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RESEARCHARTICLE

CHANGE IN GAIT PARAMETERS OF FORWARD WALKING AFTER GIVING BACKWARD WALKING TRAINING AMONG NORMAL INDIVIDUAL

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ABSTRACT

Background: Backward walking has emerged as an important therapy. Backward walking is regulated by same central pattern generator as forward walking. Gait parameter of interest were step length, stride length, step width and cadence. Measurement was made at baseline before commencement of training and at the end of 4 weeks. ***Methods:*** Initially the subject were made to walk 10 steps forward and 9 steps backwards and was observed for any discomfort. Then patient is made to walk backward for 10 minutes per session barefoot. This training program was carried out for 20 minutes for 3 days/week for 4 weeks with 12 sessions. Pre test measurement for step length, stride length, step width and cadence is taken by making the individuals walk on the flat surface and distance I measured, then the above mentioned backward walking training protocol is given and observed for any changes. After 4 weeks of training post measurement is taken and observed for any changes. ***Result:*** Intervention of forward walking after backward walking significantly improved the cadence, but not other variables are significant. ***Discussion:*** The improvement in walking cadence with RW achieved in the present study may be explained highlighting the biomechanical factors. RW differs from FW by the fact that during RW, there is concentric contraction of quadriceps and eccentric contraction of hamstrings. Further, in the early stance phase of gait cycle during RW, there is activation of knee extensors and ankle plantar flexors. ***Conclusion:*** This study concluded that there is change in cadence in forward walking after giving backward walking training.

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INTRODUCTION

Gait is defined as the manner in which a person walks. Gait is an idiosyncratic feature of a person that is determined by, among other things, an individual's weight, limb length, footwear and posture combined with characteristic motion (Lee, 2022). In normal walking, a gait cycle begins when the heel of the reference extremity contacts the supporting surface and ends when the heel of the same extremity contacts the ground again. The gait cycle is divided into two periods, stance and swing phase where stance constitutes approximately 60% of the gait cycle and swing comprises approximately 40% of gait cycle (Lamoreaux, 1971). Backward walking has been introduced as a means for gait performance improvement. Backward walking is thought to share similarities with forward walking but also has its own unique features. Reverse walking may also improve the function of gait parameters (Rose, 2018). Backward walking is an intervention that may be valuable for enhancing balance and self efficacy to improve mobility function (Rose, 2018). Learning to walk backwards correctly has been recommended to improve the movement components required for walking forward. Backward walking therefore has been promoted as a treatment strategy to improve gait.[4] During backward walking the same motor program is used as during forward walking but possibly running in reverse.

It has been suggested that backward walking may offer some benefits beyond those experience through forward walking alone. Backward walking appears to create more muscle activity in proportion to effort than forward walking. This suggests a greater level of energy expenditure in backward walking than in forward walking. Additionally backward walking also demands a greater oxygen consumption metabolic response and cardio respiratory function than forward walking (Yang *et al*. 2005).

METHODOLOGY

The test was conducted in both male and female college going students between the age of 18-25years.The test was mostly performed on healthy and active participants. The subject who were participating in any exercise regularly and having any quadriceps weakness, knee injury, surgery done for lower limb joint involving ligament ,meniscus in last 6 month were excluded from the test .The outcome measure used to conduct this test are ruler and inch tape. The participants actively consented to participate and fulfills the inclusion and exclusion criteria selected for the study. The exercise was conducted in a large and neat room.

The participants were instructed to wear loose clothing and were made to perform bare footed. A paper sheet of length 6m was taken for both forward and backward walking for each participant individually and each participant were made to walk on it with their foot dipped in colored paint. Red paint was used for forward walking and blue paint was used for backward walking. The gait variables for each participant were measured individually. The step length and stride length in both forward and backward walking were measured using an inch tape. The cadence and speed of each participant were measured using the distance, and timing both FW and BW using a stop watch.

RESULTS

Table-1: Pre and post test outcome measures of among normal individuals in forward walking after backward walking. The above table shows the pre and post test outcomes of outcome measures gait parameters among sample of normal individuals in forward walking after backward walking.

The cadence and speed of each participant were measured using the distance, and timing both FW and BW using a stop watch. Statistical analysis was done for determining the values of mean and SD of both forward and backward walking for all the 30 participants. Time and distance are two basic parameters of motion, and measurements of these variables provide a basic description of gait. Temporal variables include cadance. The distance variables include stride length, step length and width, and degree of toe (Winter, 1994). There was no change observed in outcome measures of step legth, stride length, step width on forward walking after giving training of backward walking. But the change on number of cadence before and after training program was observed and also it was found to be statistically significant with paired t-value of 2.398 at p value of 0.023($p<0.05$). It evidence that training program of backward has an impact of changes on number of cadence in forward walking. But there was no impact on other outcomes. The improvement in walking cadence with RW achieved in the present study may be explained highlighting the biomechanical factors. RW differs from FW by the fact that during RW, there is concentric contraction of quadriceps and eccentric contraction of hamstrings.

Table 1. Pre and post test outcome measures of among normal individuals in forward walking after backward walking

Sl. no	Outcome measures	Pre test		Post test		Paired t-test	p-value
		Range	Mean ±SD	Range	Mean ±SD		
1	**Step length**	39-72	49.93±7.56	42-69	50.13 ±6.47	$t=0.286^{NS}$	p=0.777
2	**Step width**	6-23	16.00±4.27	3-22	15.67±4.72	$t=0.918^{NS}$	p=0.366
3	**Cadence**	96-138	111.17±11.55	96-136	115.50±11.68	t=2.398*	p=0.023
4	**Stride length**	74-139	99.10±11.68	74-126	101.00±11.96	$t=1.194^{NS}$	p=0.249

Note; *-Significant ($p<0.05$), NS-Not significant ($p>0.05$).

In pre test, the step length was ranging within 39-72 with mean and SD of 49.93±7.56.. But in post test, it was found to be increased to the range 42-69 with mean and SD of 50.13 ±6.47. The parametric test for comparison of dependent outcomes the paired t-test was carried out and it was found to be not significant ($p>0.05$). Regarding step width in pre-test, it was ranging within 6-23 with mean and SD of 16.00±4.27. But in post test, it was found to be more or as similar to the range 3-22 with mean and SD of 15.67±4.72. The parametric test for comparison of dependent outcomes the paired t-test was carried out and it was found to be not significant ($p>0.05$). In pre test, the cadence was ranging within 96-138 with mean and SD of 111.17±11.55.. But in post test, it was found to be increased to the range 96-136 with mean and SD of 115.50±11.68. The parametric test for comparison of dependent outcomes the paired t-test was carried out and it was found to be significant ($p<0.05$). Regarding stride length in pre-test, it was ranging within 74-139 with mean and SD of 99.10±11.68. But in post test, it was found to be increased to the range 74-126 with mean and SD of 101.00±11.96. The parametric test for comparison of dependent outcomes the paired t-test was carried out and it was found to be not significant ($p>0.05$). The intervention of forward walking after backward walking significantly improved the cadence but not other variables were not significant.

DISCUSSION

This study examined the differences in gait parameters between forward walking and backward walking among college going students and significant differences were observed. In this study, 30 participants from Padmashree institute of physiotherapy with no disease history or difficulty with walking or orthopedic disorders were included in the study. The participants included both male and female of age group 18-25 years of age. The participants actively consented to participate and fulfill the inclusion and exclusion criteria selected for the study. The exercise was conducted in a large and neat room. The participants were instructed to wear loose clothing and were made to perform barefooted. A paper sheet of length 6m was taken and participants were made to walk on it with their foot dipped in colored paint. The gait variables for each participant were measured individually. The step length and stride length in both forward and backward walking were measured using an inch tape.

Further, in the early stance phase of gait cycle during RW, there is activation of knee extensors and ankle plantar flexors (Gurudut, 2019). This reduces hip and knee flexion in the initial contact of the stance phase of the gait cycle, thereby nullifying the ground reaction forces acting on the knee joint, causing reduced load on the patella femoral joint. Backward walking also reduces added adductor moment at knee joint, thereby decreasing the impact of compressive forces on the medial part of knee joint (Tudor-Locke, 2019). The knee flexors tend to be reciprocal activated with knee extensor in backward walking where as they are roughly co activated in forward walking suggesting a greater level of energy expenditure in backward walking, this results in increase in the cadence in forward walking (Kachanathu, 2020).

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