

EFFECT OF POST-TRAINING LIMBERING-DOWN SESSIONS ON FLEXIBILITY AND EXPLOSIVE POWER AMONG PHYSICAL EDUCATION TRAINEES

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ABSTRACT

The purpose of the present study was to examine the effect of a structured six-week post-training limbering-down programme on flexibility and explosive power among undergraduate physical education trainees. Twenty-eight male trainees (20–25 years) were randomly assigned into an experimental group (n = 14) and a control group (n = 14). The experimental group performed systematic limbering-down exercises for six weeks, five days per week (20–30 minutes per session) immediately after regular training, whereas the control group continued their normal training without additional recovery intervention.

Flexibility was assessed using the Sit-and-Reach Test, and explosive power was measured using the Standing Long Jump Test. Data were analyzed using mean, standard deviation, paired sample t-test, and independent sample t-test at 0.05 level of significance.

Results revealed statistically significant improvements in flexibility ($t = -2.705$, $p < 0.05$) and explosive power ($t = -3.931$, $p < 0.05$) in the experimental group, while no significant changes were observed in the control group. The findings indicate that structured post-training limbering-down sessions enhance neuromuscular recovery and positively influence performance-related fitness components.

Keywords: Limbering-down, Cool-down, Flexibility, Explosive Power, Recovery Training

1. INTRODUCTION

Physical fitness forms the foundation of effective participation in sports and physical education programmes. It is closely associated with health, injury prevention, and athletic performance. Physical education trainees are regularly exposed to vigorous training sessions that impose mechanical stress on muscles, joints, and connective tissues. Without proper recovery, accumulated fatigue can impair performance and increase injury risk.

An exercise session typically consists of three phases: warm-up, main activity, and recovery. While warm-up has been extensively studied, the recovery phase—commonly referred to as limbering-down or cool-down—has received comparatively less scientific attention.

Limbering-down involves low-intensity aerobic activity followed by stretching exercises. Its physiological objectives include:

- Gradual reduction of heart rate and blood pressure
- Enhanced venous return and circulation
- Removal of metabolic waste products
- Reduction of muscle stiffness
- Restoration of muscle length

Flexibility is the range of motion at a joint. It is influenced by muscle elasticity, tendon compliance, and neuromuscular coordination. Improved flexibility reduces injury risk and enhances movement efficiency.

Explosive power refers to the ability to exert maximal force in minimal time. It is a critical determinant of performance in jumping, sprinting, and throwing activities. The stretch-shortening cycle mechanism plays a key role in explosive movements, and muscle elasticity contributes significantly to this mechanism.

Although cool-down exercises are widely practiced, limited research has investigated their long-term effects on both flexibility and explosive power. Therefore, the present study was undertaken to examine these effects scientifically.

2. OBJECTIVES OF THE STUDY

1. To determine the effect of post-training limbering-down on flexibility.
2. To determine the effect of post-training limbering-down on explosive power.

3. HYPOTHESES

1. There will be a significant improvement in flexibility due to limbering down.
2. There will be a significant improvement in explosive power due to limbering down.

4. METHODOLOGY

4.1 Research Design

Randomised pre-test – post-test control group design.

Group	Pre-test	Treatment	Post-test
Experimental (n=14)	O ₁	X	O ₂
Control (n=14)	O ₁	—	O ₂

4.2 Participants

Twenty-eight undergraduate male physical education trainees aged 20–25 years were selected from Kuvempu University. Subjects were randomly assigned into:

- Experimental Group (n=14)

- Control Group (n=14)

4.3 Variables

Independent Variable:

Six-week limbering-down programme

Dependent Variables:

1. Flexibility
2. Explosive Power

4.4 Tests and Measurement

Variable	Test	Unit
Flexibility	Sit-and-Reach Test	cm
Explosive Power	(Running Long Jump Test	meters

4.5 Training Protocol

- Duration: 6 weeks
- Frequency: 5 days/week
- Session Duration: 20–30 minutes
- Exercises: Static and dynamic stretching
- Method: With and without partner (alternate days)

Control group received no limbering-down intervention.

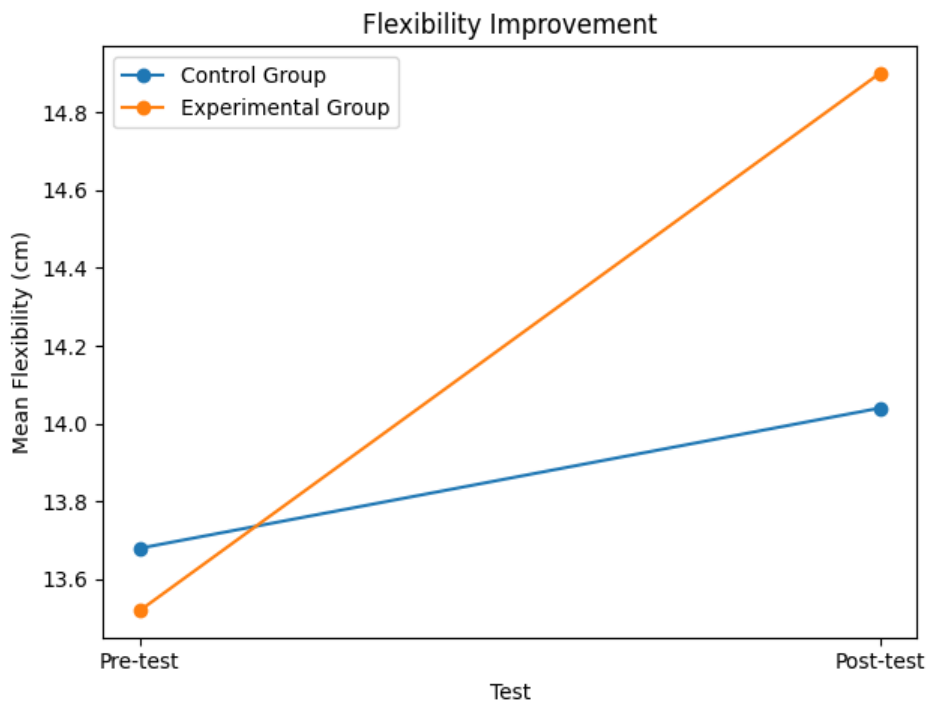
4.6 Statistical Analysis

- Mean
- Standard Deviation
- Paired sample t-test
- Independent sample t-test
- Level of significance: 0.05

5. RESULTS

Table 1: Mean, Standard Deviation, and t-value of Flexibility (Sit-and-Reach Test)

Group	Test	N	Mean (cm)	SD	t-value
Control	Pre-test	14	13.68	1.30	0.69
Control	Post-test	14	14.04	1.78	—
Experimental	Pre-test	14	13.52	1.41	-2.71*
Experimental	Post-test	14	14.90	1.09	—



Significant at $p < 0.05$

Interpretation – Flexibility (Sit-and-Reach Test)

Table 1 shows that the experimental group demonstrated a statistically significant improvement in flexibility after six weeks of structured limbering-down training ($t(13) = -2.71, p < .05$). The mean score increased from 13.52 cm to 14.90 cm, indicating improved joint range of motion and muscle extensibility.

In contrast, the control group showed only a slight, non-significant improvement ($t = 0.69, p > 0.05$).

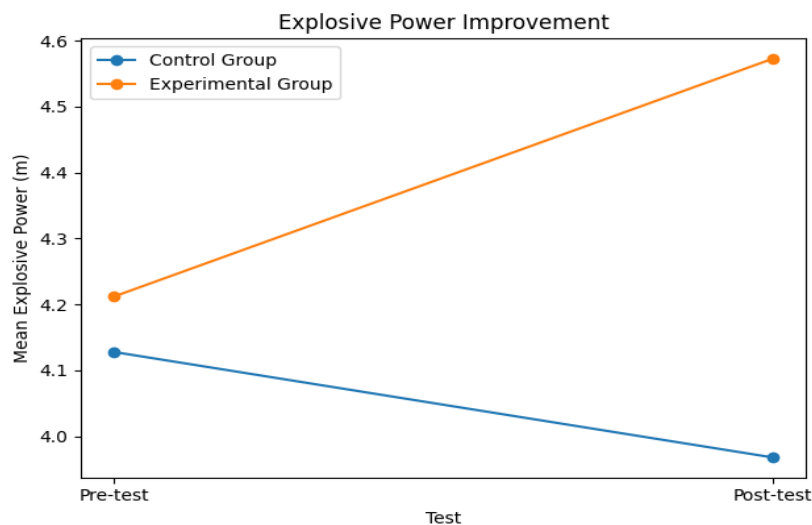
The improvement in the experimental group may be attributed to increased muscle elasticity, reduced passive stiffness, enhanced stretch tolerance, and better post-exercise circulation.

Therefore, regular post-training limbering-down exercises significantly improved flexibility, and the hypothesis is accepted.

5.2 Explosive Power

Table: Mean, Standard Deviation and t-value of Explosive Power ((Running Long Jump Test))

Group	Test	N	Mean (m)	SD	t-value
Control	Pre-test	14	4.1279	0.29134	-0.705
Control	Post-test	14	3.9679	0.76232	—
Experimental	Pre-test	14	4.2121	0.41616	-3.931*
Experimental	Post-test	14	4.5729	0.46349	—



Significant at $p < 0.05$

Interpretation

The experimental group showed a statistically significant improvement in explosive power after six weeks of limbering-down training ($t(13) = -3.93, p < .05$). The mean jump distance increased from 4.21 m to 4.57 m, indicating enhanced lower-body power.

In contrast, the control group showed no significant change ($t = -0.705, p > 0.05$).

Thus, regular post-training limbering significantly improved explosive power among physical education trainees.

6. DISCUSSION

Flexibility

- The experimental group showed significant improvement in flexibility after six weeks of structured limbering down.
- Regular stretching increased muscle elasticity and joint range of motion.
- Reduced passive muscle stiffness and improved stretch tolerance contributed to the improvement.
- The control group showed no significant change, indicating that normal training alone was insufficient to improve flexibility.

Explosive Power

- The experimental group showed significant improvement in explosive power.
- Improved muscle elasticity and better use of the stretch-shortening cycle may have enhanced force production.
- Structured recovery through limbering-down likely reduced fatigue and supported performance adaptation.
- No significant improvement was observed in the control group.

Overall

- Regular post-training limbering down positively influenced both flexibility and explosive power.
- Structured cool-down should be considered an essential part of training programs.

7. CONCLUSION

Based on the findings of the study, the following conclusions were drawn:

1. A six-week structured post-training limbering-down programme significantly improved flexibility among undergraduate physical education trainees.
2. The limbering-down programme also significantly enhanced explosive power.
3. Regular stretching during the cool-down phase contributes to improved muscle elasticity, neuromuscular efficiency, and performance adaptation.
4. Limbering-down should be considered an essential component of physical education training programmes.

8. RECOMMENDATIONS

Based on the results of the study, the following recommendations are made:

1. Physical education instructors and coaches should incorporate structured limbering-down sessions after regular training.
2. Limbering-down programmes should include systematic stretching exercises targeting major muscle groups.
3. Training schedules should allocate sufficient time (20–30 minutes) for cool-down and recovery activities.
4. Awareness should be created among trainees regarding the importance of recovery for performance enhancement and injury prevention.

9. SUGGESTIONS FOR FURTHER RESEARCH

1. Similar studies may be conducted on female physical education trainees.
2. Future research may examine the effect of limbering-down on physiological and biochemical markers.
3. Studies with larger sample sizes are recommended for broader generalization.
4. Comparative studies may be conducted between different types of cool-down methods (static, dynamic, PNF).
5. Long-term intervention studies (more than six weeks) may be undertaken to assess sustained adaptations.

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