ORIGINAL RESEARCH PAPER
Volume-8 | Issue-11 | November - 2019 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARISON BETWEEN THE EFFECTS OF PLYOMETRIC TRAINING AND CONTINUOUS MODERATE INTENSITY TRAINING ON THE FITNESS PERFORMANCE OF SEDENTARY INDIVIDUALS

Physiotherapy

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ABSTRACT

Background: Plyometric training is known to improve the production of muscle force and power. Regular jogging with moderate intensity also has multiple benefits pertaining to cardiorespiratory fitness. Therefore, this experimental study was done to compare effects of both on young sedentary individuals.
Methodology: 20 sedentary individuals between age group of 18-25 years were divided into two groups: plyometric training (PT) and continuous moderate intensity training (CMT). Both PT and CMT was performed for 6 weeks, 3 days/week. Participants were tested before and after 6 weeks using 5 outcome measures.
Result: There was no significant difference between the improvements in fitness tests between both the groups. However, PT showed statistically significantly better improvements in shuttle run test.
Conclusion: Both PT and CMT showed similar improvement in fitness performance of sedentary individuals. But PT showed better improvement in terms of speed.

KEYWORDS

plyometric training, continuous moderate intensity training, fitness performance, sedentary individuals

INTRODUCTION

Non-exercise practices can be classified as: 1) sedentary behavior and 2) light-intensity activity.[1] There is an increased sedentary behavior in today's youth which may be associated with higher risks of various chronic conditions. [2,3] According to ACSM guidelines, participating in like 150 minutes/week of moderate-to-high intensity activity helps counteract and deal with different chronic conditions.[1,4] Evidence reveals to us that our lungs, heart, muscles and even our mind require the impacts of daily exercise. Light and moderate intensity joggers have reduced death rates than non-joggers.[5] Jogging is a remarkable exercise practice because of its universality as well as longevity.[6]

New strategies to improve physical fitness of youth have been developed.[7] Various activities involve stretch-shorten cycles (SSC). A SSC involves eccentric muscle action followed by rapid concentric contraction of the same muscle. Physiological advantage is provided by SSC since this generates greater force during the concentric contraction as compared to the concentric contraction of a muscle without preceding eccentric contraction, because in SSC there is storage and return of elastic energy. When the muscle contracts eccentrically, the force generated is added to the force generated during concentric contraction without a relative increase in metabolic energy requirement. [8]

Movements that involve SSC are used in plyometric training (PT). It is a form of training that improves the production of muscle force and power. [9] Combination of the eccentric pre-stretch, amortization phase and concentric shortening phases is what makes this activity so effective in performance enhancement.[10] PT involves jumps, hop, skip, etc. and can be performed either independently or in combination with other training program. PT ranges from low intensity to high intensity exercises and has various forms which depend on the training purpose. PT improves endurance, speed, strength, muscle power, co-ordination and change in direction. [9,11]

Research on plyometric training has been focused on athletes, and less research has been done on sedentary individuals.[12] There is hardly any study done with moderate to high intensity plyometric training in young adults taking into consideration the ACSM recommendations of exercise and to use it as an alternative to CMT. Therefore, the purpose of this study was to formulate a PT exercise program for young adults similar to the 'Plyo-play' program [7] and to compare it with continuous moderate intensity jogging. Various tests used for comparison were Sit and Reach test (SNRT) for hamstring flexibility, Sargent Jump test (SJT) for lower body power, Timed Sit-Up test (1 minute) (TSUT) for abdominal strength, Modified Push-up Test (MPT) for upper body power and Shuttle Run test (4*10m) (SRT) for speed.[13,14,15,16,17]

MATERIALS AND METHODS

From the Institutional Ethical committee, the study received ethical clearance (PIMS/CPT/IEC/2018/557). Written informed consent was taken from the individuals. Twenty participants between 18-25 years of age who were not involved in any form of regular physical activity for more than 2 days per week were randomly selected and assigned to either the plyometric training group (PT) or continuous moderate intensity training (CMT) group. Individuals with any cardiovascular, pulmonary, metabolic, neurological or orthopedic condition that would have interfered with the intervention were excluded from the study. A heart rate sensor (Polar Heart rate monitor FT7 ™) was used to maintain the target heart rate during the intervention.

PROCEDURE

Outcome measures:

A warm-up and cool down session which included stretching were included in all the testing and training sessions. The tests were performed both pre and post training i.e. after 6 weeks in order to assess the effects of training on physical fitness.

1)Modified sit and reach test: The individual sat on the floor with the buttocks, shoulders and head in contact with the wall, knees extended with soles of the feet against the box. The top of the box was extended until it touched the fingertips. The individual then reached forward slowly with one hand on top of the other, sliding the fingers along the top of the box. The most distant point contacted by the fingertips was measured.[18]

2)Sargent jump test: While standing flatfooted next to a wall on their dominant side and that arm extended above the head, the individual marked on the wall the highest point that could be reached. At the moment preceding the jump, the individuals could freely flex the lower limbs, in effort to promote the highest vertical jump possible. At the highest point of the jump, the individuals extended that hand against the wall as to mark the maximum height jumped. The jump height was the subtraction between the 2 points marked on the wall. All of the individuals jumped three times and only the highest jump was considered.[14]

3)Timed sit-up test (1 minute): The participant lied supine on the mat with knees bent and the feet held flat down firmly by a partner and arms crossed in front of the chest. The heels were kept 30 to 45 cm from the buttocks. In response to the starting signal, they started performing curl ups until the elbows touched the thighs, and then uncurls until the mid-back contacts the mat. This was counted as one time. They repeated as many sit-ups as possible within one minute. [15]

4)Modified push-up test: The bent knee push-up required that the

participant lie with the hands under the shoulders and knees close together, touching the ground. The feet were raised in air. Then the arms were bent, lowering the body to the floor such that the chest touched the ground; this was the down position. The participant then performed these steps again in the same pattern until they got tired. One push-up was counted when the participant started at the up position, went to the down position, and then returned to the up position. The score was the number of pushups executed correctly before stopping or before body position was changed. [16]

5)Shuttle run test(4*10m*): Two parallel lines were drawn on the ground ten meters apart. Individuals ran back and forth as fast as possible crossing each line with both feet every time. This was performed two times, covering a total distance of 40 m (4 × 10 m). Every time they crossed any of the lines, they picked up (the first time) or exchange (second and third time) a sponge, which was previously placed behind the lines. The stopwatch was stopped when they crossed the end line with one foot and that time was recorded.[17]

Intervention:

Continuous moderate intensity training (CMT) group:

Using the Karvonen's formula, the target heart rate was calculated on the basis of intensity which was taken as 40-60%. Individuals in this group performed jogging thrice per week for 30 minutes at 40-60% of Heart rate reserve (HRR), which was being measured by a heart rate monitor. After this, resistance training was performed which included modified push-ups and curl-up, 1 set each of 10 repetitions, under therapist's supervision for 6 weeks.

Plyometric training (PT) group:

Individuals were trained thrice per week, for approximately 30 mins, on non-consecutive days for 6 weeks under therapist's supervision. The heart rate monitor was worn by the individual and the heart rate was not allowed to go above 85% of maximum heart rate. (Table 1. shows the intervention protocol for plyometric training.)

Table 1.: PLYOMETRIC TRAINING PROGRAM

W eek 1 - Week 2 (Level 1) *1 set, 10 repetitions*	**W eek 3 - Week 4(Level 2)** *1 set, 8 repetitions*	**W eek 5 -Week 6(Level 3)** *1 set, 6 repetitions*
Inclined push ups	Modified push ups	Declined push up
Leg raise	Planks	Curl up with jump
Double leg skipping	Plus jumping	Hurdle jump
Vertical jump and reach	Zig zag double leg jump	Jump & turn 180 degree
Lunges	Lunges chest pass	Lunge and jump
Figure of 8 run (10 m)	Power skip	Single leg zig zag jump
Arrow running	Lateral hops	Clock jump (8 sides)
	M-run	Squats
		Shuttle run

DATA ANALYSIS AND RESULT

Mean standard deviation were measured and paired and unpaired t tests were used. The statistical tests were done with Instat New. The mean age of the individuals in CMT was 20.5 ± 2.07 years and that of PT group was 20.22 ± 2.10 years. Comparison of pre and post intervention test scores of CMT are shown in the table (Table 2.). The comparison of pre and post intervention scores of PT group are shown in the table (Table 3.). The comparison between post intervention scores of CMT and PT are shown in the table (Table 4.). Table 4 shows that participants in the PT group completed the shuttle run test in less time as compared to participants in the CMT group.

Table 2.: Comparison Of Pre And Post Intervention Test Scores Of Cmt

TEST	PRE/POST	MEAN	SD	p value	t value	RESULT
SNRT	PRE	27.18	5.86	0.0141	3.247	SIGNIFICANT
	POST	30.37	5.78	(<0.05)		
SJT	PRE	24.87	3.82	0.0082	3.643	VERY
	POST	27.56	3.13	(<0.05)		SIGNIFICANT
TSUT	PRE	19.37	1.76	0.0064	3.841	VERY
	POST	23	2.32	(<0.05)		SIGNIFICANT
MPT	PRE	11.87	5.30	0.0085	3.618	VERY
	POST	21.37	5.75	(<0.05)		SIGNIFICANT
SRT	PRE	12.93	0.71	0.0017	4.937	VERY
	POST	12.50	0.64	(<0.05)		SIGNIFICANT

Table 3: Comparison Of Pre And Post Intervention Test Scores Of Pt

TEST	PRE/POST	MEAN	SD	p value	t value	RESULT
SNRT	PRE	28.22	6.83	0.0066	3.641	VERY
	POST	32.72	4.94	(<0.05)		SIGNIFICANT
SJT	PRE	28.72	3.40	0.0160	3.043	SIGNIFICANT
	POST	30.88	3.18	(<0.05)		
TSUT	PRE	18.88	7.45	0.0013	4.856	VERY
	POST	21.66	8.07	(<0.05)		SIGNIFICANT
MPT	PRE	17	4.30	0.0007	5.328	EXTREMELY
	POST	25.11	3.25	(<0.05)		SIGNIFICANT
SRT	PRE	13.17	0.77	0.0006	5.527	EXTREMELY
	POST	12.25	0.56	(<0.05)		SIGNIFICANT

Table 4.: Comparison Between Post Intervention Test Scores Of Cmt And Pt

TEST	GROUP	MEAN	SD	p value	t value	RESULT
SNRT	CMT	30.37	5.78	0.4267	0.8170	NOT
	PT	32.72	4.94	(>0.05)		SIGNIFICANT
SJT	CMT	27.56	3.13	0.6193	0.5073	NOT
	PT	30.88	3.18	(>0.05)		SIGNIFICANT
TSUT	CMT	23	2.32	0.4430	0.7880	NOT
	PT	21.66	8.07	(>0.05)		SIGNIFICANT
MPT	CMT	21.37	5.75	0.6446	0.4708	NOT
	PT	25.11	3.25	(>0.05)		SIGNIFICANT
SRT	CMT	12.50	0.64	0.0233	2.526	SIGNIFICANT
	PT	12.25	0.56	(<0.05)		

DISCUSSION

The primary finding of this study was that both CMT and PT for 6 weeks, 3 days/week for approximately 30 mins showed significant improvements in hamstring flexibility, lower body power, abdominal strength, upper limb strength and speed.

Another finding of this study was that both CMT and PT groups produced equal improvements in upper body strength, lower body power, abdominal strength and hamstring flexibility but improvement in speed was better in the PT group as compared to CMT group. This might be due to specific training adaptations that resulted from the maximum speed running exercises included in plyometric training. [7] Since both the groups participated in these trainings for the same period and since both the trainings included exercises for improving upper body strength, lower body power, abdominal strength and hamstring flexibility, both the groups showed equal improvements in these. These gains in fitness performance are comparable with previous studies involving 8-11 years children as the plyometric training resulted in improvements in the long jump, push-ups, half mile, curl-up, shuttle run and sit and reach flexibility. [7] Another study conducted by J. David Branch on 18 sedentary women concluded that moderate intensity exercise improves cardiovascular fitness in premenopausal sedentary women. [19] It was observed that PT was more enjoyable and so adherence to exercise program was better than CMT. PT and CMT are safe and valid and can be used to design regular physical activity programs for sedentary individuals. The ACSM guidelines of participating in 150 minutes/week of moderate-to-high intensity activity to help counteract and deal with different chronic conditions[1,4] can be fulfilled by young individuals by exercising with PT and can be a better alternative to CMT.

CONCLUSION

Both PT and CMT show similar improvements in fitness performance of sedentary individuals when measured with SNRT, SJT, TSUT, MPT and SRT. But PT shows better improvement in speed. Also, plyometric training is more enjoyable and therefore the adherence is better than CMT, making it a better alternative to CMT.

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