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**EXTENDED  
ABSTRACT**

# Effect of Foam Rolling vs. PNF Stretching on Hamstring Flexibility Among Female Teenage Netball Athletes

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## I. INTRODUCTION

Optimal hamstring flexibility is pivotal for explosive movement and injury mitigation in competitive netball [1][2]. This study critically examines the acute impacts of foam rolling versus proprioceptive neuromuscular facilitation (PNF) stretching on flexibility gains among female teenage netball athletes [3][4][5]. By contrasting these popular interventions, we aim to inform evidence-based warm-up strategies tailored for youth sport performance and rehabilitation protocols [1][6][7].

## II. METHODS

Twenty female netball athletes (aged 13–17) were allocated to foam rolling or PNF stretching. Both groups completed a single session following a warm-up. Foam rolling involved 3 sets per leg, 30–40 seconds each [1][4]; PNF used a towel with 6-second contractions and 10-second stretches, 3 sets per leg [3][7]. Hamstring flexibility was assessed pre- and post-intervention via the stand and reach test [5][8]. Standardized protocols, ethical clearances, and calibrated equipment ensured consistency [6].

## III. RESULTS AND DISCUSSION

### A. Acute Flexibility Response to Foam Rolling

Foam rolling improved hamstring flexibility from 4.40 cm to 8.90 cm, with a mean gain of 4.50 cm ( $\pm 4.06$ ) [1][4][8]. Although individual responses varied widely, likely due to technique or muscle condition, foam rolling may promote acute flexibility via increased blood flow and reduced tension [4][6]. However, no statistical significance was found compared to the PNF group [3][5].

### B. Acute Flexibility Response to PNF Stretching

PNF stretching led to a 3.35 cm ( $\pm 1.89$ ) average improvement, with scores increasing from 3.45 cm to 6.80 cm [2][3]. Compared to foam rolling, PNF produced more consistent outcomes, possibly due to controlled muscle activation and relaxation phases [4][5]. Yet, the between-group difference remained statistically insignificant, suggesting both methods yield comparable short-term flexibility gains [1][3][5].

### C. Practical Applicability of Foam Rolling and PNF

Foam rolling proved more practical and autonomous, requiring minimal equipment and no partner [6][8]. PNF, though effective, may be less feasible in group settings due to its reliance on assistance [3][7]. Coaches should consider context when selecting techniques; foam rolling suits self-managed routines, while PNF may benefit supervised training [1][5]. Instruction may enhance foam rolling's inconsistent outcomes [8][6].

TABLE I  
SUMMARY OF FLEXIBILITY SCORES (CM)

Group	Pre-Test	Post-Test	Improvement
Foam Rolling	4.40 $\pm$ 12.69	8.90 $\pm$ 10.37	4.50 $\pm$ 4.06
PNF Stretching	3.45 $\pm$ 5.10	6.80 $\pm$ 4.80	3.35 $\pm$ 1.89

Both groups showed improved hamstring flexibility after one session. Foam rolling had a slightly higher mean gain (4.50 cm) compared to PNF stretching (3.35 cm), suggesting greater practical benefit.

TABLE II  
BETWEEN-GROUP COMPARISON (IMPROVEMENT)

Test	p-value	Effect Size	Result
Mann-Whitney U	0.969	r = 0.02	No significant difference

Note: Mann-Whitney U was used due to violation of normality ( $p = 0.001$ )

No significant difference was found between groups ( $p = 0.969$ ). The effect size was negligible, indicating similar effectiveness of foam rolling and PNF stretching in improving flexibility.

## IV. CONCLUSIONS

This study highlights that both foam rolling and PNF stretching can acutely enhance hamstring flexibility in young netball athletes. While no method proved superior, foam rolling's accessibility offers practical value in sports settings. These findings support informed flexibility training decisions and underscore the importance of individualized, well-executed intervention strategies.

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