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COLLOQIUM PROCEEDINGS

EXTENDED ABSTRACT

The Effects of Hamstring Cooling and Cryostretching on Flexibility Among Healthy Young Adults

Ahmad Qamarul Mustafa Kamal[1], Razif Sazali[1], Muhammad Zulqarnain[1], Amrun Haziq[1], Aizzat Adnan[1], Adam Linoby[1], & Yusandra Md Yusoff[1*]

[1]*Faculty of Sports Science and Recreation, Universiti Teknologi MARA, Negeri Sembilan Branch, Seremban Campus, Negeri Sembilan, MALAYSIA*

**Corresponding author: yusandra@uitm.edu.my*

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I. Introduction

Improving hamstring flexibility is vital for injury prevention and athletic performance. While cryotherapy and stretching independently enhance flexibility, their combined effect of cryostretching still remains underexplored. This study examines the acute effects of hamstring cooling and cryostretching on flexibility in healthy young adults using a crossover design. By comparing these methods with a control condition, the research addresses gaps in combined-intervention studies and evaluates their relative effectiveness.

II. Methods

Twenty-five healthy adults aged 18–25 underwent hamstring cooling, cryostretching, and control conditions in a randomized crossover design. Hamstring cooling involved ice application, while cryostretching combined icing with proprioceptive neuromuscular facilitation. Control involved rest only. Each condition was performed on separate days with rest intervals. Flexibility was assessed pre- and post-intervention using the Sit-and-Reach Test, with changes in scores used to evaluate effectiveness.

III. Results and Discussion

Hamstring cooling yielded the lowest flexibility gain (32.6 ± 9.52 cm). Though it significantly differed from cryostretching ($p < 0.001$), its comparison with the control was not statistically significant ($p = 0.071$). This aligns with prior research indicating cooling may inhibit flexibility by reducing muscle spindle activity, suggesting it is less suitable for flexibility-focused warm-ups.

Cryostretching produced the greatest flexibility improvement (36.0 ± 9.06 cm), significantly outperforming both cooling ($p < 0.001$) and control ($p = 0.006$). The cold application likely reduced pain sensitivity, enabling deeper muscle stretch during PNF. This synergy supports prior findings and offers a potent, short-term flexibility enhancement method combining thermal and mechanical mechanisms.

Comparatively, cryostretching had the most pronounced impact on flexibility, followed by control (34.0 cm), and cooling. The control group's moderate improvement underscores the value of active intervention. Cryostretching's superior performance indicates strong practical utility in athletic and rehabilitative settings for rapid flexibility gains.

Repeated Measures ANOVA revealed significant differences among interventions: $F\ (2, 48) = 23.2$, $p < 0.001$. Post hoc Tukey tests confirmed cryostretching significantly outperformed others. These findings support cryostretching as an effective, real-world strategy for enhancing acute flexibility, while suggesting hamstring cooling is better reserved for post-activity recovery contexts.

TABLE I
DESCRIPTIVE STATISTIC

Descriptives

	Post _Hamstring Cooling	Post_Cryostretching	Post_Control
N	25	25	25
Missing	0	0	0
Mean	32.6	36.0	34.0
Median	35.0	37.5	35.3
Standard deviation	9.52	9.06	9.21
Minimum	14.9	16.4	16.0
Maximum	52.6	53.9	51.3
Skewness	−0.205	−0.516	−0.410
Std. error skewness	0.464	0.464	0.464
Shapiro-Wilk W	0.960	0.957	0.963
Shapiro-Wilk p	0.417	0.364	0.480

**Cryostretching showed the highest flexibility score (36.00 cm), significantly higher than Hamstring Cooling (32.60 cm) and Control (34.00 cm) groups ($p < 0.05$).*

TABLE II
WITHIN AND BETWEEN-SUBJECT EFFECTS

Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p
Conditions	147	2	73.75	23.2	< .001
Residual	153	48	3.18		

Note. Type 3 Sums of Squares

[3]

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p
Residual	6026	24	251		

Note. Type 3 Sums of Squares

**The ANOVA test showed a significant difference in flexibility between the three interventions ($p < 0.001$), and all groups met the test conditions, making the results valid.*

TABLE III
POST HOC COMPARISON

Post Hoc Comparisons - Conditions

Comparison							
Conditions		Conditions	Mean Difference	SE	df	t	P_{tukey}
Post_Hamstring Cooling	-	Post_Cryostretching	−3.42	0.554	24.0	−6.17	< .001
	-	Post_Control	−1.43	0.505	24.0	−2.83	0.024
Post_Cryostretching	-	Post_Control	1.99	0.449	24.0	4.42	< .001

**Cryostretching improved flexibility more than cooling and control ($p < 0.001$). Cooling was also better than control ($p = 0.024$).*

IV. CONCLUSIONS

Cryostretching significantly enhances hamstring flexibility in healthy young adults and outperforms both cooling and rest. While cooling may reduce flexibility acutely, cryostretching combines cold-induced analgesia and PNF to yield superior results. These findings support cryostretching as a practical intervention for rapid flexibility improvement in athletic and rehabilitative settings.

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