilateral and contralateral changes to the excitability and inhibition in healthy participants.

Tendon neuroplastic training (TNT) refers to the combination of isometric or isotonic strength training secondary with an externally-paced audio or visual cue. Patients perform a strength training task that loads the affected tendon which adequately address both the deficits in tendon strength and motor control seen in tendinopathy (Patrick Welsch etal., 2018)

CONCLUSION

The study is concluded that Tendon neuroplasticity training along with conventional therapy reduces Pain and improves Hand grip.

LIMITATIONS

1) Study sample size was small
2) Only Badminton players were selected
3) Only Male players were selected

CONFLICT OF INTEREST

No Potential conflict of interest relevant to this article was reported

ACKNOWLEDGEMENT

The Authors sincerely thank Dr. G Bakthavathsalam, Chairman; Mrs. Vasanthi Ragu, Vice Chairman; Mr. Prabhu Kumar, CEO; and Prof. V Mohan Gandhi, CEO, K.G Hospital, Coimbatore, India for their support.

REFERENCES

1. Ahmad, Z., Siddiqui, N., Malik, S. S., Abdus-Samee, M., Tytherleigh-Strong, G., & Rushton, N. (2013). Lateral epicondylitis: a review of pathology and management. The bone & joint journal, 95-B(9), 1158–1164. https://doi.org/10.1302/0301620X.95B9.29285

2. Bhabra, G., Wang, A., Ebert, J. R., Edwards, P., Zheng, M., & Zheng, M. H. (2016). Lateral Elbow Tendinopathy: Development of a Pathophysiology-Based Treatment Algorithm. Orthopaedic journal of sports medicine, 4(11), 2325967116670635.https://doi.org/10.1177/2325967116670635

3. Cutts, S., Gangoo, S., Modi, N., & Pasapula, C. (2019). Tennis elbow: A clinical review article. Journal of orthopaedics, 17, 203–207. https://doi.org/10.1016/j.jor.2019.08.005

4. Haile, G., Hailemariam, T. T., & Haile, T. G. (2021). Effectiveness of Ultrasound Therapy on the Management of Chronic Non-Specific Low Back Pain: A Systematic Review. Journal of pain research, 14, 1251–1257. https://doi.org/10.2147/JPR.S277574

5. Karanasios, S., Korakakis, V., Moutzouri, M., Drakonaki, E., Koci, K., Pantazopoulou, V., Tsepis, E., & Gioftsos, G. (2022). Diagnostic accuracy of examination tests for lateral elbow tendinopathy (LET) - A systematic review. Journal of hand therapy: official journal of the American Society of Hand Therapists, 35(4), 541–551. https://doi.org/10.1016/j.jht.2021.02.002

6. Pienimäki, T. T., Siira, P. T., & Vanharanta, H. (2002). Chronic medial and lateral epicondylitis: a comparison of pain, disability, and function. Archives of physical medicine and rehabilitation, 83(3), 317–321. https://doi.org/10.1053/apmr.2002.29620

7. Rio, E., Kidgell, D., Moseley, G. L., Gaida, J., Docking, S., Purdam, C., & Cook, J. (2016). Tendon neuroplastic training: changing the way we think about tendon

rehabilitation: a narrative review. British journal of sports medicine, 50(4), 209–215. https://doi.org/10.1136/bjsports-2015-095215

8. Welsh P. (2018). Tendon neuroplastic training for lateral elbow tendinopathy: 2 case reports. The Journal of the Canadian Chiropractic Association, 62(2), 98–104.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp6-14 EISSN 2583-4304

URL: https://www.ijptrs.com/view-issue/99/Fulltext

DOI:https://www.ijptrs.com/public/images/content/722nikhil%20rrr.pdf

A Literature Review on the Effect of High-Intensive Interval Exercise Training on Cardiorespiratory Fitness

Nikhil Gujarati[1], Dr. Anjali Suresh[2], Dr. R. Sedhunivas[3]

1. MPT second year student Department of Physiotherapy, Garden city University,
2. Head of Department, & Professor, Department of Physiotherapy, School of Health Sciences, Garden City University,
3. Assistant professor, Department of Physiotherapy, School of Health Sciences, Garden City University, Bangalore, Karnataka, India.

Corresponding Author's Email: nvignesh194@gmail.com

Submission: 23rd June 2023

Revised: 10th July 2023

Publish: 31st July 2023

Abstract

Overeating, inadequate exercise, a sedentary lifestyle, and decreased fat oxidation all contribute to obesity, a disease that increases the risk of illness and death early in life. The goal of this literature review was to determine how cardiorespiratory fitness was impacted by high-intensity interval training from various articles. Online search engines such as a PubMed and Google Scholar were searched and 21 articles from 2009 and 2022 were chosen. The data were tallied in accordance with the literature review mixed research study, the number of participants, the conditions, the mode of treatment, and the conclusion. High-intensity interval training improves six out of ten general physical skills in athletes, including stamina, power, and cardiovascular/respiratory endurance, according to this evaluation of the literature. The remaining four physical abilities are speed, coordination, agility, and precision are the remaining four physical aptitudes that have not yet been identified.

Keywords: (HIIT) High-Intensity Interval Training, (MICT) Medium intensity circuit training Aerobic capacity, VO2 max.

Table of content

Indian Journal of Physiotherapy and Rehabilitation Science
IJPTRS Vol 2(3) July-August-September 2023 pp6-14 EISSN 2583-4304

INTRODUCTION:

Every healthy adult should engage in at least 150 minutes of moderate exercise or physical activity or at least 75 minutes of high-intensity exercise or physical activity each week, according to the World Health Organisation. However, 1.4 billion individuals, or more than 25% of the population, do not meet these suggested levels of physical exercise.

There have been more obese people throughout the world during the past 40 years, and current trends point to an increase in this number until 2030. Obesity is a condition that causes early morbidity and mortality and is explained by an altered energy balance brought on by overeating, insufficient exercise, a sedentary lifestyle, and impaired fat oxidation. In addition to helping with weight control, endurance exercise also enhances respiratory and cardiovascular health.

HIIT (HIGH-INTENSITY INTERVAL TRAINING):

A well-known type of exercise for enhancing cardiovascular endurance, respiratory fitness, aerobic capacity and health, and fat reduction is high-intensity interval training. The core of HIIT is repeating workouts or training sessions at maximal exertion while alternately taking rest intervals. High-intensity interval training's key benefits are its brief duration and plenty of workout variants, which keep sessions from growing monotonous.

When compared to moderate-intensity continuous training for weight loss, HIIT treatment might be a more enjoyable and appealing kind of exercise. Through this training regimen, power and anaerobic capacity are increased, simulating the effects of low-intensity endurance exercise.

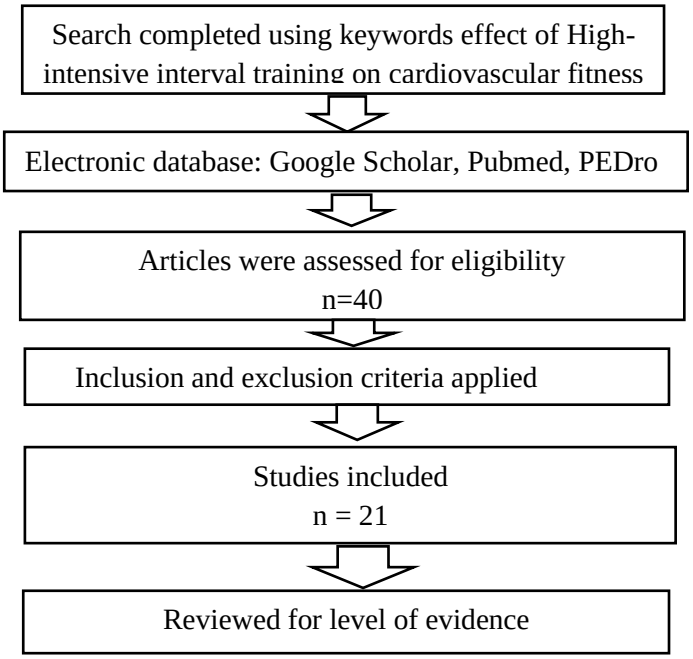
In both healthy and ill populations, HIIT can be used as an alternate training method to traditional endurance training to bring about positive physiological and biochemical changes. According to recent research, HIIT may be a time-effective approach to promote health in the inactive overweight/obese population.

Increased skeletal muscle, mitochondrial biogenesis, and mitochondrial function—which manifests itself as higher oxidative phosphorylation capacity—could all be contributing factors to this improvement.

Exercise that involves brief bursts of high-intensity activity, such as intermittent exercise that increases heart rate and oxygen consumption to 90% of maximum levels and is followed by recovery periods are referred to as HIIT.

MATERIALS AND METHODS:

Literature Search Methodology Online search engines that are used to collect journals are Google Scholar and PEDro. The authors identified articles based on the keywords. The articles were collected in full text. A total of 40 articles were identified, out of which 21 articles were



Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp6-14 EISSN 2583-4304

NO	AUTHORS	TITLE	YEAR	STUDY DESIGN	CONCLUSION
1.	**Travis W Beck, et al**	The effects of four weeks of creatine supplementation and high-intensity interval training on cardiorespiratory fitness: a randomized controlled trial	2022	Randomized Control Trial	HIIT is an effective and time-efficient way to improve maximal endurance performance. The addition of Cr improved VT, but did not increase TWD.
2.	**Jaroslaw Domaradzki, et al**	The Relative Importance of Age at Peak Height Velocity and Fat Mass Index in High-Intensity Interval Training Effect on Cardiorespiratory Fitness in Adolescents: A Randomized Controlled Trial	2022	Randomized Control Trial	The effects of HIIT and APHV were analyzed according to the sexes, the significant influence of the APHV on ΔFI was observed (very close to significant, in fact) in girls.
3.	**Kangle Wang, et al**	Effects and dose–response relationship of high-intensity interval training on cardiorespiratory fitness in overweight and obese adults: a systematic review and meta-analysis	2021	Systematic Review	Dose–response relationship analysis provided some preliminary data regarding the training period, training intensity, and session duration. However, it is still not possible to provide accurate recommendations currently. Further studies are still needed to identify the most appropriate training variables to prescribe effective HIIT programs for improving CRF in overweight and obese adults.
4.	**Hadi Nobari, et al**	Effects of 8 Weeks of High-Intensity Interval Training and Spirulina Supplementation on Immunoglobin Levels, Cardio-Respiratory Fitness, and Body Composition of Overweight and Obese Women	2021	Experimental Study	The data in the present study demonstrated the effectiveness of spirulina supplementation and HIIT concurrently in making significant changes in IgA concentrations and FFM. Taking spirulina with HIIT for overweight and obese women may be helpful not only for losing FFM but also for boosting IgA, which plays an important role in the immune system.

Inclusion criteria:

1. Articles discussing the effect of aerobic exercise were included.
2. Articles published only in the English language were included.
3. Articles from 2009-2022 have been taken.

NO	AUTHORS	TITLE	YEAR	STUDY DESIGN	CONCLUSION
5.	**Ying Wang Hao, et al**	Impact of high-intensity interval training on cardiorespiratory fitness, body composition, physical fitness, and metabolic parameters in older adults: A meta-analysis of randomized controlled trials	2021	Randomized Control Trial	This systematic review and meta-analysis showed that HIIT induces favorable adaptions in cardiorespiratory fitness, physical fitness, muscle power, cardiac contractile function, mitochondrial citrate synthase activity, and reduced blood triglyceride and glucose levels in older individuals, which may help to maintain aerobic fitness and slow
6.	**Marie Carmen Valenza, et al**	High-intensity interval training effects in cardiorespiratory fitness of lung cancer survivors: a systematic review and meta-analysis	2021	Systematic Review	The findings indicated a beneficial effect of HIIT for improving cardiorespiratory fitness in lung cancer patients in early stages around oncological treatment moment. Nevertheless, this review has several limitations, the total number of studies was low, and the stage and subtype of lung cancer patients were heterogeneous that means that the conclusions of this review should be taken with caution.
7.	**N. Sultana, et al**	The effect of low-volume high-intensity interval training on cardiovascular health outcomes in type 2 diabetes: A randomised controlled trial	2020	Randomized Control Trial	Twelve minutes of low-volume HIIT per week leads to improvements in central arterial stiffness and cardiovascular health in inactive individuals with obesity and T2D
8.	**Rhona Martin Smith, et al**	High Intensity Interval Training (HIIT) Improves Cardiorespiratory Fitness (CRF) in Healthy, Overweight and Obese Adolescents: A Systematic Review and Meta-Analysis of Controlled Studies	2020	Systematic Review	HIIT is an effective method to improve CRF in adolescents, irrespective of body composition. Notably, meta regression analysis identified that prolonged high volume HIIT programs are similarly effective to short term low volume HIIT programs. .

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp6-14 EISSN 2583-4304

NO	AUTHORS	TITLE	YEAR	STUDY DESIGN	CONCLUSION
9.	**John Ab, et al**	Effect of high-intensity interval training on cardiorespiratory fitness, physical activity and body composition in people with schizophrenia: a randomized controlled trial	2020	Randomized Control Trial	Effect of high-intensity interval training on cardiorespiratory fitness, physical activity and body composition in people with schizophrenia: a randomized controlled trial
10.	**Jesús Alarcón-Gómez, et al**	Effects of a HIIT Protocol on Cardiovascular Risk Factors in a Type 1 Diabetes Mellitus Population	2020	Experimental Study	6-week HIIT protocol, was sufficient to improve VO2max, HRV, body composition and fasting glucose in a previously sedentary T1DM population. HIIT seems an interesting approach for reducing cardiovascular risk in T1DM individuals.
11.	**David C. Andrade, et al**	Acute effects of high-intensity interval training session and endurance exercise on pulmonary function and cardiorespiratory coupling	2020	Experimental Study	The present study shows that EE elicited an increase of CRC in healthy individuals, independent to parasympathetic modulation of the heart; however, an acute bout of HIIT or EE did not modify pulmonary function, as determined by clinical spirometry.
12.	**Matthew P. Wallen, et al**	High-intensity interval training improves cardiorespiratory fitness in cancer patients and survivors: A meta-analysis	2020	Meta Analysis	Quantitative assessment of HIIT studies indicates good compliance, with a significant effect on peak V̇O2 and peak oxygen pulse compared with UC in cancer patients and survivors. HIIT demonstrates a comparable effect with MICT to improve peak V̇O2.
13.	**Nathan A. Johnson, et al**	The Effect of Low-Volume High-Intensity Interval Training on Body Composition and Cardiorespiratory Fitness: A Systematic Review and Meta-Analysis	2019	Systematic Review	These data suggest that low-volume HIIT is inefficient for the modulation of total body fat mass or total body fat percentage in comparison with a non-exercise control and MICT.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp6-14 EISSN 2583-4304

NO	AUTHORS	TITLE	YEAR	STUDY DESIGN	CONCLUSION
14.	**Christopher Hurst, et al**	The effect of 12 weeks of combined upper- and lower-body high-intensity interval training on muscular and cardiorespiratory fitness in older adults	2019	Experimental Study	Combined upper- and lower-body HIT has small clinically relevant beneficial effects on muscular and cardiorespiratory fitness in older adults.
15.	**Jennifer Crozier, et al**	High-Intensity Interval Training After Stroke: An Opportunity to Promote Functional Recovery, Cardiovascular Health, and Neuroplasticity	2018	Experimental Study	Larger randomized controlled trials are necessary to establish (a) effectiveness, safety, and optimal training parameters within more heterogeneous poststroke populations; (b) potential mechanisms of HIIT-associated improvements; and (c) adherence and psychosocial outcomes.
16.	**Jing-xin Liu, et al**	Effectiveness of high-intensity interval training on glycemic control and cardiorespiratory fitness in patients with type 2 diabetes: a systematic review and meta-analysis	2018	Systematic Review	HIIT may induce more positive effects in cardiopulmonary fitness than MICT in T2D patients.
17.	**Rebecca Mary, et al**	The effect of home-based low-volume, high-intensity interval training on cardiorespiratory fitness, body composition and cardiometabolic health in women of normal body mass and those with overweight or obesity: protocol for a randomized controlled trial	2018	Randomized Control Trial	Supervised laboratory-based HIIT interventions are effective in improving cardiometabolic health. More pragmatic exercise protocols may however show to be successful for mitigating barriers to the engagement in physical activity and exercise resulting in positive benefits to health. Investigation into home-based HIIT regimens are important in women, where globally the rising trend of overweight and obesity overshadows that of men. The results from this study may therefore inform future research on effective exercise prescription for women's health.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp6-14 EISSN 2583-4304

NO	AUTHORS	TITLE	YEAR	STUDY DESIGN	CONCLUSION
18.	**Ruth Stoklund Thomsen, et al**	Effect of high-intensity interval training on cardiovascular disease risk factors and body composition in psoriatic arthritis: a randomised controlled trial	2018	Randomized Control Trial	**Conclusion** in patients with PsA, 3 months with HIIT was associated with a substantial increase in VO_{2max} and a reduction in truncal fat percentage compared with controls. The beneficial effect on VO_{2max} was also sustained through 9 months.
19.	**TomásRodolfo Reyes Amigo, et al**	Effectiveness of High-Intensity Interval Training on cardiorespiratory fitness and body composition in preadolescents: A systematic review	2018	Systematic Review	HIIT in adolescents can significantly improve cardiorespiratory fitness, BMI, and decrease body fat percentage, in comparison to moderate intensity training and non-training control group conditions
20.	**Schaun, Gustavo, et al**	Whole-Body High-Intensity Interval Training Induce Similar Cardiorespiratory Adaptations Compared With Traditional High-Intensity Interval Training and Moderate-Intensity Continuous Training in Healthy Men	2018	Experimental Study	Our results demonstrate that HIIT-WB can be as effective as traditional HIIT while also being time-efficient compared with MICT to improve health-related outcomes after 16 weeks of training. However, HIIT-T and MICT seem preferable to enhance performance-related outcomes compared with HIIT-MICT.
21.	**Zhaowei Kong, et al**	High intensity interval training in norm baric hypoxia improves cardio respiratory fitness in over weight Chinese young women	2017	Experimental Study	5-wk of HIIT improved cardiorespiratory fitness and blood lipids in overweight Chinese young females, while the additive effect of the HIIT under normobaric hypoxia solely enhanced cardiorespiratory fitness, but not body composition or serum lipid profile.

DISCUSSION:

Short bursts of high-intensity exercise, such as intermittent activity that achieves 90% of maximum heart rate (HR) and maximal oxygen uptake (VO2max), are separated by times of recovery or rest. This kind of exercise training is known as HIIT.

The results of all the studies showed that high-intensity interval training is an effective way to help inactive young women lose body fat and improve their anthropometric indices. Additionally, it may be observed that the degree of activity played a significant role in the rise in adiponectin levels.

Compared to other forms of exercise, HIIT is good in increasing VO2max, aerobic capacity, and cardiovascular fitness.

CONCLUSION

The results of this study show that high-intensity interval training enhances six out of ten general physical abilities in athletes, including stamina, power, and cardiovascular/respiratory endurance. Speed, coordination, agility, and accuracy are the other four physical aptitudes that have not yet been tested.

REFERENCES:

1. Riswanti I. Media Buletin Dan Seni Mural Dalam Upaya Meningkatkan Pengetahuan Tentang Obesitas. J Heal Educ. 2016;1(1):62–70.
2. Chiu CH, Ko MC, Wu LS, Yeh DP, Kan NW, Lee PF, et al. Benefits of different intensity of aerobic exercise in modulating body composition among obese young adults: A pilot randomized controlled trial. Health Qual Life Outcomes. 2017;15(1):1–9.
3. Wilkinson KM. Increasing obesity in children and adolescents: an alarming epidemic. Vol. 21, JAAPA: official journal of the American Academy of Physician Assistants. JAAPA; 2008.
4. Patel H, Alkhawam H, Madanieh R, Shah N, Kosmas CE, Vittorio TJ. Aerobic vs anaerobic exercise training effects on the cardiovascular system. World J Cardiol. 2017;9(2):134.
5. Yakubovich M. Aerobic and anaerobic exercise: analyzing the benefits of different forms of exercise for adults diagnosed with type 2 diabetes. Univ Honor Theses [Internet]. 2017;442.
6. Hackett D, Hagstrom AD. Effect of overnight fasted exercise on weight loss and body composition: A systematic review and meta-analysis. J Funct Morphol Kinesiol. 2017;2(4).
7. Kong Z, Fan X, Sun S, Song L, Shi Q, Nie J. Comparison of high-intensity interval training and moderate-to-vigorous continuous training for cardiometabolic health and exercise enjoyment in obese young women: A randomized controlled trial. PLoS One. 2016;11(7):1–16.
8. Andini A, Indra E novita. Perbedaan pengaruh frekuensi latihan senam aerobic terhadap penurunan persentase lemak tubuh dan berat badan pada members wanita. Medikora [Internet]. 2016;15(1):39–51.
9. Tabata I. Tabata training: one of the most energetically effective high-intensity intermittent training methods. Vol. 69, Journal of Physiological Sciences. Springer Tokyo; 2019. p. 559–72.
10. Domaradzki J, Cichy I, Rokita A, Popowczak M. Effects of Tabata training during physical education classes on body composition, aerobic capacity, and anaerobic performance of under-, normal-and overweight adolescents. Int J Environ Res Public Health. 2020;17(3).
11. Bahr R and Sejersted OM. Effect of intensity of exercise on excess postexercise O2 consumption. Metabolism 40: 836–841, 1991.
12. Billat VL, Flechet B, and Petit B. Interval training at _VO2max: Effects on aerobic performance and overtraining markers. Med Sci Sports Exerc 31: 156–163, 1999.
13. Gibala MJ and McGee SL. Metabolic adaptations to short-term high-intensity interval training: A little pain for a lot of gain? Exerc Sport Sci Rev 36: 58–63, 2008.
14. Gray AB, Telford RD, and Weidemann MJ. Endocrine response to intense interval exercise. Eur J Appl Physiol Occup Physiol 66: 366–371, 1993.
15. Haram PM, KemiOJ, Lee SJ, BendheimMØ, Al-Share QY, Waldum

HL, Gilligan LJ, Koch LG, Britton SL, Najjar SM, and Wisløff U. Aerobic interval training vs. continuous moderate exercise in the metabolic syndrome of rats artificially selected for low aerobic capacity. Cardiovasc Res 81: 723–732, 2008.
16. Kemi OJ, Haram PM, Loennechen JP, Osnes JB, Skomedal T, Wisløff U, and Ellingsen Ø. Moderate vs. high exercise intensity: Differential effects on aerobic fitness, cardiomyocyte contractility, and endothelial function. Cardiovasc Res 67: 161–172, 2005.
17. Reuter BH and Hagerman PS. Essentials of Strength Training and Conditioning (3rd ed). Baechle T and Earle R, eds. Champaign, IL: Human Kinetics, 2008. pp. 499.
18. Rozenek R, Funato K, Kubo J, Hoshikawa M, and Matsuo A. Physiological responses to interval training sessions at velocities associated with _VO2max. J Strength Cond Res 21(1): 188–192, 2007.
19. Frayn KN. Calculation of substrate oxidation rates in vivo from gaseous exchange. J Appl Physiol Respir Environ Exerc Physiol 1983; 55:628–34.
20. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods 2007;39:175–91.
21. Schubert MM, Clarke HE, Seay RF, Spain KK. Impact of 4 weeks of interval training on resting metabolic rate, fitness, and health-related outcomes. Appl Physiol Nutr Metab 2017;42:1073–81.
22. Cohen J. Statistical power analysis for the behavioral sciences. New York, NY: Routledge; 1988.
23. Astorino TA, Schubert MM. Changes in fat oxidation in response to various regimes of high intensity interval training (HIIT). Eur J Appl Physiol 2018;118:51–63.
24. Little JP, Gillen JB, Percival ME, et al. Low-volume high-intensity interval training reduces hyperglycemia and increases muscle mitochondrial capacity in patients with type 2 diabetes. J Appl Physiol (1985) 2011;111:1554–60.
25. Green HJ, Cadefau J, Cusso R, Ball-Burnett M, Jamieson G. Metabolic adaptations to short-term training are expressed early in submaximal exercise. Can J Physiol Pharmacol 1995;73:474–82.

IJPTRS Vol 2(3) July-August-September 2023 pp15-18 EISSN 2583-4304

Clinical Prediction Rules for Physiotherapists

Bid Dibyendunarayan Dhrubaprasad[1]

URL: https://www.ijptrs.com/view-issue/101/Fulltext

DOI:https://www.ijptrs.com/public/images/content/609bid%20sir%201.pdf

1.Head of the Department,

Department of Musculoskeletal Sciences, The Sarvajanik College of Physiotherapy, Rampura, Surat

Author: Bid Dibyendunarayan Dhrubaprasad

Email: dnbid71@gmail.com

Submission: 23rd July 2023

Revised: 28th July 2023

Publish: 5th August 2023

Table of content

INTRODUCTION

In recent years, evidence-based practice has become the cornerstone of healthcare, including physiotherapy. To ensure optimal patient outcomes, physiotherapists have increasingly relied on clinical prediction rules (CPRs). These rules serve as decision-making tools that guide clinicians in determining the most appropriate interventions for individual patients based on clinical variables. By incorporating CPRs into their practice, physiotherapists can enhance diagnostic accuracy, improve treatment efficacy, and optimize patient management. (1)

UNDERSTANDING CLINICAL PREDICTION RULES:

Clinical prediction rules are developed through systematic research, where specific clinical variables are identified and combined to predict a patient's likelihood of a particular outcome or response to treatment. These rules are derived from large datasets, often involving clinical trials or observational studies, and are validated to ensure their accuracy and reliability. CPRs are designed to assist physiotherapists in making informed decisions, reducing subjectivity, and improving the precision of their clinical judgments. (2)

Clinical prediction rules (CPRs) are evidence-based tools that enable physiotherapists to make informed decisions by predicting the likelihood of a specific outcome or response to treatment based on identified clinical variables.

Systematic research, including clinical trials or observational studies, is employed to establish the accuracy and reliability of these rules. Researchers combine and analyze large datasets to identify the most relevant and predictive clinical variables associated with a particular condition or treatment response.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp15-18 EISSN 2583-4304

CPRs are designed to reduce subjectivity and enhance the precision of clinical judgments in physiotherapy practice. They provide a standardized framework that guides physiotherapists in assessing patients and selecting appropriate interventions. By incorporating objective clinical variables, CPRs help clinicians move beyond their intuition or experience and rely on evidence-based guidelines. This systematic approach promotes consistency and ensures treatment decisions are based on reliable evidence rather than individual bias. (1)

The development of CPRs involves several key steps. Initially, researchers conduct extensive literature reviews to identify potential clinical variables that have shown associations with the targeted outcome or treatment response. These variables may include patient demographics, clinical history, physical examination findings, diagnostic test results, or functional assessments. The identified variables are tested and refined through statistical analyses to determine their individual and collective predictive value. (2)

Validation of CPRs is crucial to ensure their accuracy and generalizability. Validation studies involve applying the developed CPRs to an independent patient population to assess their performance in predicting the desired outcome. These studies evaluate the sensitivity, specificity, positive and negative predictive values, and overall diagnostic accuracy of the CPRs. Validation also helps identify necessary modifications or adjustments to optimize the rules' performance in different clinical settings and patient populations.

CPRs provide physiotherapists with valuable decision-making support in various aspects of patient care. They can aid in diagnosing specific musculoskeletal conditions by differentiating between similar clinical presentations. For example, CPR for diagnosing rotator cuff tears may incorporate age, pain location, range of motion limitations, and strength deficits. By combining these variables, the physiotherapist can assign a probability score indicating the likelihood of a rotator cuff tear, supporting clinical decision-making regarding further investigations or referral for imaging. (3)

Additionally, CPRs assist in treatment planning and intervention selection. They help identify patients more likely to respond positively to specific interventions based on their clinical characteristics. For instance, a CPR for predicting the success of exercise therapy in low back pain may include variables such as duration of symptoms, presence of leg pain, and certain physical examination findings. By considering these variables, the physiotherapist can tailor treatment plans and prioritize interventions most likely effective for individual patients.

By incorporating CPRs into their practice, physiotherapists can enhance the quality of care and optimize patient outcomes. These rules provide a structured and evidence-based approach to clinical decision-making, reducing variability and promoting standardization in physiotherapy practice. This CPR improves the accuracy of diagnoses and treatment planning and helps monitor patient progress and evaluate treatment effectiveness. (4)

CPRs can also contribute to resource optimization and cost-effectiveness. By recognizing patients who are unlikely to gain significant benefits from specific interventions, it becomes possible to avoid unnecessary treatments, lowering healthcare costs and minimizing potential adverse effects. Moreover, CPRs can aid in

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp15-18 EISSN 2583-4304

determining the optimal duration and intensity of interventions, ensuring efficient use of resources while maximizing patient outcomes.

Furthermore, CPRs have the potential to facilitate interdisciplinary communication and collaboration. By providing a standardized framework and a common language for describing clinical variables and predicting outcomes, CPRs enable effective communication among healthcare professionals. This promotes shared decision-making, enhances interprofessional cooperation, and improves patient care. (5)

It is important to note that while CPRs offer valuable guidance, they should not replace clinical expertise and professional judgment. These rules are meant to complement, not replace, the knowledge and experience of physiotherapists. Clinicians must consider individual patient characteristics, preferences, and unique circumstances when applying CPRs in practice. (6)

BENEFITS OF CLINICAL PREDICTION RULES:

1.Enhanced Diagnostic Accuracy: CPRs enable physiotherapists to identify and classify patients more accurately, improving diagnostic precision. By integrating objective measures such as patient history, physical examination findings, and diagnostic tests, CPRs help differentiate between musculoskeletal conditions and guide appropriate treatment selection.

2.Optimized Treatment Planning: CPRs aid in tailoring treatment plans to individual patients by providing evidence-based recommendations for specific interventions. These rules consider factors such as patient characteristics, functional limitations, and response to previous treatments, allowing physiotherapists to choose interventions more likely to yield positive outcomes. This personalized approach enhances treatment efficacy and promotes patient satisfaction. (7)

3.Improved Clinical Decision-Making: By using CPRs, physiotherapists can make more confident and informed decisions regarding patient management. CPRs provide a standardized framework that guides clinicians in determining whether a patient will benefit from a specific intervention, making the decision-making process more transparent and evidence-based. This reduces variability in practice and promotes consistency among clinicians.

4.Resource Optimization: Clinical prediction rules help optimize the allocation of limited healthcare resources. By identifying patients most likely to benefit from specific interventions, CPRs enable physiotherapists to focus their efforts on those most likely to respond positively. This can improve patient outcomes while conserving resources by avoiding unnecessary treatments. (2)

CHALLENGES AND CONSIDERATION:

While clinical prediction rules offer numerous advantages, their implementation in clinical practice is not without challenges. Physiotherapists should consider the following:

1.Applicability and Generalizability: CPRs may have limitations regarding their applicability to diverse patient populations and settings. Validation studies are essential to ensure that CPRs apply to a wide range of patients and settings encountered by physiotherapists.

2.Incorporating Clinical Judgment:

Clinical prediction rules should be considered adjunctive tools rather than replacing clinical expertise and judgment. Physiotherapists should integrate CPRs with their clinical experience, patient preferences, and contextual factors to make well-rounded treatment decisions.

3.Ongoing Research and Updating: CPRs should be regularly updated and refined to incorporate emerging evidence and changes in practice. Physiotherapists should stay up-to-date with the latest research to ensure the optimal application of CPRs in their clinical practice. [8]

CONCLUSION:

Clinical prediction rules have emerged as valuable decision-making tools for physiotherapists, promoting evidence-based practice and enhancing patient care. By integrating CPRs into clinical reasoning, physiotherapists can improve diagnostic accuracy, optimize treatment planning, and enhance overall clinical decision-making. However, physiotherapists must recognize the limitations of CPRs and balance their use with clinical judgment. As research in this field continues to evolve, ongoing refinement and updating of CPRs will contribute to their effectiveness in supporting physiotherapists' evidence-based practice and improving patient outcomes.

REFERENCES:

1.Beneciuk JM, Bishop MD, George SZ. Clinical prediction rules for physical therapy interventions: a systematic review. Physical therapy. 2009;89(2):114-24.

2. Cowley LE, Farewell DM, Maguire S, Kemp AM. Methodological standards for the development and evaluation of clinical prediction rules: a review of the literature. Diagnostic and Prognostic Research. 2019;3(1):16.

3. Laupacis A, Sekar N, Stiell lG. Clinical Prediction Rules: A Review and Suggested Modifications of Methodological Standards. JAMA. 1997;277(6):488-94.

4. Childs J, Cleland J. Development and Application of Clinical Prediction Rules to Improve Decision Making in Physical Therapist Practice. Physical therapy. 2006;86:122-31.

5. Cook CE. Potential pitfalls of clinical prediction rules. The Journal of manual & manipulative therapy. 2008;16(2):69-71.

6. Wasson JH, Sox HC, Neff RK, Goldman L. Clinical Prediction Rules. New England Journal of Medicine. 1985;313(13):793-9.

7. Beattie P, Nelson R. Clinical prediction rules: what are they and what do they tell us? The Australian journal of physiotherapy. 2006;52(3):157-63.

8. Hunter BR, Carpenter CR. The development of clinical prediction rules. Doing Research in Emergency and Acute Care2015. p. 139-47.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp19-25 EISSN 2583-4304

URL:https://ijptrs.com/view-issue/105/Fulltext

DOI:https://ijptrs.com/public/images/content/239N1.pdf

1.Principal, K.G. College of Physiotherapy, 2. Assistant Professor, K.G. College of Physiotherapy, 3. BPT Intern, K.G. College of Physiotherapy(Affiliated to the Tamilnadu Dr. M.G.R Medical University), Coimbatore, Tamilnadu, India

Corresponding Author's Email: nithyadinesh59@gmail.com

Submission: 24th July 2023

Revised: 9th August 2023

Publish: 20th August 2023

Table of content

Effect of Plyometric training versus Calisthenics training on Vertical jump performance in Collegiate Volleyball players

Manoj Abraham M[1], Nithya N[2*], Sri Ram Kumar S G[3]

ABSTRACT

Background: Volleyball players need greater amount of physical fitness components as the game involves sudden change in directions inside the volleyball court. The training program for Volleyball players should enhance the sport – specific skills. As far as volleyball players are concerned, vertical jump is one of the most important physical fitness components. The effect of different training protocols on vertical jump performance has to be identified. The aim of the study was to analyse the effect of Plyometric training versus Calisthenics training on Vertical jump performance in collegiate volleyball players.

Materials and Methods: 30 collegiate volleyball players were selected according to the selection criteria and were divided into two groups with 15 subjects in each group. Subjects in Group A received Plyometric training and Subjects in Group B received Calisthenics training. Sargent jump test was used to measure vertical jump performance.

Results: An Independent sample 't' test was used to compare the two groups. The Statistical Analysis showed a significant difference in Sargent jump scores in Group A (M=55.09, SD=1.67) and in Group B (M=50.36, SD=1.35), t(28)= 8.54. The result suggests that Plyometric training group have shown significant improvement following training.

Conclusion: The study concludes that the Plyometric training is more effective in improving Vertical jump performance than Calisthenics training in collegiate volleyball players.

Keywords: Calisthenics training, Plyometric training, Volleyball players, Vertical jump performance.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp19-25 EISSN 2583-4304

INTRODUCTION

Volleyball is considered to be the famous team sport which is played in multi-direction. It is a very explosive and high paced sport in which the players are continuously moving inside the volleyball court.

Volleyball is a limited-contact sport that is played at all levels of skill and on multiple surfaces. The volleyball training programme requires a combination of aerobic fitness, flexibility, strength and power for enhanced sport-specific skills. Since the game is point-oriented, the player hits the ball in a fast pace between each other for gaining a point, the team who lets the ball down offers a point to the opponent. Volleyball involves many movements, like diving, short sprinting, lateral change of direction and most importantly, vertical jumping. Therefore, increasing vertical jump height is a critical factor for improving performance[1].

Volleyball is a very complex physically enduring sport that requires enough amounts of core strength as well as lower body strength to produce powerful vertical jumps as well as coordination for landing back on the ground due to the rapid postural movements and sway. Calisthenics is the form of an exercise training program based around your body weight, using minimal equipment[2].

The ultimate goal of Plyometric training is to improve the dynamic muscle performance and it can be accomplished by various exercises like hopping, skipping and jumping. Volleyball players do the movements like jumps, hops and lunges in a repeated manner. 6 weeks of Plyometric training has increased the root mean square EMG of vastus medialis, lateralis and hamstring muscles during countermovement jump (CMJ). Therefore, it was concluded that Plyometrics increases the dynamic athletic performance in terms of speed, agility, vertical jump and lower limb muscle activity[3].

Calisthenics are aerobic and dynamic exercises and are suitable for sedentary and also for older people. They are rhythmic, smooth, enjoyable exercises that are easy to perform alone or in a group format and can be modified according to subject's fitness levels. Calisthenics consist of a variety of simple movements that are intended to increase body strength and flexibility using the weight of one's own body as resistance[4].

The Vertical jump is most commonly related and highly necessary for the basic three skills in volleyball like blocking, serving and spiking. Vertical jump height plays a considerably different role in each of the three skills such as the vertical jump height during blocking action is a crucial part, whereas the vertical jump height during serving or spiking is a determinant for the sports success[5].

The effect of various training programs in volleyball players have been analysed in many studies but the effect of different training programs in player's vertical jump performance have not been identified. The aim of the study was to evaluate the effect of Plyometric training versus Calisthenics training on Vertical jump performance in collegiate volleyball players.

MATERIALS AND METHODS

It is a pre-test and post-test experimental study design. This study was conducted on 30 subjects at play-ground of

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp19-25 EISSN 2583-4304

K.G College of Physiotherapy, Saravanampatti, Coimbatore under the supervision of team trainer. The purpose and nature of the study was explained to each subject. A clear explanation was given about the procedures and a written consent form was obtained from each subject.

The subjects were included in this study based on the inclusion criteria [Collegiate volleyball players who were playing volleyball since 1 year, Male volleyball players, Age group of the subjects ranging between 18-26 years, BMI of the subjects ranging between 19-24, Subjects who were not involved in any specific training program for the past 6 months, No history of any injury for the past 2-3 months] and exclusion criteria [Subjects with cardio respiratory disorders, Subjects with orthopaedic and neurological impairments, Unwilling and uncooperative subjects]. The subjects were divided into two groups of 15 in each based on the purposive sampling method.

Subjects in Group A received Plyometric training in addition to their regular volleyball training, whereas the subjects in Group B received Calisthenics training in addition to their routine volleyball training. A standardized protocol for both Plyometric training and Calisthenics training were adopted and the players were trained accordingly. Each subject in both groups underwent training for 45 minutes per day for 3 days in a week for 12 weeks. Each subject had 10 minutes of warm up session and 10 minutes of cool down session.

The entire study was carried out for a period of 6 months and each subjects received training for twelve weeks. The baseline characteristic were similar in both groups. Pre and posttest evaluation of Vertical jump was measured using Sargent baseline characteristics were similar in both Jump test.

RESULTS

The demographic characteristics of all subjects including their age, height, weight, body mass index and the baseline values of Sargent Jump test scores are included in Table 1.

A comparison of the Sargent Jump Test scores measured at the baseline and during the final training session for both groups revealed that the Group A (subjects who received Plyometric training) has increased Vertical jump performance significantly when compared with Group B (subjects who received Calisthenics training) ($p<0.05$). A significant ($p<0.05$) increase in Vertical jump performance was observed by the end of the training session in both the groups (Table 2) (Figure 1).

DISCUSSION

A volleyball player who is inside the court has to be alert always to perform the necessary skills to remain active inside the court.

The purpose of the study was to compare the effect of Plyometric training and Calisthenics training on Vertical jump performance in collegiate volleyball players. 30 active collegiate volleyball players were selected according to the selection criteria and were divided into 2 equal groups in such a way that players in Group A received Plyometric training and players in Group B received Calisthenics training in addition to their routine volleyball training. Statistical analysis was done Independent sample ‘t’ test.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp19-25 EISSN 2583-4304

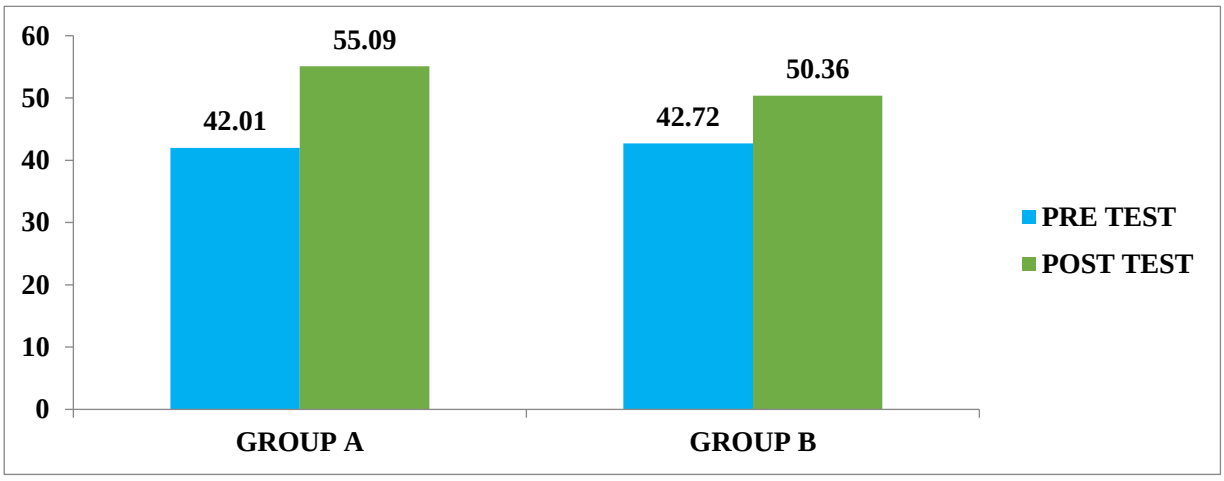
Table 1: Comparison of demographic characteristics of subjects in the Group A and Group B

Subject Characteristics	Group A Mean ± Standard Deviation	Group B Mean ± Standard Deviation
Age (years)	22.00 ± 2.54	22.40 ± 3.02
Height (cm)	177 ± 4.82	179.27 ± 4.23
Weight (kg)	79.47 ± 3.74	82.73 ± 5.56
Body Mass Index	23.31 ± 1.17	23.91 ± 1.07
Sargent Jump Test Score	42.01 ± 1.64	42.72 ± 1.52

Table 2: Comparison of Sargent jump test scores between the Group A and Group B using the independent t-test

Subject Characteristics	Group A Mean ± Standard Deviation	Group B Mean ± Standard Deviation
Sargent Jump Test Score	55.09 ± 1.68	50.36 ± 1.34

Figure 1: Comparison of the pre-test and post-test values of Sargent Jump Test Score in Group A and Group B



Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) July-August-September 2023 pp19-25 EISSN 2583-4304

Based on the results, paired 't' test have shown that there was a significant improvement in Vertical jump performance in both Plyometric training group and in Calisthenics training group following the respective training. Unpaired 't' test have shown that there was a significant difference between both Plyometric training group and Calisthenics training in their Vertical jump performance.

Sargent jump test used in this study is directly proportional to vertical jump measures. An alteration in the jump height will show a comparative change. These results support the earlier findings of a study which was done in 2012 and it proposed that the efficiency of the composed Plyometric training program on youth volleyball players improves the force capabilities in their usual training period[6]. Another study which was done in 2005, evaluated the correlation of 3 different parameters using various methods of Plyometric training in university level undergraduates. The study proved that Plyometric training can make the leg muscle stronger and increase the power significantly[7].

A study was conducted in 2013 which analysed about the AAHPER fitness test and Volleyball skills in players who had Calisthenics training. Seventy-six tenth-grade boys participated in one of the following three physical education classes for five weeks. The calisthenics consisted of strength, agility and flexibility exercises similar to a program warm-up of a high school volleyball classes consisted of drills and competition adapted within the scope of this study, it is concluded that daily Calisthenics class or a combination of Calisthenics and volleyball class caused greater improvements in muscular endurance, as measured by sit-ups and pull-ups than an all-volleyball class[8].

Plyometric training usually excites the muscle fibers (elastic part) and the connective tissue. This mechanism allows the muscle to store the energy during the entire deceleration phase and produce that same energy during the acceleration phase[9,10]. A study which was done in 2000, stated that Plyometric training increases the leg strength and also the vertical jump ability of players[9].

A previous study done in 2010, postulated that as a result of Plyometric training, one can find improved stretch-shortening cycle of the muscle, which in turn results in the enhancement of the musculotendinous and the neural unit and thereby produces maximum force in the shortest time[11].

The mechanism of adaptation which occurs following Plyometric training includes lengthening of both muscles and the tendons, considerable increase in the quantity of stored energy during the eccentric loading phase, stimulation of more number of motor units, improved neural firing rate and a consequent production of greatest power in the concentric phase and also improved joint proprioception[12].

A study was conducted about the effect of calisthenics exercises on the vertical jump height on intermediate female volleyball players. They added that in any sporting activity, the performance is influenced by the psychological status of that athlete. Calisthenics exercises helps in concentrating mind and body coordination. If done properly, it can reduce anxiety and enhance athletic performance. They stated that as a result, Calisthenics exercises show a significant effect on the strength of the vertical jump height of the female volleyball players when trained for 4 weeks under the fixed protocol[3].

Both groups had a better outcome because of the training regimen, but the group trained with Plyometric training is more effective than Calisthenics training on vertical jump performance.

The limitations of the study are as follows. The study was conducted on a smaller sample size and it included only male collegiate volleyball players. The scope of the study was limited due to short duration, it focused on two training techniques and one outcome measure was analyzed.

Further studies are recommended to include female volleyball players. Larger sample size and different training programs can be included. Elite volleyball players can be included in further studies. Other parameters like Agility and Flexibility can also be included.

CONCLUSION

In conclusion, Plyometric training is more effective in increasing vertical jump performance than Calisthenics training in collegiate volleyball players.

ACKNOWLEDGEMENT

The authors sincerely thank Dr. G. Bakthavathsalam, Chairman, Mrs. Vasanthi Raghu, Vice Chairman and Prof. V. Mohan Gandhi, CEO, KG Hospital, Coimbatore, Tamilnadu, India for their support and logistical help to conduct this research.

ETHICAL CLEARANCE – Institutional Ethical Committee, K.G. College of Physiotherapy, Coimbatore, Tamilnadu, India.

SOURCE OF FUNDING – Self.

CONFLICT OF INTEREST – Nil.

REFERENCES

1. Kumar A, Jadiya MK. The Effect of Plyometric Training and Strength Training among Male College Volleyball Players - A Comparative Study. Indian J Youth Adol Health. 2021;8(3):15-19. DOI: http://doi.org/10.24321/2349.2880.202114.

2. Niharika V Ramanarao Cintre, Dr. Ronald Prabhakar, Dr. Archana Methe. Effect of calisthenics exercises on the vertical high jump on intermediate female volleyball players. Int J Phys Edu Sports Health 2022;9(3):93-96.

3. Sozbir Kerim. (2016). Effects of 6-Week Plyometric Training on Vertical Jump Performance and Muscle Activation of Lower Extremity Muscles. The Sport Journal.

4. R Srivastava, Effect Of Pilates, Calisthenics And Combined Exercises On Selected Physical Motor Fitness, 1st edition Isara Publications. 2016.

5. Lian O, Refsnes PE, Engebretsen L, Bahr R. Performance characteristics of volleyball players with patellar tendinopathy. Am J Sports Med 31: 408-413, 2003.

6. Vassil, K., & Bazanovk, B. (2012). The effect of plyometric training program on young volleyball players in their usual training period. *Journal of Human Sport and Exercise*, 7(1), S34-S40.

7. Abass AO. Correlational effects of plyometric training on leg muscle strength, endurance and power characteristics of Nigerian University undergraduates. Int J African African Am Studies 2005; 4(1): 42-52.

8. B Don Franks A, George C, Moore B. Effect of calisthenics and volleyball on the

IJPTRS Vol 2(3) July-August-September 2023 pp19-25 EISSN 2583-4304

AAHPER fitness test and volleyball skill. American journal of health, physical education, and Recreation. 2013;40(2):288-292.

9. Fatouros IG, Jamurtas AZ, Leontsini D, Taxildaris K, Aggelousis N, Kostopoulos N, et al. Evaluation of Plyometric Exercise Training, Weight Training, and Their Combination on Vertical Jumping Performance and Leg Strength. *J Strength Cond Res*. 2000;14(4):470-6.

10. Markovic G. Does plyometric training improve vertical jump height? A meta-analytical review. *Br J Sports Med*. 2007;41(6):349-55.

11. Markovic G, Mikulic P. Neuro-musculoskeletal and performance adaptations to lower-extremity plyometric training. *Sport Med*. 2010;40(10):859-95.

12. Moran J, Sandercock GRH, Ramirez-Campillo R, Todd O, Collison J, Parry DA. Maturation-related effect of low-dose plyometric training on performance in youth hockey players. *Pediatr Exerc Sci*. 2017;29(2):194-202.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

Effectiveness of Multisensory balance training versus Vision deprived balance training on balance and gait speed in stroke patients – A Comparative study.

URL: https://ijptrs.com/view-issue/104/Fulltext

DOI:https://ijptrs.com/public/images/content/191Rutuja.pdf

1.MPT (neurosciences physiotherapy), 2.HOD, MPT neurophysiotherapy, 3. Principal, MPT musculoskeletal Physiotherapy, PES Modern college of physiotherapy, Pune, Maharashtra, India.
Corresponding author: Dr. Rutuja Indapure
Email: rutujaindapure@gmail.com

Submission: 24th August 2023

Revised: 4th September 2023

Publish: 14th September 2023

Table of content

Dr. Rutuja Indapure1, Dr. Abhijit Satralkar2, Dr. Sucheta Golhar3.

ABSTRACT

Background: India has high Stroke prevalence. Stroke causes motor & sensory loss which contributes to balance & gait impairment. Multisensory exercises & Vision deprived training helps re-train sensory pathway & regain function. Many individual studies have been conducted but there is limited evidence on which training program is more effective. Thus, present study aimed at comparing 2 exercise protocol to find out which is more effective on balance & gait speed. **Material & methodology**: With ethical clearance & written consents,40 (aged 40-60 years), were selected & randomly assigned to 2 groups by chit method: Group A (evens)[multisensory training] & Group B(odds)[vision deprived training]. Pre & post (after 6 weeks) assessment done, for balance = Berg's balance scale & gait speed = 10 Meter walk test.

Group A→ 5 minutes = warm up, 30 minutes = multisensory balance training program

Group B→ 5 minutes = warm up, 30 minutes = vision deprived balance training.

Analysis→ within group = paired t test & between group = unpaired t test. **Result**: Within groups showed significant difference (p=0.00). On comparison, between groups showed no significant difference for balance (p= 0.85) & gait speed (p=0.94). **Discussion**: multisensory training activates the proprioceptive and somatosensory system. Vision deprivation causes compensatory plastic changes in the brain that is in the absence of one sensory system the other systems take charge to help the brain adjust to the changes. **Conclusion**: Both training program are equally effective on balance & gait speed in stroke patients.

Keywords: Balance, Gait speed, Multisensory training**,** Stroke, Vision Deprived Balance Training, Berg's balance scale

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

Introduction

In low- and middle-income countries like India, Stroke caused an estimated 5·7 million deaths in 2005. The number of global deaths is projected to rise to 6·5 million in 2015 and to 7·8 million in 2030 (Strong et al (2007), p. 182). Stroke is one of the leading cause of death and disability in India. The estimated adjusted prevalence rate of stroke range is 84-262/100,000 in rural and 334-424/ 100,000 in urban areas (Pandian & Sudhan, 2013, p. 128). The World health organization defines stroke as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origins"(Truelsen et al(2000), para. 1.1.1).

Stroke is characterized by sudden loss of neurological function caused by an interruption of blood flow to the brain. Changes in level of consciousness, sensory, motor, cognitive and perceptual impairments are seen post stroke. Motor defects are characterized by paralysis (hemiplegia) or weakness (hemiparesis) on the side of the body, opposite to the side of the lesion. Gait is altered post stroke. Balance is disturbed following stroke with impairments in alignment, stability, symmetry (O'Sullivan et al (2014)). Stroke hampers the quality of life of a patient. It is seen that about 40% of physical domain, 55% of psychological domain, 75% of social domain and 50% of environmental domains of health related quality of life was poor following stroke(Shetty et al(2016),p.10). It is seen that in stroke patients balance impairment is associated with lower quality of life (Schmid et al (2015),p.340).

Balance is the condition in which all the forces acting on the body are balanced such that the center of mass is within stability limits, the boundaries of the base of support. Stroke patients usually show uneven weight distribution and increased postural sway in standing(O'Sullivan et al (2014). Postural instability in hemiplegic patient is seen in both directions that is Antero-posterior& Medio-lateral (Corriveau et al, 2004,p.1099). This is due to disruption to the central sensory motor processing that lead to inability to recruit postural strategies and adapt postural movements to changing task and environmental demands (O'Sullivan et al (2014).

Grace Vincent et al (2018,p.3) found that there is 36.8% prevalence of balance impairment following stroke. Balance is a complex process which requires input from the somatosensory systems, visual, vestibular, and general exterosensibility, in order to generate a motor response allowing the transition between dynamic and static activities. Balance training is utilization and integration of these systems. Hence it is postulated that the balance training in stroke may be a useful exercise and may result in better out comes and improved function (Woollacott & Shumway-cook, 2001).

A study done by A. Middleton et al (2017,p.8) concluded that individuals with chronic stroke are already walking "at capacity" in the community and, as a result, are unable to increase their walking speed in response to environmental demands. The inability to increase walking speed on demand may limit these individuals' ability to be functional ambulators in the community. Balance is a significant contri-

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

butor to the ability to increase walking in individuals with chronic stroke.

Gait is defined as the manner in which a person walks(eg. Cadence, step length, stride length, speed and rhythm (O'Sullivan et al (2014)). The hemiparetic gait shows decreased velocity and cadence and increased double limb support (Von Schroeder et al,1995,p.25).Walking is an incredibly complex task. A majority of the gait cycle is spent in single leg stance and during this phase, the center of mass is traveled outside the margin of stability, thus making this phase inherently unstable, Therefore, balance recovery is critical to having a stable and safe ambulation (Middleton et al,2017,p.6[1].Kara K Patterson et al (2008,p.304) found that 55.5% community dwelling stroke participants showed statistically significant temporal asymmetry and 33.3% exhibited statistically significant spatial asymmetry.

Multisensory stimulation approach is a therapeutic program that uses sensory stimulation and helps to recover functional sensibility in the affected area and learn adaptive functioning (Misha & Velmurugan,2017,p.369).
Multisensory teaching combines three learning senses, auditory (hearing and speaking), visual (seeing and perceiving), and kinesthetic (touch and movement (Nissee Neelima Raj et al,2016,p.558).
Nicola S et al (2008,p.318) concluded that physical therapy program focusing on balance rehabilitation in patients with chronic hemiplegia should include exercises performed in sensory challenging conditions. In a study conducted by Majeed kutty & Latheef Majida (2013,p.79) showed that multisensory balance training caused significant improvement in gait and balance in diabetic patients.

Conventional physiotherapy balance training exercises with masked vision is vision deprived balance training.
Compared to conventional physical therapy exercises, blindfold balance training, a sensory motor stimulation based on visual deprivation is able to modify gait parameters (Bonni et al ,2018,p.12.The results of the study conducted by Jibi Paul (2014,p.52) show that conventional therapy along with masked vision could bring about significant changes in balance, mobility and function of patients suffering from balance impairment post stroke .A study conducted by Bonan et al (2004) concludes that Vision overuse may be a compensatory strategy for coping with initial imbalance by traditional rehabilitation, hence vision deprived rehabilitation improves balance more effectively than balance with free vision. Masked vision enhances concentration through the somatosensory pathway towards promotion of balance through sensory re-education.
As previously conducted studies prove effect of individual training program on various parameters of balance and gait in stroke patients, this study aims to compare the effects of multisensory balance training and vision deprived balance training on balance and gait speed at the end of 6 weeks of intervention based on the following hypothesis:

- Null hypothesis(H0)- Both multisensory balance training and vision deprived balance training will be equally effective on balance and gait speed in stroke patients.
- Alternate hypothesis (H1) – Multi-sensory balance training is more effective than vision deprived balance

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

balance training on balance in stroke patients.

- H2- Multisensory balance training is more effective than vision deprived balance training on gait speed in stroke patients.
- H3-Vision deprived balance training is more effective than multisensory balance training on balance in stroke patients.
- H4- Vision deprived balance training is more effective than multisensory balance training on gait speed in stroke patients.

Materials & Method

This experimental study consisted of 2 active groups with total of 20 subjects in each group and was conducted in hospitals and rehabilitation centers, old age homes in and around the city, over a span of 6 weeks. The target population for the study were subjects diagnosed with stroke (>6months) (O'Sullivan et al (2014).
Selection criteria for the study was as follows:
Inclusion criteria:

1. Demographic characteristics = subjects with Age = 40 to 60 years(Tripathi & Vibha,2010), Gender=Both males and females were included.

2. Population= Presence of stroke for more than 6 months(O'Sullivan et al (2014)

3. Clinical characterisrics- Subjects able to walk 10 meters independently with or without assistive device (Flansbjer et al,2005), who had a Mini mental score >24(lee et al,2014) and Bergs

4. balance score < 40(O'Sullivan et al (2014) with intact Sensations were included.

Exclusion criteria:

1. Recent injuries- Patients having musculoskeletal or surgical problems of lower extremity which affect mobility. Eg. Recent (within 6 months) fractures, dislocations (Jibi Paul (2014)), were exluded.

2. Co-morbid conditions- Cardiovascular (uncontrolled high blood pressure, diabetes), respiratory problems like dyspnea (Kutty & Majida, 2013) were excluded.

3. Other neurological conditions- like brain tumor, demyelinating disease (Basheer KB et al, 2018) were excluded.

4. Other disorders: Subjects with auditory and vestibular disorders(Flansbjer et al,2005) were excluded.

Procedure:

The subjects who met the selection criteria were included in the study and were randomly divided in 2 groups using a random chit method, on the basis of patient's arrival. A written consent was obtained from the patient /guardian at the beginning of the study. All the subjects underwent a pre intervention testing for balance and gait speed followed by a 6 weeks training program. Post intervention test results for balance and gait speed in both groups was collected at the end of 6 weeks.

Intervention details:

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

Group A consisted of 20 subjects who underwent multisensory balance training [MBT](Kutty & Majida (2013) . The exercise program consisted of:

1. Walking on firm surface (floor) - forward, backward and side walk
2. Walking on soft mattress - forward, backward and side walk
3. Walking on foam mattress - forward, backward and side walk
4. Challenges from obstacle
5. Unipedal stance on firm
6. Unipedal soft surface,
7. Double leg stance on firm surface,
8. Tandem standing on firm surface
9. Tandem walking on firm surface and
10. Rising from the chair without use of hands.

Exercise frequency: 3 times/ week, for 6 weeks (Kutty & Majida (2013).

Exercise duration: 30minutes per day (Grace Vincent et al (2018),

Photograph: Rising from the chair without use of hands

Group B consisted of 20 subjects who underwent Vision deprived balance training [VDBT] (Jibi Paul (2014)). A blindfold was used to mask the vision. The exercise program consisted of balance exercises with masked vision in different positions:

1.Supine position: bilateral bridging, unilateral bridging, side turning exercises

2.Sitting position: manual perturbations and chair sit to stand in sitting position;

3.Standing position: forward, backward and side walking.

Exercise frequency: 3 times/week for 6 weeks (Bonni et al ,2018).

Exercise duration: 30 minutes per day (Von Schroeder et al ,1995)

Progression: The exercises were progressed with additional 5 repetitions after every 2 weeks for 6 weeks (Jibi Paul (2014), as follows- 1-2 week=10 repetition, 2-4 week=10+5(=15) repetition, 4-6 week=15+5(=20) repetition.

Photograph: Bilateral bridging with masked vision

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

Outcome measures:

1. Berg's balance scale (berg at al,1992) was used for measuring balance.
Administration: Instructions were given verbally, demonstrated and repeated to patients, performance was observed and

noted. Interpretation: score below 45 indicates fall risk.
2. 10-meter walk test was used for measuring gait speed (Palmer,2015)**.** Administration: The total marked distance was 14 meters and the subjects were timed over the middle 10 meters. Standing behind the first mark (0 meters), the subjects were instructed to walk to the last mark (14 meters) and were informed that they would be timed for middle part (from 2 meter – 12 meter) of the walkway. The subjects were told to walk at a self-selected comfortable pace ("like walking in the park") (shamay S.M.Ng et al,2012). Interpretation: The minimal detectable change in gait speed (at comfortable pace) is 0.15 meters/second in stroke (Tyson & Connell,2009)The collected data was analyzed using the statistical software IBM SPSS statistics 20.0

Results

In this study, no statistically significant difference was found on comparing the pre-post values of Berg's balance scale(BBS) (Table1) and 10 meter walk test(10MWT) (Table 2) in both groups. The analysis was done using unpaired t test in terms of mean ± SD. Level of significance was fixed at p=0.05 and any value less than or equal to 0.05 was considered to be statistically significant. This indicated that both the training programs had equal effect on balance and gait speed.

Table 1: Comparison of bergs balance scale values in terms of {Mean (SD)} among both groups using unpaired t test.

Group	Pre BBS (Mean± SD)	Post BBS (Mean± SD)	t value	p value	Results
Multisensory	36.25 ± 4.972	40.65 ± 5.8694	1.791	0.081	**Not significant**
Vision deprived	33.10 ± 6.905	37.65 ± 6.869			

(p > 0.05 = Not Significant)

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

Table 2: Comparison of 10-meter walk test values in terms of {Mean (SD)} among both groups using unpaired t test

Group	Pre 10MWT (gait speed) (m/sec) (Mean ±SD)	Post 10MWT (gait speed) (m/sec) (Mean ± SD)	t value	p value	Results
Multisensory	0.2530 ± 0.03028	0.2770 ± 0.03097	0.502	0.619	**Not significant**
Vision deprived	0.2585 ± 0.03856	0.2845 ± 0.04045	0.658	0.514	

(p > 0.05 = Not Significant)

However, the study found that within group comparison of individual training program showed statistically significant difference when analyzed using paired t test in terms of mean ± SD. Level of significance was fixed at p=0.05 and any value less than or equal to 0.05 was considered to be statistically significant.

In group A, pre-post values of Berg's balance scale (BBS) and 10 meter walk test(10MWT) show significant difference, indicating improvement in balance and gait speed post 6 weeks training with multisensory balance exercise program (Table 3).

Table 3: Within group comparison of bergs balance scale and 10MWT (pre–post) values in terms of {Mean (SD)} in group A (MBT) using paired t test

Variable	Pre (Mean± SD)	Post (Mean± SD)	t value	p value	Result
Bergs balance scale test	36.25 ± 4.972	42.25 ± 6.414	11.937	**0.000***	**Significant**
10-meter walk test	0.2530 ± 0.03028	0.2770 ± 0.03097	5.022	**0.000***	**Significant**

(p > 0.05 = Not Significant*)

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

In group B pre-post values of Berg's balance scale(BBS) and 10 meter walk test(10MWT) show significant difference, indicating improvement in balance and gait speed post 6 weeks training with vision deprived balance exercise program (Table 4).

Table 4: Within group comparison of bergs balance scale and 10MWT values (pre-post) in terms of {Mean (SD)} in group B (VDBT) using paired t test

Variable	Pre (Mean± SD)	Post (Mean± SD)	t value	p value	Result
Bergs balance scale test	33.10 ± 6.095	37.65 ± 6.869	6.784	**0.000****	**Significant**
10-meter walk test	02585 ± 0.03856	0.2845 ± 0.04045	4.183	**0.00***	**Significant**

(p > 0.05 = Not Significant)

Discussion

The main objective of the study was to compare the effects of two different balance training exercises on balance and gait speed in stroke patients. Sensory information from somatosensory, visual and vestibular systems must be integrated to interpret complex sensory environments. As subjects change the sensory environment, they need to re-weight their relative dependence on each of the senses. (Horak,2006,p.ii9). the multisensory exercises and vision deprived exercise target the patients sensory system, thus making them prone to use the available sensory inputs to integrate a postural control response.

Postural control is a complex skill based on the interaction of dynamic sensorimotor processes. The two main functional goals ofpostural behaviour are postural orientation and postural equilibrium. Postural orientation involves the active alignment of the trunk and head with respect to gravity, support surfaces, the visual surround and internal references. Sensory information from somatosensory, vestibular and visual systems is integrated, and the relative weights placed on each of these inputs are dependent on the goals of the movement task and the environmental context. Postural equilibrium involves the coordination of movement strategies to stabilise the centre of body mass during both self-initiated and externally triggered disturbances of stability(Horak,2006,p.ii7).

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

In the present study, on comparing the multisensory exercise with vision deprived exercise we found that there was no significant difference seen between both the groups for balance (p =0851) and gait speed (p=0.948). We conclude that both the exercise regimen i.e multisensory balance training and vision deprived balance training were equally effective on balance and gait speed in stroke patients at the end of 6 weeks of intervention. Thus proving the null hypothesis (H0). This is in accordance with the study conducted by Alain. Y et al (2008) who concluded that there were significant differences seen in within group comparison of the balance and walking parameter, but on comparison no evidence was found for superiority of either of the exercises protocol on balance in stroke patients.

The present study was unsuccessful in providing a statistical significant results on comparing both the groups. The possible reason could be a small sample size that created less scope to get a combined effect. However, the present study was able to successfully conclude that the individual training program had a significant effect on balance and gait speed.

Based on the previous study that say, hemiplegic patients are dependent excessively on vision for balance and stability (Bonan et al (2004)), we made the hypothesis that vision deprived balance training can be effective in improving balance and gait speed in stroke patients. A study conducted by Jung-Hee Kim and Eun-Young Park (2013,p.4) states that balance has an effect on the activities of daily living and interventions that use balance training could be the most effective for improving activities of daily living in community-dwelling stroke patients. In this study we found out that within group comparisons of group A (multisensory balance training) and Group B (vision deprived balance training) for balance and gait speed in stroke patients were found to be significant at the end of 6 weeks of intervention.

The improvements in balance seen in the present study can be explained as , deficit of the central integration of sensory inputs (somatosensory, visual and kinesthetic) lead to balance impairment following stroke (Nicola S et al (2008,p.313), during the multisensory training various inputs through tandem standing , one leg stand and tandem walking activate the proprioceptive system and through use of different surfaces for walking (soft, foam and firm)activates the somatosensory system (Kutty & Majida, 2013,p.84). The vision deprived training will allow the individual to make use of the somatosensory and kinesthetic system more than vision to maintain balance. All this provides a challenging environment for the sensory system thus improving the outcome (Nicola S et al (2008,p.318).

Multisensory processes can not only improve learning and memory under ‘normal’ circumstances but also create opportunities for remediation in cases of sensory loss via their highly plastic and dynamic representational abilities (Murray et al,2016,vol.39,p577).

By training the different sensory systems separately and combined, the subjects learned to rely on the most appropriate sensory information and suppress those which are more undependable. In this manner, proprioceptive adaptation and sensory-motor coupling mechanism were stimulated(Kristinsdottir & Baldursdottir,2013,p.1215-1216)..

The results of the present study are is in accordance with the study conducted by

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 2(3) Julyl-August-September 2023 pp 26-38 E-ISSN 2583-4304

Addie Middleton et al (2018) who proved that balance exercises are effective in improving walking speed in stroke patients. It is also seen that balance is a significant contributor to the ability to increase walking speed in individuals with chronic stroke (Middleton et al,2018). Improvement in balance correlates well with improvement in gait speed as concluded by bonan et al(2004). The results of this study are also in accordance with the study conducted by Kutty & Majida (2013) who proved that multisensory balance training is effective in improving balance.

The present study concludes that vision deprived balance training is effective in improving balance which is in accordance with the results of the study conducted by jibi paul (2014). This can be explained as proprioception and somatosensory pathway has been found to contribute to the vision deprived therapy to a great extent as stroke patients are disabled by the weakness persisting after stroke; deprived visual feedback promotes the use of affected side and prevents the compensatory over use adaptability (Basher K B et al,2018,p.4).

Vision deprivation causes compensatory plastic changes in the brain through cross modal reorganization i.e in the absence of one sensory system the other systems take charge to help the brain adjust to the changes (lazzouni & Lepore,2014).

Sustained severe perturbations of visual experience may induce functional and structural plastic changes. Thus, sensory experience shapes functional and structural brain organization (Noppeney,2007,p.1177) leading to enhanced motor learning.

This is supported by the results of the study conducted by Kim & Moon (2015) who concluded that, treadmill training with eyes close was found to be effective in improving balance and gait than the treadmill training with eyes open in stroke patients. Therefore, treadmill walking with visual deprivation may be useful for the rehabilitation of patients with chronic stroke.

The results of the study conducted by Sung Jun Moon et al (2012,p.411) provide an explanation for the present study by concluding that visual cue deprivation improves gait speed, step length, step time, functional ambulatory performance in stroke patients.

Thus we conclude that 6 weeks of multisensory balance training and vision deprived balance training protocols can be used as an effective tool in improving balance and gait speed and also enhancing motor learning in stroke patients.

Conclusion:

The study findings conclude that on comparison, both the balance training program were equally effective in improving balance and gait speed in stroke patients. However, the individual balance training program showed significant improvement in balance and gait speed in stroke patients. Hence, based on the study findings, it is recommended that systemic stimulation of sensory systems should be included in rehabilitation protocol to improve postural control for overall maintenance of balance and gait in stroke survivors.

Stroke has a lot of impact on activities of daily living and quality of life which in turn affect the balance and gait and overall wellbeing. Taking these factors into consideration in further research with a relatively bigger sample size would be helpful in better formation of an inclusive rehabilitation protocol.

Acknowledgement

I wish to express my sincere gratitude to the Principal, Dr. Sucheta Golhar and the ethical committee, my project guide, Dr. Abhijit Satralkar, for his precious time and guiding me to carry out my thesis successfully. I express my deepest gratitude to all the participants who put a lot of effort in fulfilling the physical demands of the exercise and for their active participation and cooperation and their valuable time. Without them this dissertation would have not been successful. I would like to take this opportunity to thank my parents and my colleagues who were there when needed.

Conflicts of Interest: Authors have no conflict of interest to declare.

References:

1. Berg KO, Maki BE, Williams JI, Holliday PJ, Wood-Dauphinee SL. (1992). Clinical and laboratory measures of postural balance in an elderly population. Archives of physical medicine and rehabilitation, 73(11), 1073–1080.

2. Bonan IV, Colle FM, Guichard JP, Vicaut E, Eisenfisz M, Huy PT, Yelnik, A. P. (2004). Reliance on visual information after stroke. Part I: Balance on dynamic posturography. Archives of physical medicine and rehabilitation, 85(2), 268–273.

3. Bonan IV, Yelnik AP, Colle FM, Michaud C, Normand E, Panigot B, Roth P, Guichard JP, Vicaut E. (2004). Reliance on visual information after stroke. Part II: Effectiveness of a balance

4. Rehabilitation program with visual cue deprivation after stroke: a randomized controlled trial. Archives of physical medicine and rehabilitation, 85(2), 274–278.

5. Bonnì S, Ponzo V, Tramontano M, Cinnera M, Caltagirone C, Koch G, Peppe A. (2018). Neurophysiological and clinical effects of blindfolded balance training (BBT) in Parkinson's disease patients: a preliminary study. European journal of physical and rehabilitation medicine, 55(2), 176–182.

6. Downs S., Marquez, J, & Chiarelli, P. (2013). The Berg Balance Scale has high intra- and inter-rater reliability but absolute reliability varies across the scale: a systematic review. Journal of physiotherapy, 59(2), 93–99.

7. Flansbjer, U. B., Holmbäck, A. M., Downham, D., Patten, C., & Lexell, J. (2005). Reliability of gait performance tests in men and women with hemiparesis after stroke. Journal of rehabilitation medicine, 37(2), 75–82.

8. Horak FB. (2006). Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls?. Age and ageing, 35 Suppl 2, ii7–ii11.

9. Kim, J. H., & Park, E. Y. (2014). Balance self-efficacy in relation to balance and activities of daily living in community residents with stroke. Disability and rehabilitation, 36(4), 295–299.

10.Kim, Y. W., & Moon, S. J. (2015). Effects of treadmill training with the eyes closed on gait and balance ability of chronic stroke patients. Journal of physical therapy science, 27(9), 2935–2938.

11. Kristinsdottir EK, Baldursdottir B. (2014). Effect of multi-sensory balance training for unsteady elderly people: pilot study of the "Reykjavik model". Disability and rehabilitation, 36(14), 1211–1218.

12. Kutty, N. A., & Majida, N. A. (2013). Effects of Multisensory Training on Balance and Gait in Persons with Type 2 Diabetes: A Randomised Controlled Trial. Disability, CBR & Inclusive Development, 24(2), 79–91.

13. Lazzouni, L., & Lepore, F. (2014). Compensatory plasticity: time matters. Frontiers in human neuroscience, 8, 340.

14. Lee, Y., Her, JG., Choi Y., Kim, H. (2014). Effect of Ankle-foot Orthosis on Lower Limb Muscle Activities and Static Balance of Stroke Patients Authors' Names. Journal of physical therapy science, 26(2), 179–182.

15. Middleton A., Braun C. H., Lewek MD., Fritz, SL. (2017). Balance impairment limits ability to increase walking speed in individuals with chronic stroke. Disability and rehabilitation, 39(5), 497–502.

16. Moon S., Kim Y., Kim, T. (2012). The Effects of Balance Training with Visual Cue Deprivation on Gait Function in Patients with Stroke. Journal of Korean society of physical medicine, 7(4), 411-421.

17. Murray MM., Lewkowicz DJ., Amedi A., Wallace MT. (2016). Multisensory Processes: A Balancing Act across the Lifespan. Trends in neurosciences, 39(8), 567–579.

18. Ng SS, Ng PC, Lee CY, Ng ES, Tong MH. (2012). Walkway lengths for measuring walking speed in stroke rehabilitation. Journal of rehabilitation medicine, 44(1), 43–46.

19. Noppeney U. (2007). The effects of visual deprivation on functional and structural organization of the human brain. Neuroscience and biobehavioral reviews, 31(8), 1169–1180.

20. O'Sullivan SB, Schmitz TJ, Fulk GD. (2014). Physical rehabilitation (6th ed.). F.A. Davis.

21. Palmer E, M atlick D, Council RO. (2015). 10 meter walk test. EBSCO: Cinhal information systems,10-15.

22. Pandian JD, Sudhan P. (2013). Stroke epidemiology and stroke care services in India. Journal of stroke, 15(3), 128–134.

23. Patterson KK, Parafianowicz I, Danells CJ, Closson V, Verrier MC,Staines WR, Black SE, McIlroy WE. (2008). Gait asymmetry in community-ambulating stroke survivors. Archives of physical medicine and rehabilitation, 89(2), 304–310.

24. Paul J, Balakrishnan P, Izham M. (2014). Comparative effect of vision deprived balance training over free vision balance training among stroke subjects. International Journal of Physiotherapy, 1(2), 46–53.

25. PM Misha, Velmurugan G. (2017). Effects of multisensory exercises on improving physical function and reducing number of falls in subjects with diabetic

neuropathy. International Journal Medical and Exercise Science, 03(03), 367–378.

26. Raj Y, Neelima N, Vadivelan K, Sivakumar VP. (2016). Comparison of Multisensory Versus Strengthening exercises on Functional Mobility and Balance in Elders. International Journal of Physiotherapy, 3(5), 507-511.

27. Riyas Basheer K B, Sukumar S, Deepu S Chandran, Purusotham chippala. (2015). Effects of unstable surface task oriented training and visual deprived balance training in hemiparetic individuals: A comparative study. Kerala, India.

28. Schmid AA., Van Puymbroeck M, Altenburger PA, Miller KK, Combs SA, Page SJ. (2013). Balance is associated with quality of life in chronic stroke. Topics in stroke rehabilitation, 20(4), 340–346.

29. Shetty S, Kundapur R. (2016). Quality Of Life in Stroke Patients - A Qualitative Study. Journal of Health and Allied Sciences, 06(04), 10–13.

30. Smania N, Picelli , Gandolfi M, Fiaschi A, Tinazzi M. (2008). Rehabilitation of sensorimotor integration deficits in balance impairment of patients with stroke hemiparesis: a before/after pilot study. Neurological sciences, 29(5), 313–319.

31. Strong K, Mathers C, Bonita R. (2007). Preventing stroke: saving lives around the world. The Lancet. Neurology, 6(2), 182–187.

32. Tripathi M., Vibha D. (2011). Stroke in young in India. Stroke research and treatment, 2011.

33. Truelsen T, Begg S, Mathers C. (2000). The Global Burden of Cerebrovascular Disease. World Health Organization.

34. Tyson S, Connell L. (2009). The psychometric properties and clinical utility of measures of walking and mobility in neurological conditions: a systematic review. Clinical rehabilitation, 23(11), 1018–1033.

35. Vincent-Onabajo G, Musa HY, Joseph E. (2018). Prevalence of Balance Impairment Among Stroke Survivors Undergoing Neurorehabilitation in Nigeria. Journal of stroke and Cerebrovascular diseases, 27(12), 3487–3492.

36. Von Schroeder HP, Coutts RD, Lyden PD, Billings E, Nickel VL. (1995). Gait parameters following stroke: a practical assessment. Journal of rehabilitation research and development,32, 25–31.

37. Woollacott M, Shumway-Cook A. (2002). Attention and the control of posture and gait: a review of an emerging area of research. Gait & posture, 16(1), 1–14.

38. Yelnik AP, Le Breton F, Colle FM, Bonan IV, Hugeron C, Egal V, Lebomin E, Regnaux JP, Pérennou D, Vicaut E. (2008). Rehabilitation of balance after stroke with multisensorial training: a single-blind randomized controlled study. Neurorehabilitation and neural repair, 22(5), 468–476.

Managing Editor
Indian Journal of Physiotherapy and Rehabilitation Science (IJPTRS)
E: e.ijptrs@gmail.com, w: https://www.ijptrs.com/