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Effects of short bouts of stair climbing on fitness fatness index among overweight individuals

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ABSTRACT

Background: Overweight is an important public concern. The future prevalence of overweight in India to 2040 among adults aged 20-69 years. Fitness Fatness Index (FFI) is a recently developed index that is used to predict cardiovascular disease (CVD) risk. This study focused on the Effects of Short bouts of stair climbing on Fitness Fatness Index among overweight individuals.
Materials & Methods: A total of 36 subjects were included and divided into two groups group A and Group B. Group A underwent a short bout of stair climbing training for 3 times per day, 3 days a week, a total of 54 training sessions over 8 weeks. Group B is a control group. Fitness Fatness Index was calculated by the ratio between cardiorespiratory fitness (submaximal test) and waist-to-height ratio.
Results: There was a significant difference between the Pre and Post-test scores between group A and Group B when evaluated with submaximal exercise test for cardiorespiratory fitness (VO_2max) and waist-to-height ratio. A statistically significant improvement was obtained in Group A (Mean-18.79 and 22.89) with $p < .05$ who underwent the training when compare with control group.
Conclusion: Based on the results short bout of exercise have improved the cardiorespiratory fitness among overweight individuals. The study concluded that there is a significant effect on Fitness Fatness Index stress among overweight individuals by short bout of stair climbing training. These results are obtained in comparison with the control group.
Keywords: Cardiorespiratory fitness, Fitness Fatness Index, Overweight, Short Bout of Stair Climbing.

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INTRODUCTION

Overweight is a public health issue. According to the World Health Organization (WHO), in 2020, the global overweight prevalence was 38%. Future prevalence of overweight among adults (20-69 years of age) in India by 2040. (Shammi Luhar, et al., 2020). Overall, the overweight prevalence among Indian adults between the ages of 20-69 is expected to rise by approximately 2-fold from 2010 to 2040. Patients who are overweight and obese may have a better outcome than their peers with normal body mass index (BMI) after developing clinical cardiovascular disease (CVD). Fitness Fatness Index (FFI) is a recently developed index that is used to predict cardiovascular disease (CVD) risk. It is a measure of the ratio between an individual's cardiorespiratory fitness (CRF) and waist-to-height ratio (Daniel J. Leahy et al., 2022). Short bouts of Stair climbing increase Cardiorespiratory Fitness in young sedentary adults. Studies have shown that stair climbing is safe and beneficial. Minor alterations in physical activity levels (e.g., stair climbing) in sedentary populations (Valentino, Sydney E., et al) improve VO2max and improve weight loss in overweight adults (W. Daniel Schmidt, PhD, et al.,) (Ina Shaw et al.,2020).

Physical activity has long been recognized as an important part of maintaining good health and preventing illness (Shephard RJ). Despite this, a significant proportion of adults in most developed nations are not physically active enough to achieve any significant health and fitness outcomes (Blair SN). It has also been suggested that promoting physical activity among previously inactive individuals may be the most effective way to prevent cardiovascular disease on a population level(Caspersen CJ, Heath GW). According to current physical activity guidelines, every adult should do 30 minutes of moderate-intensity physical activity most, if not all, five days a week. (Blair SN, et al). Accumulating exercise in short bursts throughout the day is one of the strategies recommended to achieve this activity goal. This approach has been tested experimentally with 10-minute bouts of activity (Murphy MH., et al.,). However, so far only one study on stair climbing has demonstrated that accumulation of very short bursts of exercise lasting approximately 2 minutes can also provide health benefits.

Approximately 39% of the global adult population were classified as overweight (Body Mass Index (BMI) 25.0–29.9 kg/m2) or obese (BMI > 29.9kg/m2) in 2014; a doubling since 1975. Whereas the prevalence of obesity was 6.4% among women and 3.2% among men in 1975, it had risen to 14.9% and 10.8%, respectively by 2014[13]. In developing countries like India, the increasing prevalence of overweight and obesity has coincided with the demographic and epidemiological transitions, in which mortality and fertility have declined, and lifestyle-related diseases have become more common (Dandona L. et al.). The prevalence of overweight and obesity in India is increasing faster than the world average. For instance, the prevalence of overweight increased from 8.4% to 15.5% among women between 1998 and 2015, and the prevalence of obesity increased from 2.2% to 5.1% over the same period (WHO). This fast-paced growth has been accompanied by notable increases in the burden of non-communicable diseases (NCDs). Whereas in 1990 the number of life years lost to disability (DALYs) attributable to communicable, maternal, neonatal, and nutritional disorders exceeded that attributable to NCDs in virtually all of India’s states, currently the opposite is true. Given the extent of the

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increase in prevalence of overweight and obesity, and its relationships with NCDs (Kelly T.,et al.,), reliably predicting its future prevalence has become increasingly important.

A sedentary lifestyle which includes prolonged sitting time during waking hours and low energy expenditure, increases the risk of adverse health events, cardiovascular disease, and type two diabetes (T2DM) (Dempsey PC). This type of lifestyle leads to lower levels of cardiorespiratory fitness (CRF) and increased fatness, increasing cardiometabolic risk and mortality (Laukkanen JA). Improving CRF and lowering fatness with exercise promotes cardiovascular health and longevity. The Fitness-Fatness Index (FFI), developed in 2016, combines these two cardiometabolic risk factors and has been shown to be better at identifying those at risk of adverse cardiovascular events than either measure alone. FFI is calculated by measuring maximal CRF in metabolic equivalents (METs) divided by the waist to height ratio (WtHR). A 1-unit increase in FFI is clinically significant and has been found to reduce all-cause mortality (9%) and cardiovascular disease (CVD) specific mortality by 13% (Sloan RA et.,).

Establishment of Fitness Fatness Index (FFI) To establish FFI and changes in FFI, anthropometric measurements of waist (cm) and height (cm) and maximal CRF testing was required at baseline and 12-weeks post intervention. The FFI was calculated as maximal CRF expressed as metabolic equivalents (METs) divided by the waist-to-height ratio (WtHR). [FFI = CRF (METs) / WtHR] CRF was determined by the maximal oxygen uptake (VO2max mL·kg-1·min-1) via a graded maximal exercise test (GXT), in further detail below, converted to METs by dividing by 3.5 mL·kg-1·min-1. WtHR was calculated by dividing the anthropometric measurements of waist (cm) by height (cm). A higher number indicates a greater FFI.

Current physical activity guidelines recommend that every adult should engage in 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week (Blair SN, et al). One strategy advocated to meet this activity goal is to accumulate exercise in short bouts throughout the day. The efficacy of this approach has been shown experimentally using 10-minute bouts of activity (Murphy MH et al.,). However, to date only one stair climbing study has shown that accumulating very short bouts of exercise lasting about two minutes can also confer health benefits (Boreham C et al.,). In this study only one group has undergone exercise and control group didn't receive any exercises, since to find out how much add on effective is the short bout of stair climbing when compared to the normal lifestyle.

MATERIALS & METHODOLOGY:

Pre and post experimental study design. This study was conducted at KG College of physiotherapy, KG pain relief center, Coimbatore, conducted over a period of 6 months. 50 participants enrolled and only 36 were selected based on inclusion and exclusion criteria. The experimental flow chart outlining the study design is shown in Figure 1. Only males age between 35 to 45 years. Males who are eligible as per BMI score >25 and <30 were included. Males under any medications, musculoskeletal disorders, using drugs, alcohol and cigarette, cardiovascular disease, hypertension, neurological deficit, any

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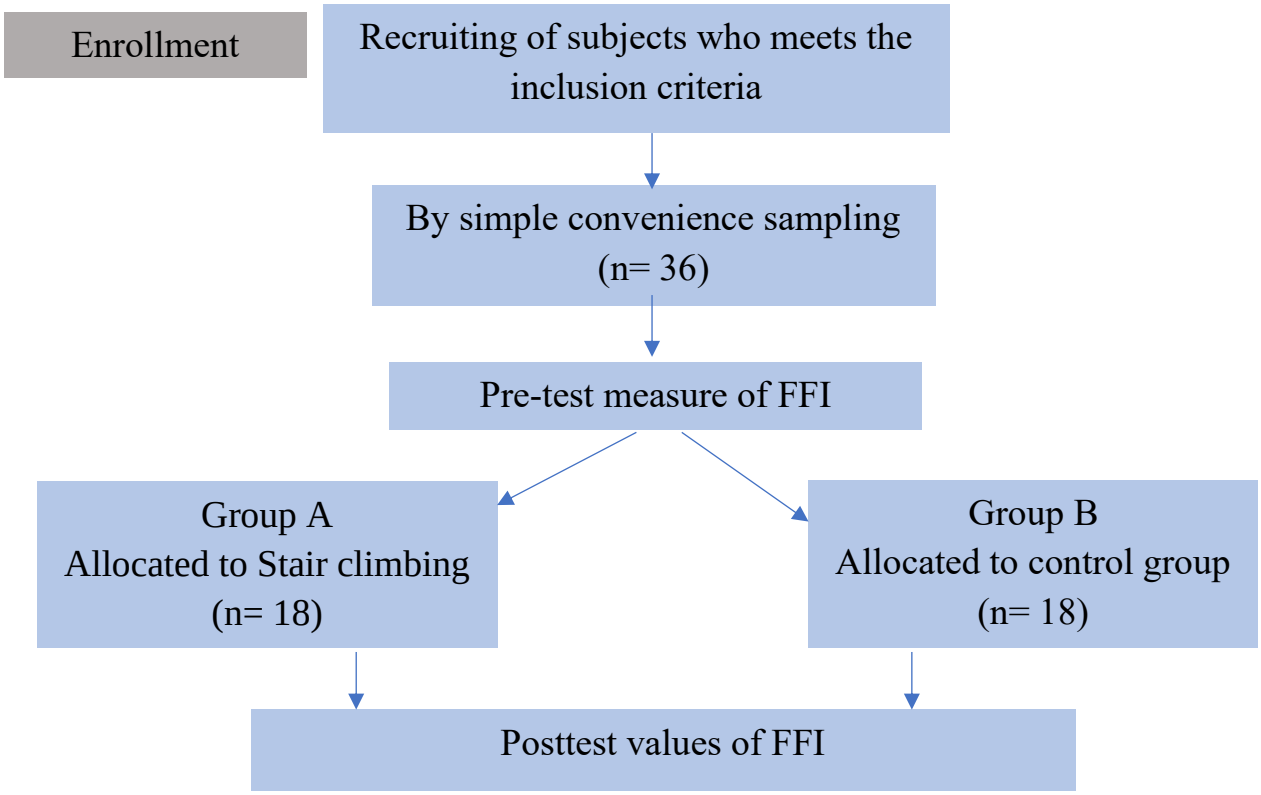
fractures, any recent surgeries, carcinoma were excluded. All the subjects have explained the purpose and test procedures and written informed consent and basic assessment were taken before their enrolment in the study. Participants were divided into two groups: Experimental Group A (n=18) and Group B Control Group (n=18). Group A underwent a short bout of stair climbing training for 3 times per day, 3 days a week, a total of 54 training sessions over 8 weeks. A single bout of the 3-flight staircase. 3 X 20s sprints with 2 minutes recovery. 58±4 stairs were climbed/ bout of 180±11 stairs /session. Group B is a control group was not Perform any kind of Exercise; Pre-Outcome Measures were taken on day 1 and Post Outcome Measures were taken after the end of the 8th week of intervention. Both groups underwent baseline anthropometric testing and a submaximal test to determine the baseline FFI. Anthropometric measures included waist circumference and height to calculate waist-to-height ratio. Height was measured on a stadiometer to the nearest 0.5cm. Waist circumference was measured at the top of the right iliac crest with a nonelastic tape measure to the nearest 0.1cm. WHtR was calculated by dividing waist in cm by height in cm.

Fitness-Fatness Index: To determine Fitness-fatness index (FFI), estimated VO_2 max was used from the submaximal cardiorespiratory test, along with waist-to-height ratio. Estimated VO_2 max was calculated using the Queens College Step test. From this metabolic equivalent (MET) was calculated (VO_2/3.5), while WHtR was determined by dividing the participant's recorded waist circumference in cm by their height in cm. These two values were then divided to obtain FFI.

PROCEDURE:



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Sample size calculation:

Sample size, $n= 4pq/L^2$

Where, P= 90% = 0.09, q= 1-q = 0.10, L= 10%= L^2 = 0.01(marginal error), n= 36

Total 36 subjects were divided into two groups through simple random sampling method.

Ethical concern:

The study was approved by ethical committed of K.G hospital, Coimbatore

Characteristics	Group	N%
Age	35-45 years	40 ± 3.06
BMI	>25 - <30	27.02 ± 1.33
Educational	Educated	(22)60%
	Uneducated	(14)40%
Socio-economic level	Low	5 (13.3%)
	Moderate	22 (60%)
	High	9 (26.7%)

Table 1: Demographic data

The participant's demographic data were age, BMI, educational and socioeconomic level asshown in Table 1.

Groups	Mean values	N	Mean difference	SD	t value	P value
Group A (pre-test)	18.79	18	4.1	3.9209	8.2974	<0.0001
Group A (post-test)	22.89	18				
Group B (pre-test)	18.79	18	0.98	3.8214	4.4761	<0.0003
Group B (post-test)	19.77	18				

Table 2: Fitness-Fatness Index (pre and post-test mean scores)

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The Mean values, mean difference, SD, t-value and P-value of Fitness Fatness Index scoresof Group A and Group B are shown in Table 2.

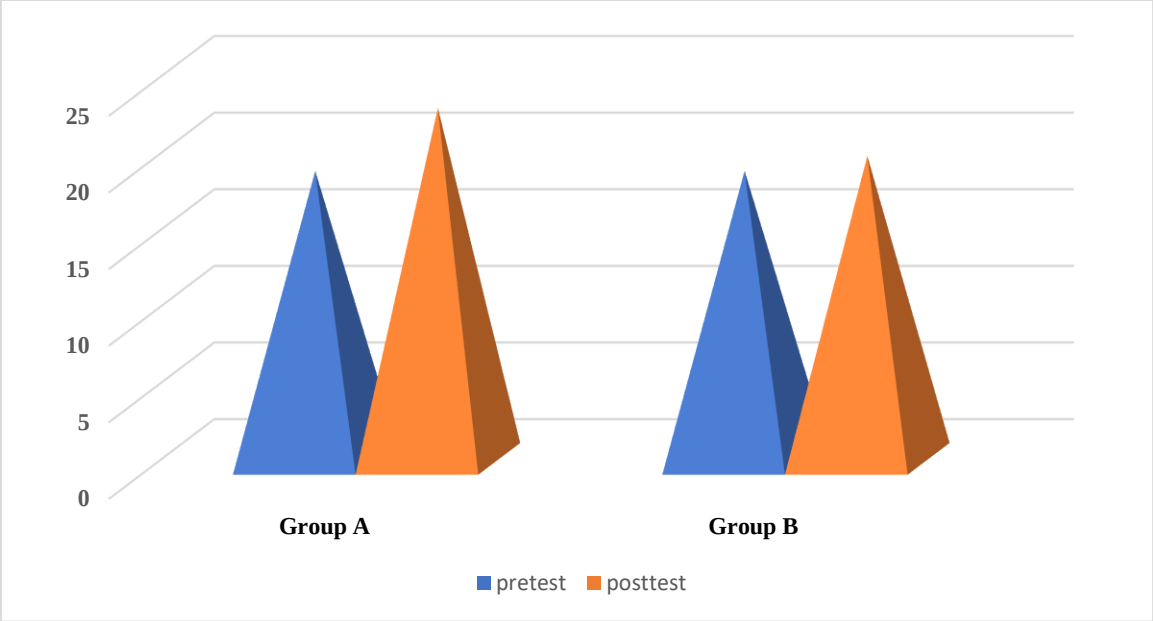

Figure 1. Pre-Test and Post Test Mean Values for Fitness Fatness Index

RESULT

The purpose of the study was to find out the effects of short bouts of stair climbing exercise on Fitness Fatness Index among overweight individuals. Fitness Fatness Index was calculated by ratio of Cardiorespiratory fitness with waist-to-height ratio. Cardiorespiratory fitness is obtained by using Queens college step test (submaximal step test) and convert it into METs. Our currentstudy results indicated that there is significant improvement in their cardiorespiratory fitness by short bouts of stair climbing exercise.

DISCUSSION

These findings show that an eight-week stair climbing programme characterized by multiple short bouts of vigorous activity can result in positive changes in important CVD risk factors. The substantial 17.1% improvement in VO2MAX reported in the present study provides evidence that just over 11 minutes a day of stair climbing is sufficient to elicit cardiovascular adaptations. Although genetic predisposition may account for about 40% of the variation in VO2MAX, 19 physical activity is the key determinant of the remaining 60%. Low levels of cardiorespiratory fitness have been found to be as strong a predictor of mortality as the conventional risk factors, such as cigarette smoking, and are a stronger predictor than hypercholesterolemia and hypertension.

It has also been observed that even small improvements in cardiorespiratory fitness can result in reduced risk of all-cause mortality. Improvement in cardiorespiratory fitness of the magnitude shown in this study should reduce risk of mortality by about 20%, Stair climbing is a vigorous activity because it requires participants to raise all their body mass against gravity. Energy expenditure is proportional to mass raised and speed of climbing is a relatively small contributor

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to metabolic cost.

Stair climbing is a vigorous physical activity, even at slow speeds, that can increase cardiorespiratory fitness with a lower time commitment than conventional physical activities. stair climbing interventions are one of the few physical activity initiatives that repeatedly change behavior. It has been estimated that the increased energy consumption from these interventions is six times more cost-effective than their nearest competitor. Repeated stair climbing at work, or in the home environment as reported here, would allow daily accumulation of stair climbing episodes. Unlike formal exercise sessions such as sport, stair climbing is a plausible behavior for most of the population. No particular skills are required, there is no competition, and there are few presentational concerns.

The exercising subjects in this investigation showed significant decreases in body weight, body mass index (kg/m2), sum of skinfolds and sum of circumference measures from baseline to post-treatment while the values for the non-exercising control subjects increased slightly over the same time frame. The fact that the control subjects in our study did not lose weight is perplexing and conflicts with other research that generally supports weight loss with caloric restriction. This could also explain the relatively small amount of weight lost by the exercising subjects as well, despite the significant calorie deficit they would have likely incurred with an increase in exercise induced energy expenditure.

CONCLUSION

In conclusion, based on the results of this study it appears that two or three short bouts of exercise have the same effect as one continuous bout of exercise with regard to aerobic fitness and weight loss in overweight individuals.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest about this manuscript.

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Challenges Faced by Physiotherapy Teachers in India and itsSolutions

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ABSTRACT

This article highlights the challenges physiotherapy teachers face in India and explores potential solutions to improve their working conditions. The challenges include a lack of recognition and support within the education system, financial constraints, heavy workloads, limited research and professional development opportunities, outdated curricula, and the absence of a clear career progression pathway. Efforts are being made by professional associations, institutions, and policymakers to address these challenges, with a focus on advocating for recognition, infrastructure improvement, enhanced research opportunities, and better policies. Collaboration among stakeholders, investment in research, interdisciplinary teamwork, and addressing low-quality institutions are crucial steps toward positive change.

The article concludes by emphasizing the need for collective commitment to ensure that physiotherapy teachers receive the necessary support, recognition, and resources for delivering quality education and contributing to the field.

Keywords: Physiotherapy Teachers, Challenges, India

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INTRODUCTION

The field of physiotherapy in India is confronted with many challenges, particularly concerning the plight of physiotherapy teachers. Recognizing that individual experiences and circumstances may vary among teachers and institutions is important. However, several common obstacles hinder their ability to deliver quality education. I have attempted to shed light on these challenges and explore potential solutions to improve the conditions for physiotherapy teachers in India.

CHALLENGES

One of the primary issues physiotherapy teachers face is the lack of recognition and support within the Indian education system. Unlike other medical disciplines, physiotherapy has not received the same level of recognition, resulting in limited support for teachers in terms of funding, infrastructure, and research opportunities. Consequently, teachers often struggle to access the necessary resources, impeding their ability to provide high-quality education. [1]

In addition to inadequate recognition, physiotherapy teachers also face financial constraints. Compared to their counterparts in other healthcare professions, they often receive low salaries and limited opportunities for career advancement. This not only hampers their job satisfaction but also restricts their ability to stay updated with the latest developments in the field through training and conferences. [2-4]

Furthermore, heavy workloads pose significant challenges for physiotherapy teachers in India. Due to a shortage of faculty and an increasing number of students, teachers are burdened with excessive responsibilities. This compromises the learning environment, reduces individual attention, and contributes to burnout. Balancing teaching responsibilities with research, clinical work, and personal commitments becomes arduous for these teachers. [1, 5]

Another critical challenge is the limited emphasis on research and professional development opportunities within India's physiotherapy field. Many physiotherapy teachers aspire to contribute to the field through research, publications, and innovation. However, lack of funding, mentorship, and institutional research support hinder their ability to explore and advance their academic careers. [6]

Outdated curricula and teaching methods further exacerbate the challenges faced by physiotherapy teachers.[7] Some programs in India may suffer from obsolete curricula and teaching methods that do not align with current best practices and advancements in the field. As a result, teachers must continuously update their knowledge and adapt teaching methods to ensure quality education. [2, 7]

Moreover, unlike other countries, India lacks a clear career progression pathway for physiotherapy teachers. The absence of a structured promotion system discourages professional growth and impedes career advancement for these teachers.

In certain states, the entry requirements for the Bachelor of Physiotherapy program entail achieving a minimal passing score in the 12th standard science stream. While

this policy might grant access to a wider pool of candidates, it raises concerns among physiotherapy educators and the broader community. The reason for this concern stems from the observation that not all students possess the same level of intellectual aptitude, and this can have implications for the quality of future physiotherapists being produced.

Physiotherapy demands a comprehensive understanding of human anatomy, physiology, and intricate clinical skills. Students with a robust academic foundation tend to excel in these areas, which are crucial for becoming effective and proficient physiotherapists. However, allowing students with lower academic capabilities into the program can potentially result in a disparity in the competence and skillset of graduates.

Physiotherapy educators in India face challenges regarding their students, particularly those who may struggle academically. The rigorous coursework and demanding practical training can overwhelm students who may not be adequately prepared intellectually. This disparity between students' capabilities and the program's demands can lead to educator frustration, suboptimal teaching experiences, and student attrition.

Syllabus overload only compounds these challenges, with the extensive curriculum, time constraints, and mandatory clinical training adding complexity. This situation can cause stress, hinder deep learning, and impede students' mastery of crucial subjects.

The overarching concern is that by compromising on admission standards, the quality of physiotherapy professionals being produced could be compromised as well. This could negatively impact patient care and outcomes, as physiotherapists play a critical role in facilitating the recovery and well-being of individuals through precise assessments and tailored interventions.

REMEDIES

While the challenges are significant, efforts are being made to address them and improve the conditions for physiotherapy teachers in India. Professional associations and institutions advocate for increased recognition, better infrastructure, and enhanced research and professional development opportunities. However, achieving comprehensive change will require sustained commitment and collaboration among all stakeholders.

Government policies also play a crucial role in shaping the physiotherapy profession in India, and poor policies can further contribute to the challenges physiotherapy teachers face. Adequate recognition and regulation of the profession are essential for securing support, funding, and resources.

Furthermore, integrating physiotherapy services within the larger healthcare system and ensuring adequate reimbursement and insurance coverage are key policy considerations that must be addressed.

Additionally, investment in research and development is vital for the growth and advancement of the physiotherapy profession. Government policies must prioritize funding for physiotherapy research to promote evidence-based practice, innovation, and advancements in the field.

Instances of professional conflicts or tensions between healthcare professionals, including physiotherapists and medical doctors, can occur in any healthcare system. However, it is important to emphasize that generalizing such conflicts to an entire profession or all interactions would be inaccurate and unfair. Encouraging collaboration, mutual respect, and interdisciplinary teamwork is crucial for fostering a positive and productive healthcare environment.

Concerted efforts are needed from regulatory bodies, educational institutions, and relevant stakeholders to address the concerns related to the mushrooming of low-quality physiotherapy colleges in India. Ensuring sufficient infrastructure, adherence to quality standards, and proper appointments of faculty members are essential steps in providing quality education and training to physiotherapy students.

To address the difficulties of syllabus overload, institutions should regularly assess their curriculum, prioritize essential content, incorporate technology for blended teaching, encourage interdisciplinary collaboration, provide adaptable teaching approaches, and invest in faculty development. These efforts aim to establish a more balanced and effective educational environment for physiotherapy educators in India, enabling them to support their students' diverse learning needs better.

Regarding BPT admission criteria, it becomes essential for educational institutions, policymakers, and the physiotherapy community to contemplate the ramifications of admission policies collectively. Finding a harmonious equilibrium between inclusivity and upholding rigorous academic benchmarks becomes paramount, ensuring that forthcoming physiotherapists are equipped and competent to provide optimal care to those requiring it.

CONCLUSION

The challenges faced by physiotherapy teachers in India are significant, encompassing issues of recognition, support, remuneration, workload, research opportunities, curriculum, career progression, and government

policies. Efforts are being made to address these challenges, but a collective commitment is required to bring about meaningful change. By advocating for their rights, actively participating in educational reforms, engaging in research, prioritizing professional development, collaborating with policymakers, fostering mentorship, and promoting collaborative relationships with students, physiotherapy teachers can contribute to positive change and enhance the profession's recognition and working conditions.

All stakeholders must work together to ensure that physiotherapy teachers receive the support, recognition, and resources they need to deliver quality education and contribute effectively to physiotherapy.

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Functional Rehabilitation of Cervical Spinal Cord Injury

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TITLE : Functional Rehabilitation of Cervical Spinal Cord Injury
I have single case study on C6 C7 cervical spinal cord injury patient and shown some functional improvement.

INTRODUCTION:

The Spinal cord is part of the central nervous system (CNS). it is situated inside the vertebral canal of the vertebral column [(1)] spinal cord is divided into segments : cervical, thoracic, lumbar, sacral and coccygeal . the cervical spine has 7 stacked bones called vertebrae , labeled C1 through C7 .The locations of C6 – C7 vertebrae are both in the lowest levels of the cervical spine , near the base of the neck . the types of spinal cord injury corresponding to these regions of the spine have the potential to impact everything below the top of the ribcage – resulting in quadriplegia or paraplegia .[(2)] C6-C7 spinal cord level is a group of muscles involved in straightening the elbow , lifting the wrist , elongating the fingers to an outstretched hand and the triceps muscle in the upper arm. Outcome of C7 is ability to be physically independent with personal care and ADLs , independent with bed mobility , can transfer independently with potential to use lift transfer , Greater function use to hands including stronger grasp and increased dexterity therefore less reliant on splints , able to use a manual wheelchair , able to drive with vehicle modifications , potential to live independently with support and require assistive equipment. As is the case with any spinal cord injury, the damage is characterized as complete or incomplete depending on the severity.

KEY WORDS : SCI Patient , SCIM , WISCI , Multidisciplinary Approach , Public Utility Services Training , Vocational Training , Sports Training and Institutional Rehabilitation .

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PATIENT HISTORY:

Patient suffered an injury to cervical spine while diving into swimming pool on 12/05/2022 at night. He underwent surgery in afternoon at Surat on next day and here he was admitted for 3days. After that he was at home rest 1 and half months then he took treatment for 2 months in hospital at Surat. Now he started treatment here Jaya rehabilitation center of Bidada from 10/11/2022. [3]

AIM:

To find the effectiveness of multidisciplinary approach for C6-C7 spinal cord injury patient activities of functional independent.

Also, he is eager to give JEE exam, to increase his handwriting speed with hand adaptive device support on a vocational training.

REVIEW OF LITERATURE:

Functional Outcome Following Spinal Cord Injury: A Comparison of Specialized Spinal Cord Injury Center vs General Hospital Short-term Care; Allen W. Heinemann, PhD; Gary M. Yarkony, MD; Elliot J. Roth, MD; Linda Lovell; Byron Hamilton, MD, PhD; Karen Ginsburg, MA; J. Thomas Brown, MD; Paul R. Meyer Jr, MD;Arch Neurol. 1989;46(10):1098-1102. doi:10.1001/archneur.1989.00520460084017.

MATERIAL & METHODOLOGY:

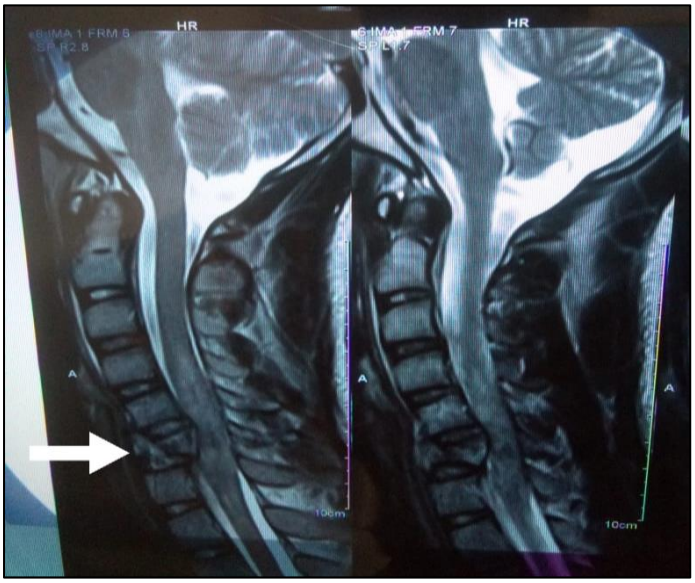

Figure:1 Shows C5 and C6 vertebra fracture

Figure:2 Shows Patient functional training

SINGLE CASE STUDY

Patient is assessed with spinal cord injury measures spinal cord independence measure (SCIM)[4] and walking index spinal cord injury (WISCI)[5] pre and post rehabilitation at interval of 1 and half month .The patient is trained in institutional rehabilitation set up with varies training like weight bearing exercise, strengthening exercise , for upper limb and lower limb , core strengthening , positioning , trunk facilitation , wheelchair ambulation ,gait training , functional training , utility training , balancing activities , vocational training , advices. The patient is also motivated to go to community for social life with psychological counselling. patient is not actively participating in community, that's why we have try to some sports & recreation activities like a club throwing and playing musical instrument.

Also for his exam preparation, he is finding it very useful to improve his writing speed through the writing splint (chuck grasp splinting) like a tripod grasp.

INTERVENTION:

Strengthening exercises of U/E and L/E, Trunk strengthening exercises, Bed mobility and activity exercises, Wheelchair ambulation, Wheelchair activity, sitting balance, Back strengthening exercises, sit to stand with assistive device (walker and KAFO) and one person support, After one and half month using AFO, Standing on standing frame and parallel bar, Gait training and ADL activity. (6)

RESULT:

The patient is pre and post rehabilitation on SCIM and WISCI and it shows significant improvements in it the results are as below

ON ADMISSION

AFTER ONE AND HALF MONTH

SCIM:40/100, 53/100

WISCI:0/20, 6/20

He has been sent to participate in para-athletic sports as he has shown such improvement in sports activities. After using hand adaptive devices, he has a try to some better hand writing and increasespeed also in vocational training that's why he got a motivated to preparing JEE & boardexam. he has appeared JEE exam recently and complete the paper, he can also be motivated other online exam and attending school and tuition regularly. he has gone for club throwing at state level para-athletic sports and national junior para-athletic sports he can also driving practicing with modified vehicles and he also need a transfer training to more independent for life.

CONCLUSION:

The patient with cervical spinal cord injury has chance to live independently with rehabilitation approaches like physiotherapy, vocational training, utility training, functional training and sports training Quadriplegic patient with multidisciplinary functional rehabilitation approach and vocational & sports training can participate on board exam and para-athletic sportscompetition. The patient will become productive for the society as well as for the family & nation.

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A Cross-Sectional Study on Prevalence of Metabolic Syndrome and Its Predominant Components among Pre and Post-Menopausal Women in South Delhi

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ABSTRACT

Background: Postmenopaus refers to the stage in a woman's life following menopause. Objective of study is to investigate the prevalence of metabolic syndrome (Mets) among pre and postmenopausal women in South Delhi as well as to identify association of MetS with various sociodemographic factors and menopausal status of women.

Materials and methods: The convenience sample for the study consisted of 320 females from South Delhi, aged 40-65, with recent medical reports, 160 of whom were premenopausal and 160 of whom were postmenopausal. The study employed a cross-sectional survey design. The NCEP ATP III criteria, which diagnose metabolic syndrome (MetS) when at least three of the five components are present, were used to evaluate MetS. Anthropometric parameters were measured using standard protocols.

Result: 45.9% of the women in the research, whose mean age was 50.42 ± 7.905 years, had metabolic syndrome. The prevalence was higher in postmenopausal women (64%) compared to premenopausal women (21.9%), and common characteristics included elevated waist circumference, elevated triglyceride levels, and hypertension. Significant correlations between education, age, employment, exercise habits, and physical inactivity were found in the research ($p<0.005$). Women who have undergone menopause were more susceptible to some aspects of the MetS.

Conclusion: In South Delhi, postmenopausal women had a greater risk of metabolic syndrome, which is strongly correlated with age, occupation, education, physical inactivity, and exercise habits. It is imperative to priorities lifestyle modifications and heightened physical exercise in order to tackle this.

Keywords- Menopause, post-menopausal women, pre-menopausal women, metabolic syndrome

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INTRODUCTION

Metabolic syndrome (MetS) is a collection of risk factors for Type 2 diabetes mellitus and cardiovascular disease (CVD). It has deglycation (abnormal blood sugar levels), dyslipidemia (an unhealthy lipid profile), central obesity, and hypertension as components. These factors all lead to an increased vulnerability to diabetes and cardiovascular disease[1]. premenopausal is the phase when females have irregular or sometimes regular periods phase before menopause. Postmenopausal women have a higher incidence of MetS than premenopausal women due to changes in the estrogen hormone level. Researches have shown higher prevalence of MeTs in postmenopausal women compared to premenopausal [1,2]. The prevalence of MetS varies from population to population and ethnic variation. Asian Indians are more prone to MetS than Caucasians [1]

Studies in the past have shown that women are more likely to develop MetS and CVD after the age of 55 years (postmenopausal phase). Changes during the menopausal transition increase the risk of CVD (45-55 years). Weight gain and menopause is the main predictor of MetS [3]. Central obesity, high blood pressure, hyperglycemia, poor glucose tolerance, hypertriglyceridemia, and low HDL-C levels are risk factors for MetS. 20-25% of the world population who have MetS are three times more prone to die from stroke and heart attack compared to people who do not have MetS [2,4,5].

The study used the NCEP ATP III Criteria to assess the occurrence of metabolic syndrome (MetS) in women from South Delhi, both pre- and postmenopausal. It also tried to establish any links between MetS and various socio-demographic characteristics, as well as the participants' menopausal status. Previous study using similar approaches has helped to understand the prevalence of MetS in both premenopausal and postmenopausal women [6,7,8,9].

METHODOLOGY

Participants

It was a Cross-sectional study which was conducted from November 2021 to August 2022 in the Outpatient department of DPSR University Delhi. Prior approval was taken from Research Committee of School of Physiotherapy DPSRU. A convenience sample of 320 females was taken, of which 160 were premenopausal and 160 were postmenopausal women. Women of age 40-65 years, with availability of medical reports in the last 1 month and who volunteered to participate in the study were included. Exclusion criteria were Perimenopausal women, not willing to participate, and co-existence of any other serious illness (including HRT, taking antidiabetic and antihypertensive drugs). Women with polycystic ovarian syndrome, and fatty liver, were excluded from the study.

Procedure

A team of skilled interviewers gathered the data. Demographic information was obtained by using a self-structured questionnaire.

The following parameters were used to assess metabolic syndrome: waist circumference greater than 88cm, fasting blood glucose levels greater than 110mg/dL, HDL cholesterol less than 50mg/dL, systolic blood pressure greater than 130 mmHg, diastolic blood pressure greater than 85mmHg, and triglyceride levels greater than 150mg/dL. The presence of three of the five components, according to these criteria, confirms the presence of metabolic syndrome (MetS).

Using defined methods, anthropometric measurements such as height, weight, blood pressure (both systolic and diastolic), and waist circumference were gathered. A

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weighing machine was used to record weight, and a stadiometer was used to measure height. Waist circumference was measured by putting a measuring tape between the tip of the lower rib and the iliac crest. Waist circumference (in cm) was divided by hip circumference (in cm) to compute the waist-to-hip ratio (WHR). Following a 5-minute rest interval, blood pressure was taken on the left arm, just above the cubital fossa.

DATA ANALYSIS

Data was entered in Microsoft excel. SPSS software version 24 was used for data analysis. Descriptive analysis was done which were represented through tables and graphs. Continuous data were provided as mean standard error of the mean (SEM), whereas categorical variables were presented as proportions. Statistical significance was determined in the comparison analysis at a level of p 0.05.

RESULTS

This study included 320 women (160 post-menopausal and 160 premenopausal women) from south Delhi. Mean age of females was 50.42 ± 7.905 years. BMI ranged from 21-47 kg/m2 with 28.32 ± 3.68 kg/m2 as the mean value. Waist circumference ranged between 65-116 cm with 88.45 ± 6.84 as the mean value. Out of 320 females 147 females had presence of metabolic syndrome. According to the study's findings, the majority of the subjects possessed at least two MetS characteristics. Overall prevalence was 45.9%, in pre-menopausal it was 21.9% and in post-menopausal it was 64%. Compared to other metabolic components elevated waist circumference, triglyceride levels, and hypertension are the most frequent characteristics in this study.

Table1 shows significant association of metabolic syndrome with education, age, employment, exercise habits and physical inactivity ($p<0.005$). Table 2 shows association of metabolic syndrome with menopausal status. The odds of postmenopausal women developing high fasting blood glucose (>110mg/dL) was 4.69 times higher than premenopausal women. ($X2 = 18.94$) (p value = 0.00). The odds of postmenopausal women developing greater waist circumference (>88cm) was 2.77 time greater than premenopausal women (p value 0.00). The odds of postmenopausal women developing high SBP (>130mmhg) was 3.33 times higher than premenopausal women (p value = 0.00) and the odds of postmenopausal women also developing high DBP (>85mmhg) was 3.44 times higher than premenopausal women (p value = 0.00). This study shows the odds of postmenopausal women developing high triglyceride level (>150mg/dL) was 3.55 time higher than premenopausal women (p value = 0.00). The odds of postmenopausal women developing low HDL-C (<50mg/dL) was 0.40 times lower than premenopausal women (p value = 0.00)

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Variable	Variable 2	χ2	P value	Significance
METABOLIC SYNDROME	Education	17.779	0.000	Sig
	Age	7.317	0.026	Sig
	Employment	7.448	0.014	Sig
	Marital status	3.386	0.184	Non-Sig
	Family type	4.978	0.017	Non-Sig
	No of children	1.181	0.758	Non- Sig
	Exercise habits	15.010	0.000	Sig
	Physical inactivity	0.074	0.052	Sig
	Income	0.027	0.087	Non-Sig

Table-1: Association of various factors with prevalence of MetS using chi square test.

Components	Post-menopausal N (%)	Pre-menopausal N (%)	Total	X^2	Odds ratio (95%CI lower-upper)	P value
FBG (More than 110mg/Dl)	25(7.8%)	3(0.93%)	28(8.8%)	18.94	4.69(2.86-8.80)	Significant
Waist circumference (More than 88cm)	100(31.25%)	60(18.75%)	160(50%)	20.00	2.77(1.76-4.36)	Significant
SBP (More than 130mmHg)	68(21.25%)	29(9.06%)	97(30.3%)	22.50	3.33(2.00-5.56)	Significant

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DBP (More than 85mmHg)	74(23.12%)	32(10%)	106(33.12 %)	24.88	3.44(2-5.65)	Significant
TG (More than 150mg/dl)	118(36.87%)	48(15%)	166(51.87 %)	61.33	3.55(3.02-6.68)	Significant
HDL (Less than 50mg/dl)	37(11.56%)	68(21.25%)	105(32.81 %)	13.52	0.40(0.25-0.66)	Significant

Table-2: Association of metabolic syndrome with menopausal status.

DISCUSSION

The present study stands out since there aren't many Indian studies that have looked at the relationship between MS and menopause. The current study also examined the relationship between the metabolic syndrome and various sociodemographic elements. This study included 320 women (160 post-menopausal 160 and premenopausal women) from south Delhi. The prevalence of metabolic syndrome was reported to be 45.9% overall, with postmenopausal women having a greater prevalence (64%), compared to premenopausal women's 21.9%. The result of present study is in line with results of study by Naina Mehndiratta, et al 2020 in a study done in Amritsar, North-western India on 200 females Their results showed a prevalence of 16% and 42% in pre and postmenopausal women respectively [4]. Another research done by Sandeep Sharma et al 2016, in North India showed that the prevalence of MetS was 62.6% which is higher than present study [10]. The study among urban adult women in South Delhi, India showed that the overall prevalence of metabolic syndrome was 29.6% using NCEP/ATP-III criteria [11] which is lower than the present study.

With an overall frequency of 45.9%, the study examined the association between menopause and metabolic syndrome in 320 women from south Delhi, India. The prevalence was higher in postmenopausal women (64%) than in premenopausal women (21.9%). Comparable research conducted in Amritsar and North India revealed differing prevalence percentages; one study[4] found that the prevalence in premenopausal women was 16%, while the prevalence in postmenopausal women was 42%. Another study[10] found that the prevalence was greater, at 62.6%. The results of this study show how the frequency of metabolic syndrome varies throughout India and are in line with certain previous research while deviating from others[11].

The results of the study show significant association of metabolic syndrome with age, education, employment, exercise habits and physical inactivity. This study demonstrates that MetS rises with ageing, as has also been demonstrated by other researchers. As per literature the prevalence of MetS rises with ageing with highest prevalence in second to third decade of life [12]. There was a significant association between the Mets and Education level with higher prevalence in women who were less educated compared to those who were highly educated and these findings are similar with other studies [12,13]. Author postulate that this could be because educated individuals are more aware of their own health, follow a healthy lifestyle and are less likely to get Mets. However further researches are needed to better understand the association of education

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level and metabolic syndrome. This study demonstrates that the risk of Mets rises with inactivity and falls with regular exercise practices, which was previously demonstrated by an earlier author [14,15]. Inactivity may exacerbate insulin resistance and abdominal obesity, both of which can lead to metabolic syndrome. The metabolic syndrome can be treated and prevented through exercise. The study found a link between women's employment status and the prevalence of Mets. Kang et al stated that postmenopausal women's employment appears to be strongly associated with a decreased prevalence of MetS, but not premenopausal women. It is thought that elements like socioeconomic level and lifestyle characteristics may have an impact on this. [16] This study did not find any relation of marital status, number of children, family type and income with MetS.

The NCEP ATP III CRITERIA was used in study. Notably, all MetS components were considerably greater in postmenopausal women, including elevated systolic and diastolic blood pressure, lipids, fasting blood sugar, and increased waist circumference. Previous research on the association between menopause and blood pressure has found that systolic blood pressure rises in postmenopausal women while diastolic blood pressure remains stable [17]. However, our study found that both systolic and diastolic blood pressures were significantly higher in postmenopausal women with metabolic syndrome. This finding shows that diastolic blood pressure may be a substantial risk factor for cardiovascular disease in this population. Several variables, including an increased testosterone to estrogen ratio, raised endothelin levels, oxidative stress, obesity, and sympathetic nervous system activation, have been identified as potential contributors to postmenopausal hypertension. [18] The study discovered considerably higher triglycerides in postmenopausal women with metabolic syndrome, correlating with other studies that reported inconsistent results on how menopause impacts triglycerides. Some studies show no change, while others show an increase after menopause. Notably, one study suggests that the combination of high triglycerides and a large waist circumference may be a strong predictor of cardiovascular risk in postmenopausal women[19].

In addition, we discovered reduced HDL cholesterol levels in postmenopausal women with metabolic syndrome. Various studies show that HDL cholesterol levels rise and fall after menopause. However, as shown in Kreisberg's study, declines in HDL cholesterol are regarded as a substantial risk factor for coronary heart disease in postmenopausal women[20]. Furthermore, postmenopausal women with metabolic syndrome had higher fasting blood sugar levels, which were likely driven by age-related changes in glucose tolerance, insulin sensitivity, and decreased physical activity. Waist circumference was raised in both pre- and postmenopausal women, with greater values in the latter group, according to NCEP criteria. Several studies, like Lobo's, have found a link between increased weight, obesity, and the chance of developing metabolic syndrome in postmenopausal women, underlining the influence of central obesity on metabolism and overall health. [21].

CONCLUSION

Based on the assessment criteria, postmenopausal women were more likely to develop MetS than premenopausal women. Significant association of metabolic syndrome with age, education, employment, exercise habits and physical

inactivity was seen. Compared to other metabolic components elevated waist circumference, triglyceride levels, and hypertension are the most frequent characteristics in this study. These elements could make postmenopausal women with metabolic syndrome more susceptible to cardiovascular disease. In conclusion, MetS poses a serious hazard to the health of women and an ageing population. Longitudinal research is needed to understand the process underlying postmenopausal MetS.

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Functional Independence of Bilateral above Knee Amputee with Stubbies Prosthesis - A Single Case study

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ABSTRACT

An adult male, 23 years old who met with an accident and loss his both limb above knee, finding difficulty in ambulation and dependent for transfers & ambulation. He was suggested by his relatives to seek medical opinion and it was decided to give a stubbies prosthesis by keeping in mind the stability & ambulation factors. Although height of patient reduces, he becomes totally independent in his Activities of Daily living as well as the ambulation and using public utility services.

Keywords: Ambulation, stubbies prosthesis, Functional Independence, Rehabilitation, Public Utility Services

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INTRODUCTION

Now a day road traffic accidents are quite common. Due to road traffic accidents so many young energetic person losing their body parts & become dependent for Activities of Daily Living & ambulation on others.

Loss of Bilateral lower extremities affects the ambulation and psychological status of the person. Loss of bilateral Lower extremities from above knee leads problems in ambulation for person with disability. Two types of prosthesis can be use for the such kind of person.

1.High tech prosthesis in which patient's height is not affected but when ever patient wants to go for ambulation he needs assistance in form of family member or caregivers. Patient remains dependent for the ambulation. There is high risk of fall associated with it.

2.Another prosthesis is stubbies prosthesis which will decrease height of patient but more stable than the high tech prosthesis. After complete rehabilitation training he become independent for his ambulation. There is a less risk of fall with stubbies.

Rehabilitation of the person with loss of Bilateral Lower extremities is more difficult than loss of one lower extremity as Lower extremities mainly responsible for the stability. As we know stability is the need for mobility. With proper mobility only person can ambulate.

Best rehabilitation is possible when we get both stability & mobility at their best level.

A male of 23 years of age, who was working in chemical factory, belonging to low socioeconomic status, was intelligent man, with good communication skills.

He met with an accident when he was going back to his home after job. He has loss both his legs above knee level. The possibility is there he can be ambulate with regular high tech Above knee prosthesis but he become ambulate on the cost of stability & high chance of fall were there as he finds difficulty to balance himself on prosthesis.

EXAMINATION

- The patient is examined by the clinical therapist for the joint integrity and strength of the remaining part of the body.
- Range of motion of the all joints of the body
- Manual muscle testing of the bilateral upper extremities, trunk and bilateral Hip joint
- Physical examination shows that patient has proper range of motion of all joints & good strength of all required musculature.
- Patient is also examined by the prosthetic & Orthotic professionals for the proper healed stump and advance availability of possible prosthesis for him.
- X-ray of pelvis showed both hips contained and no abnormality in both hip.
- Patient is also assessed with functional independence measure, Locomotor capability index basic and advanced at three levels i.e at the time of admission, after one month of rehabilitation, after two month of rehabilitation.
- Patient's stump measured and casting done of the stump so that proper fitted stubbies prosthesis can be made.

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- Until the prosthesis get ready patient sent to the physiotherapy department where upper

MANAGEMENT

- strengthening exercise given to person with initially low weight high repetition and progress toward maximum weight low repetition.
- With upper extremity strength training abdominals and back, side trunk strengthening exercise has been taught to the person.
- Balance training with stump static and dynamic started so that whenever the prosthesis is ready person can balance himself on prosthesis.
- As prosthesis was ready donning and doffing of the prosthesis taught to the person as well as also made him aware about the care of prosthesis and stump the prosthesis fitted.
- Psychological counseling of the person had been done for acceptance of the stubbles with proper explanation about risk of fall, maintenance of prosthesis, independency in life.
- Then physical therapist had started the balance training of person on prosthesis and gradually gait training and balancing started first in parallel bar, walker , bilateral Elbow crutches, single stick and then independent walk.
- With gait training person also advised to visit occupational therapy
- department where he had been taught easy way for Activities of daily living with prosthesis and repetition of the ADLS so he become more confident about his life.
- After completion of gait training step wise person also shifter to public utility services training centre where he became aware about how to use public transport services with ease if he had any difficulty with use of public utility services then it had been resolved by the therapist.
- After two months of training every exercise protocol, necessary advises explained to the person.

RESULT

The patient is now independent for more than a year, taking up a job and comfortable with Stubbies throughout the day.

Table no. 1

Particular	At Admission	After 1month	After 2month
Functional Independent Measure Score	102	111	116
Locomotor Capability Index(LCI)	0	8	24
LCI Basic Activities	0	7	16
LCI Advanced Activities	0	1	8

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DISCUSSION

As the stubbies prosthesis has given successful result with this patient. We have also tried same type of prosthesis for another two person one male & female which have also shown good results with person independency. But we have large population to be treated further more care report is necessary to be sure that stubbies prosthesis is more successful than high tech prosthesis.

CONCLUSION

The stubbies prosthesis is better option of Bilateral above knee amputation for the ambulation of the person. After complete rehabilitation person becomes independent not only activities of daily living but also in using the Public transport services.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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Development and Test Efficacy of a Novel Walker on Gait Parameters and Energy Expenditure in Children with Spastic Diplegic Cerebral Palsy

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ABSTRACT

Background: A walker is an assistive device used to provide stability and relieve full or partial weight bearing on a lower extremity. These are frequently prescribed to children with Cerebral Palsy (CP) to provide additional stability during ambulation. Traditionally, anterior and posterior walkers have been used as walking aids but the information about the use of these walkers in terms of gait and energy consumption is lacking.

Aim: The purpose of this study is to compare the efficacy of a novel walker with the traditional posterior walker in terms of gait parameters and energy expenditure in subjects with spastic diplegic CP.

Methods: A novel walker consists of two rigid square frames attached with four wheels and a handle with height adjustment features is constructed. A seat is attached to the upper square frame for sitting provision and reducing fatigue. 30 spastic diplegic CP children (mean age: 6.6 ±1.4 years) with poor trunk control were subjected to a 10-meter walk test for measuring gait parameters (step length, stride length, velocity, cadence, and walking width) and energy expenditure in the form of physiological cost index. The post-test comparison was performed between both walkers and the data was analyzed through an Independent Students t-test with a significance level (α) set at 0.05.

Results: The subjects walked with significantly higher velocity (18%) and improved PCI (58%) using a novel walker compared to the posterior walker ($p<0.05$). However, other temporal-spatial gait parameters did not show any statistical difference ($p>0.05$), although these were improved with the use of novel walker compared to the posterior walker.

Conclusion: The novel walker improves the gait parameters and energy expenditure, and therefore, its use may be encouraged as an adjunct to physical and orthotic therapy in subjects with spastic diplegic CP.

Keywords: Cerebral palsy; efficacy; energy; gait; novel; posterior; walker

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INTRODUCTION

Cerebral palsy (CP) is primarily a disorder of movement and posture. It is a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of its development [1]. It is referred to as a static encephalopathy because, despite the constant primary lesion, the clinical pattern of presentation may change over time due to growth and developmental spasticity, and central nervous system maturation [2]. Spasticity primarily impairs voluntary movements but can occasionally be beneficial for weight bearing or support. Extensor tone in the limbs aids in standing and maintains muscle bulk and bone density [3]. Most of the children with CP have difficulty while walking independently because of impaired postural control, abnormal muscle tone and pathological muscular coordination [4]. Different types of walking aids and assistive devices are often prescribed for assisting and providing the stability necessary for ambulation. Assisted walking may not only improve the growing child mobility but also make a difference in their ability to explore the environment and interact with their peers [5]. However, extremely high heart rates and slow walking speed were recorded in the children with CP during ambulation with walking aids [6].

Walkers are frequently prescribed to children with CP to provide additional stability required for ambulation. Traditionally, an anterior walker has been used as a walking aid. However, a child using an anterior walker tends to lean forward while pushing the walker. The Posterior Walker is sparely used and it is designed to be positioned behind the child because it facilitates a more upright posture [6]. However, it can also be very difficult to collapse and adjust. In the past, studies have been conducted on the comparison of the anterior walker and posterior walkers. Most of the studies have focused on gait analysis, energy consumption, and kinetics and kinematics of the upper extremity in children with spastic diplegic cerebral palsy, however, the information about the use of these walkers is heterogeneous and controversial [7,8]. In systematic reviews, researchers have compared the use of anterior and posterior walkers by children with cerebral palsy to determine which type of walker is preferable. *Poole et al. (2017)* has studied the outcomes including velocity, pelvic tilt, hip flexion, knee flexion, step length, stride length, cadence, double stance time, oxygen cost and participant/parental preference and found heterogeneity and low quality of existing evidence that prevented the recommendation of one walker type [7]. *Tao et al. (2020)* in another review found similar gait parameters and upper extremity functions in both types of walkers, but they concluded that the posterior walker was preferable due to its relatively low oxygen cost [8]. Furthermore, there have been conflicting results in the literature regarding gait parameters and energy expenditure between anterior and posterior walkers. The novel approach of designing walkers for maintaining an upright posture, reducing energy expenditure, and improving gait parameters in people with cerebral palsy has not been thoroughly investigated. An attempt was made in this study to design and develop a novel walker to address issues of height provision, assist the user in walking with proper posture, and improve biomechanical efficiency. Therefore, this study intends to establish the biomechanical efficacy of the novel walker and compare it with the standard posterior walker. This research will help to plan appropriate ambulatory devices for CP children,

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reducing energy expenditure and improving gait parameters.

MATERIALS AND METHODS

2.1 Subject characteristics

- Sample size: Thirty subjects with spastic diplegic CP with age range 4-10 years
- Inclusion criteria: The subjects with poor trunk control with good hand grip power. They were able to understand the command and able to walk independently with a walker. None had undergone orthopaedic or neurosurgical intervention before being enrolled in this study.
- Exclusion criteria: The subjects with poor neck and sitting balance or with profound developmental retardation, multiple disabilities and COVID positive test findings during screening were excluded.
- Ethical approval and Consent: The study was approved by the Institutional Ethics Board of SVNIRTAR, DA/MPO/08/2019 on March 03, 2020. All patients signed an informed consent form and were informed about the purpose of the study with their parents. The CTRI registry number is CTRI/2022/01/039642.

2.2 Description of Walkers

Basically, the posterior walker is designed to be used by individuals who can fully support their own weight and are able to take steps. Posterior walker design neglects the rapid growth and typical activities of young children. In contrast, the novel walker designed and developed in this study has taken the basic functional requirements of children with spastic diplegic CP into consideration. This has been a modified approach ensuring the advantages of different variants of walkers available in the global market. The features of the walkers used for comparison in this study are elaborated below.

Fig. 1 Walkers used (a) Posterior and (b) Novel in the study

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Posterior Walker	Novel Walker
• It is positioned behind the child allowing an upright position. • It has four wheels, two handles, and wraps around the back of the user to ensure proper posture (Fig. 1a). • It has no provision for height adjustment. Its height is 23 inches.	• It is designed to be used with a square frame outside the patient trunk. • It consists of two square frames and four wheel attached to the corners for increasing the base of support, with a handle. • The height adjustment facility with telescopic bars is available that can adjusted to match the measurement of the patient (i.e. greater trochanter to floor). • There are 3 vertical bars out of which two are proximally connected with smaller square frame and distally connected with the base square frame. The front vertical bar is proximally attached to handle and distally attached to the base square frame (Fig. 1b). • A seat is attached to the upper smaller square frame for provide sitting facility and reduce fatigue during ambulation. • The seat height can be adjusted from 16 to 22 inches and the handle height can be raised from 22 to 26 inches.

2.3 Study tools and Parameters

A 10-meter walk test [9] was used for measuring gait parameters. The energy expenditure was measured by using Physiological Cost Index (PCI) by using an oxymeter. Parameters such as step length, stride length, velocity, cadence, width of walking base were measured by using stop watch and measuring tape.

2.4 Study procedure

Following the initial screening, assessment, and evaluation, demographic data such as age, gender, height, and weight were collected. The patients were divided into two groups at random. Group A (n=15) subjects were tested with the posterior walker, while Group B (n=15) subjects were tested with the novel walker. The posterior walker was prefabricated whereas the novel walker was height adjusted to the subject's needs. The handle height was positioned at elbow 15 degree flexion for the individual subject. The training on their use during gait was provided for one month prior to the evaluation so that they were familiar with both types of walkers. The subjects were told to walk on a 10-meter walk test paper using a modified walker or a posterior walker (Fig. 2). An oxymeter was used to measure energy expenditure before and after each experiment. A stop watch and measuring tape were also used to measure step length, stride length, velocity, cadence, and the width of the walking base. The standard COVID protocol was maintained during data collection.

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2.5. Data analysis and statistics

All data were managed in a Microsoft Excel spread sheet. The statistical analyses were conducted using SPSS v. 21.0 (SPSS Inc, Chicago, Illinios). Independent student t-test was performed to analyze the difference between posterior and novel walker. The tests were applied at 95% confidence interval and a *p*-value less than or equal to 0.05 was considered statistically significant.

Fig. 2 Performance of subjects using (a) Posterior and (b) Novel Walkers in 10-meter walk test

RESULTS

The demographic data of included subjects is presented in Table 1. There were 70% boys and 30% girls. There was no significant difference between group A and B for all demographic parameters.

Study Group	Number	Age (year)	Height (cm)	Weight (kg)	BMI (kg/m2)
A	15 (Boys = 12, Girls = 03)	6.6 ± 1.4	117.9 ± 3.7	21.2 ± 3.5	15.3 ± 1.7
B	15 (Boys = 10, Girls = 05)	6.8 ± 1.7	116.8 ± 3.5	20.1 ± 3.6	14.7 ± 1.5

Table 1 Demographic information of subjects

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The results of gait parameters and energy expenditure are presented in Table 2. It show that the mean values of step length, stride length, cadence and velocity is more whereas width of walking base and PCI is less in novel walker than that with posterior walker. However, the results show significant improvement only in terms of velocity and PCI with novel walker ($p<0.05$).

The reduction in walking base and PCI indicate improved gait efficiency. It was observed that the subject walked with 18% higher velocity using novel walker compared to posterior walker and the PCI value indicates that novel walker is 58% more energy efficient compared to posterior walker. However, other parameter like step length, stride length, cadence and velocity did not show any statistical difference between novel walker and posterior walker ($p>0.05$).

Parameters	Posterior Walker	Novel Walker	P value
Step Length (cm)	21.2±2.7	22.8±2.8	p>0.05
Stride Length (cm)	43.0±5.2	45.4±5.1	p>0.05
Cadence (steps/min)	63.8±6.8	68.2±7.6	p>0.05
Velocity (m/min)	7.3±1.7	8.7±1.6	p<0.05
Walking Width (cm)	15.1±2.4	13.2±1.8	p>0.05
PCI (beats/min)	2.48±0.54	1.03±0.32	p<0.05

Table 2 Comparison of Results between Posterior and Novel walker

DISCUSSION

This study intended to compare the effect of the novel walker and posterior walker use on gait parameters and energy expenditure in subjects with spastic diplegic cerebral palsy. Their upper extremities were good functionally and the grade of spasticity in their upper extremities was less than grade 1+ on the modified Ashworth scale. To avoid the learning effect, the children were familiarized with both types of walkers for a period of 1 month. To satisfy the objective, the comparison was made between group A and B with regard to temporal-spatial parameters (step length, - stride length, cadence, velocity, and width of walking base) and energy expenditure measured by PCI. The link between gait parameters and energetic cost shows how variations in step length, cadence, step width, and step variability affect the mechanical work and metabolic cost involved in gait.

The results of our study indicate that the gait parameters such as step length, stride length, cadence, and velocity with a novel walker (22.8±2.8; 45.4±5.1; 68.2±7.6 and 8.7±1.6) are higher than posterior walker (21.2±2.7; 43.0±5.2; 63.8±6.8 and 7.3±1.7)

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showing improvement. However, except velocity ($p<0.05$), the other gait parameters did not show any statistical significance ($p>0.05$) between both groups. The width of the walking base and PCI were decreased with the use of a novel walker (13.2±1.8; and 1.03±0.32) compared to a posterior walker (15.1±2.4; and 2.48±0.54) that indicate improved energy efficiency. An earlier study has reported differences in gait parameters between different variants of a walker. However, there have been inconsistencies in previous reports. *Levangie et al. (1990) and Logan et al. (1989)* showed higher step lengths using a posterior walker compared to the anterior walker ($p<0.05$) [10, 11]. *Chandra Kumar et al. (2019)* showed higher stride length while walking with a posterior walker than the anterior walker ($p<0.05$) [3]. In contrast, the research work performed by *Greiner et al. (1993)* showed no significant difference in step length between the two variants of the walker ($p>0.05$) [12]. *Poole et al. (2017)* observed no significant difference in cadence between the two variants of the walker ($p>0.05$) [7]. In contrast, *Baker et al. (2008)* reported increased steps with the use of an anterior walker ($p<0.05$) [13]. Concerning velocity, the study conducted by *Logan et al. (1990), Strifling et al. (2008), and Konop et al. (2009)* resulted in lower velocity by using a posterior walker [10, 14, 15], however, *Mattsson and Andersson (1997)* and *Poole et al. (2017)* found that the posterior walker was faster than the anterior walker [4, 7]. In contrast, *Park et al. (2001)* and *Chandra Kumar et al. (2019)* found no significant difference in velocity by using an anterior walker and posterior walker ($p>0.05$) [3, 6]. In the same study [3], the authors reported a decrease in step width with the use of the posterior walker ($p< 0.05$) and *Park et al (2001)* observed lesser energy consumption with the posterior walker compared to the anterior walker ($p<0.05$) [6]. In similar reports, the authors employed the heart rate method to calculate the energy expenditure index and found that posterior walker users consumed less energy [14, 15]. However, only one study using perceived exertion obtained a higher energy cost in posterior walker users [4]. These evidence-based narratives synthesized reports indicate the controversial results between different variants of walker use in terms of gait and energy analysis in subjects with CP.

It was observed that the CP subjects acquired a more upright posture with better trunk alignment with the use of the novel walker. The increased step and stride length with the use of a novel walker could be because the usage of a novel walker leads to the position of the center of mass falling inside the base of support. This may cause co-contraction of trunk and knee muscles as well as activation of hip extensors, resulting in a better hip-knee angle and correct foot contact. As gait parameters increase, causing the locomotion approaches normal and the child uses less energy while walking. *Mockford and Caulton* [16] addressed how increasing stride length may imply improve walking stability in children with CP. *Logan et al.* [10] corroborate this hypothesis and discovered a considerable increase in stride length with the posterior walker and a significant decrease in double stance time indicating improved stability. It is important to remember that ambulation with walking aids must be integrated into daily life. Reduced energy expenditure is desirable to encourage the walker to use for longer durations. As a result, while selecting a walking aid, energy conservation is critical. Since one of the goals of intervention for children with CP is their capacity to walk, the use of a walker can help these non-ambulant subjects with impairments to take their first steps toward independence and improve their mobility,

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autonomy, involvement, and social function.

Some of the major limitations of the study include the use of non-instrumental gait analysis which could have provided more insight into the kinematic and kinetic analysis and comparison between novel and posterior used by the authors. Secondly, the acclimatization time for both walkers was one month, which can be considered less time for CP subjects. Lastly, the comparison of gender specific differences for temporal-spatial gait parameters was not undertaken in this study. Therefore, future studies are indicated to check the long-term efficacy with a large number of samples to generalize the findings.

CONCLUSION

The novel walker improved the gait parameters and energy expenditure compared to the posterior walker in subjects with spastic diplegic cerebral palsy. The subjects using the novel walker acquired more upright posture with better trunk alignment. The use of novel walker encourages involvement and improved the physical activity of users with parental satisfaction. Therefore, the use of this novel walker should be encouraged as a part of rehabilitation with physical and orthotic therapy in subjects with cerebral palsy.

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Declarations

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Conflict of interests

The authors declare that there is no conflict of interest.

Ethics approval

This research followed guidelines of the Declaration of Helsinki and was approved by the Institutional Review Board of Swami Vivekanand National Institute of Rehabilitation Training and Research (SVNIRTAR), India.

Consent to participate

The well-informed written consent was obtained from the individuals or their parents prior to their participation in this study.

Written Consent for publication

Not applicable.

Availability of data and material

The authors declare that they have written entirely original work, and if the authors have used the work and/or words of others, then this has been appropriately cited or quoted. All data and materials will be furnished upon request.

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