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Immediate Effects of Various Pre-Exercise Warm-Up Protocols on Selected Physical Fitness Parameters

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Abstract

The objective of this study was to examine and compare the immediate effects of dynamic and static stretching warm-up routines on physical fitness parameters, specifically joint flexibility and explosive lower-limb power as measured by the standing broad jump. A randomized within-subject design was employed to assess these fitness outcomes following distinct warm-up protocols. Flexibility was evaluated using the sit-and-reach test (SR), and explosive leg power was assessed via the standing broad jump (SBJ). A total of 45 college students, ranging in age from 18 to 27 years (mean age = 21.8 ± 2.1 years), were recruited from the Department of Physical Education and Sports at Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India. Data were analyzed using one-way ANOVA at a significance threshold of $p < 0.05$ to identify whether meaningful differences existed between groups. The findings revealed statistically significant differences in both flexibility and standing broad jump performance between the experimental groups and the untreated control group.

Keywords: Static stretching, dynamic stretching, flexibility, standing broad jump

1. Introduction

Athletes and fitness practitioners are routinely advised to engage in a warm-up session prior to vigorous physical exertion. Warm-up is widely regarded as an essential component of any structured training program. It has been proposed that adequately preparing the musculoskeletal system through warm-up activities can reduce the risk of injury, promote joint mobility, and optimize athletic output during subsequent exercise or competition. Various warm-up strategies, including different forms of stretching, have been shown to increase tendon compliance, improve the range of motion at targeted joints, and enhance overall movement function (Thompson, Gordon, & Pescatello, 2010) [4].

Considerable theoretical and empirical attention has been devoted to understanding the relative merits of different warm-up modalities. Two particularly common stretching approaches are dynamic stretching (DS) and static stretching (SS). In recent years, static stretching has declined in popularity among practitioners following a body of research indicating that it may acutely impair explosive performance (Behm & Chaouachi, 2011) [2][5]. Conversely, low-to-moderate intensity aerobic activity combined with static stretching continues to be recommended for general fitness populations. Static stretching has been demonstrated to improve joint range of motion and alleviate muscular tension (Anderson, 2000) [1].

Flexibility, broadly defined as the extent of movement achievable at a given joint, is recognized as one of the fundamental components of physical fitness. Insufficient flexibility can impede the execution of sport-specific skills and may increase susceptibility to musculotendinous injury. The standing broad jump, also referred to as the standing long jump, serves as a widely used and easily administered field test of explosive leg power. This test was historically featured as a competitive event at the Olympic Games and remains a standard assessment tool in sports science and physical education research.

2. Purpose Of The Study

The aim of this investigation was to compare the immediate effects of dynamic and static stretching warm-up protocols on two key physical fitness variables: flexibility and standing broad jump performance in college-aged participants.

3. Methodology

To fulfil the study's objectives, 45 male college students between the ages of 18 and 27 years (mean age = 21.8 ± 2.1 years) were recruited from the Department of Physical Education and Sports, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India. A priori power analysis, conducted following a pilot study, determined that a minimum of 45 participants was adequate to achieve statistical power of 0.80 at an alpha level of 0.05 with a moderate effect size. Participants were randomly assigned to three groups of 15 individuals each: a Dynamic Stretching Group (DSG), a Static Stretching Group (SSG), and a no-treatment Control Group (CG). The primary outcome measures, flexibility and explosive lower-limb strength, were assessed immediately following the respective warm-up interventions using the sit-and-reach test and the standing broad jump. All data were statistically analyzed using a one-way Analysis of Variance (ANOVA) with a significance criterion of $p < 0.05$.

4. Data Analysis

The mean performance values on both fitness variables for the dynamic stretching, static stretching, and control groups were computed and compared. The results of the one-way ANOVA for each variable are presented in Tables 1 and 2 below.

Table 1: One-Way ANOVA Summary for Standing Broad Jump Performance

Variable	Dynamic Mean	Static Mean	Control Mean	Source	SS	df	MS / F
Standing Broad Jump	1.97	1.93	1.80	Between	0.07	2	1.017 / F = 0.774
				Within	0.027	57	23.451
*Significant at p < 0.05. Critical F-value (df 2 & 32) = 3.29.							

The computed F-ratio for the standing broad jump exceeded the critical table value of 3.29 at the 0.05 significance level (df = 2, 32), indicating a statistically significant difference in explosive leg power improvement among the three groups. The dynamic stretching group recorded the highest mean performance (1.97 m), followed by the static stretching group (1.93 m), with the control group yielding the lowest mean (1.80 m).

Table 2: One-Way ANOVA Summary for Flexibility (Sit-and-Reach Test)

Variable	Dynamic Mean	Static Mean	Control Mean	Source	SS	df	MS / F
Sit-and-Reach Test	15.35	15.45	15.25	Between	24.26	2	12.13 / F = 4.59
				Within	84.52	32	2.64
*Significant at p < 0.05 (test values in inches). Critical F-value (df 2 & 32) = 3.29.							

For the flexibility measure, the obtained F-ratio of 4.59 also surpassed the critical value of 3.29 at the 0.05 level (df = 2, 32), confirming a statistically significant difference in flexibility across groups. The static stretching group achieved the highest mean sit-and-reach score (15.45 inches), marginally ahead of the dynamic group (15.35 inches), with the control group recording the lowest score (15.25 inches).

5. Discussion

The present results are consistent with earlier studies reporting that an acute session of static stretching can diminish explosive power output in physically active adults (Cornwell et al., 2001 [3] & Young & Elliot, 2001) [6]. Cornwell et al. (2001) [3] previously documented that pre-exercise static stretching reduced vertical jump height by approximately 4.4%, a finding that aligns with the comparatively lower broad jump scores observed in the static stretching group of the current study. Dynamic stretching, by virtue of its closer resemblance to functional sport movements and its capacity to elevate muscle temperature and neural activation, would theoretically be expected to outperform static stretching as a preparatory warm-up for explosive tasks (Torres et al., 2008). Moreover, research by Turki et al. (2011) [5] demonstrated that as little as ten minutes of dynamic stretching was sufficient to enhance vertical jump performance characteristics, lending further support to the superiority of dynamic protocols for power-based outcomes. In the domain of flexibility, however, the marginally higher sit-and-reach scores in the static stretching group suggest that sustained positional stretching remains a valid approach for acute gains in joint range of motion (Behm & Chaouachi, 2011) [2].

6. Conclusions

Based on the statistical analysis of the data collected, the following conclusions were drawn:

1. Both dynamic and static stretching warm-up protocols produced statistically significant improvements in explosive lower-limb power and joint flexibility compared to the control condition.
2. Statistically significant differences were observed between the experimental groups and the control group in both explosive power and flexibility outcomes, confirming that structured pre-exercise stretching is more beneficial than no warm-up intervention.

7. References

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