

Effects of Post-Isometric Relaxation and Static Stretch Training on Hamstring Flexibility among 9 – 11 years old children

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Abstract

Background: Flexibility is an important physical fitness marker playing a vital role in maintaining normal biomechanical function in sports and activities of daily life. Inadequate flexibility is a causative factor that may lead to muscle injury, particularly if the hamstring group of muscles is involved.

Objective: To compare the effectiveness of Post-isometric relaxation (PIR) and Static Stretching (SS) on hamstring flexibility among young children.

Materials and Methods: One hundred and twenty 9 – 11 years old children identified as having hamstrings tightness assessed by passive straight leg raise test were recruited and allocated into three groups: post-isometric relaxation, static stretching and control group. Both intervention groups performed stretching and the control group was not involved in any stretching programme. The exercises were performed for 5 days in a week for six weeks. Passive straight leg raise test was used to assess hamstring flexibility and the measurement was conducted pre- and post- intervention at the end of six weeks programme.

Results: A mixed ANOVA and post hoc analysis using Bonferroni adjustments was used for comparisons of the effectiveness of the stretching methods at the end of six weeks. The results demonstrated improvements in the post isometric relaxation and static stretching groups as compared to the control group ($p < 0.01$). The post isometric relaxation group showed higher gains in hamstring flexibility compared to the static stretching group ($p < 0.05$). Also, there was significant improvement in hamstring flexibility within both the intervention groups at the end of six weeks ($p < 0.01$). However, there were no significant changes in hamstring flexibility in the control group ($p > 0.05$).

Conclusion: Post-isometric relaxation is more effective than static stretching in improving hamstring flexibility among healthy young

children apparently asymptomatic for hamstring tightness. This knowledge can help teachers and physical training assistants in implementing stretching programmes in schools.

Keywords— Hamstring flexibility, Hamstring tightness, children, post isometric relaxation, static stretching

I. Introduction

Flexibility is defined as a muscle's ability to lengthen and thus, allow one or more joints to move through a range of movement [1]. Flexibility by definition is also the mobility of a body segment, which is dependent on the tolerance of soft tissue to movement and the ability of the soft tissue to work with forces applied to it [2].

Some advantages of possessing adequate flexibility include: reduced risk of injury [3]; relief from pain and enhanced athletic performance [4]. Inadequate flexibility is a causative factor that leads to muscle injury, and this statement is true in particular for the hamstring group of muscles [5]. Flexibility is an important fitness parameter for normal biomechanical functioning among sports participants [6].

Studies and reports have published about reduced muscle flexibility (shortening) observed among children and adolescent age group. This shortening is reported to be a result of growth acceleration and sedentary lifestyle that prevails in that age. These studies emphasize the importance of normal hamstring flexibility in maintaining normal posture and gait [7].

A large number of school children had limited lumbar and hamstring flexibility, in a school in Spain about 18-38 % children had reduced hamstring flexibility [8-10]. Hamstring

tightness has been associated with lower back pain among children and it is also observed that children with tight hamstrings pose a greater risk of low back pain during their adulthood [11-13].

When children are less active and spend most of the time sitting and lying on bed, the hamstring muscle that works on the bending the knee and straightening the hip gets more prone to becoming tight. The development of tightness in hamstring leads to pain and poses a higher risk to injury and can cause difficulty in walking. These discomforts or issues arising from shortened hamstrings can be avoided, if focus is made on maintaining and improving children's flexibility [14].

Various exercises and stretching programs exist in physiotherapy that can be used to manage hamstring tightness. Proper stretching is important to improve flexibility [15]. The incidence of hamstring tightness is high among children and adolescents and it is well known that it is linked with back pain, spinal deformities, disk herniation, abnormal lumbar pelvic rhythm etc. When hamstring tightness is treated with stretching exercises performed regularly, it has proven to improve hamstring flexibility [16].

Studies have established that static stretching and muscle energy technique (MET) are both effective in improving joint flexibility when compared to the control group, who do not receive any stretching program. However, there is still debate about which is the most effective way to be used by practitioners [17].

The findings from published studies about the efficacy of static stretch and post isometric relaxation in improving hamstring flexibility are debatable. As there is varying results that one method is better than the other and also some results suggest that both the techniques have same benefits [18]. The mechanism of increasing the muscle length is different in these two methods and both are safe to perform. Variety of researches have been conducted to assess and evaluate effects of different stretching methods on hamstring flexibility among different age groups, however there is little published information about the effects of PIR and SS among young healthy children asymptomatic for reduced hamstring flexibility, being measured by passive straight leg raise test. The present study aims at finding the appropriate method to improve hamstring flexibility among young healthy children who are not athletes and the outcome will be measured using passive straight leg raise test.

II. Methodology

A. *Participants*

Prior to collecting data, sample size estimation was done to provide sufficient power. A sample of one hundred twenty school children aged 9- 11 years old were identified with hamstring tightness by passive straight leg raise test (PSLR) from one school in Kota Baru District, Kelantan State, Malaysia were recruited for the study. Of them, 60 boys and 60 girls were assigned to the post isometric relaxation (PIR), static stretch (SS) and control group (CG) with equal number of boys and girls in each group with the baseline values of passive straight leg raise test scores matched for the groups.

Test retest reliability test was conducted to assess the reliability of using passive straight leg raise test. 10 subjects were recruited by convenient sampling. The subjects performed a 3 minutes warm up and then hamstring flexibility was measured. The same procedure was repeated on the consecutive day with the same subjects.

All the participants were free of injuries to the leg or back, surgery or fractures in the past six months. All the subjects

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involved in regular day to day activities and none was an elite athlete or involved in any kind of exercise or sports training program. Ethical principles meant for research involving human subjects were followed and research protocol was approved by the Research and Ethics Committee of the Universiti Sains Malaysia.

B. Measurements

All measurements were conducted in an open hall within the school premises. Prior to the test, the children completed a standardized three minutes warm up including jogging and general body stretching.

The subjects were barefoot wearing loose clothes. The subjects lay supine with the contralateral leg and pelvis stabilized by the research assistant to avoid bending of the knee and rising of the pelvis. The examiner raised the test leg, without bending the knee. Final leg raising position in which the knee could not be held straight or complaint of pain or discomfort was measured using the inclinometer placed on distal tibia. The test was performed on both sides. Three measurements were taken and the average was considered final.

C. Procedures:

A stretching intervention was conducted in the morning. It was carried on for 5 days in a week for 6 weeks. The control group did not perform any exercises and were assessed at baseline and at the end of 6 weeks.

Post Isometric Relaxation

The subjects of PIR group had the starting position as kneeling on one knee. The subject was instructed to perform anterior pelvic tilt with simultaneous trunk forward shift, to the point when a stretch in hamstring was felt. During the contraction phase the subject was asked to press the right heel slightly on the floor. This was held for 10 seconds, and was followed by a relaxation phase with a gradual increase in the range of hip

flexion. It was repeated for the other leg. Five sets of exercises with 10- second relaxation phases were performed.

Static Stretch

The SS group performed static stretch in a sitting position. The pelvis and the spine was in a free, slouched position, the knees extended, the feet relaxed, both arms raised forward and then the child was asked to bend the pelvis forward so as to feel the stretch in hamstring muscles. This position was held for 30 seconds and followed by a 30-second break.

The exercise was repeated four times.

iii. Results

All statistical analysis was performed using SPSS version 24. Details of height, weight, BMI, hamstring flexibility dominant and non dominant side of the subjects were presented using descriptive statistics. The effect of the stretching intervention on hamstring flexibility was tested using mixed ANOVA. Then post hoc analysis with Bonferroni adjustment was used for pairwise comparisons. The test retest reliability of passive straight leg raise test scores was estimated using intraclass correlation coefficient. The test retest reliability was 0.93 for dominant and 0.92 for non dominant side, which was good to proceed with the study. The statistical significance level p was set at 0.05.

At the completion of six weeks two subjects from the PIR, two subjects from SS and three subjects from the CG were excluded because of not following the intervention regularly and failure to attend assessment. Thus, a total of 113 subjects completed all the assessments. The descriptive details of the subjects and passive straight leg raise test score on dominant (PSLRD) and non dominant side (PSLRND) are presented in Table 1.

Table 1: Descriptive details of the three groups at the initial examination

	PIR n=38	SS n=38	CG n=37
	Mean (SD)	Mean (SD)	Mean (SD)
Height (cm)	137.49 (5.9)	137.1 (6.8)	136.4 (5.3)
Weight (Kg)	33.5 (11.1)	33.9 (10.2)	35.3 (10.6)
BMI (Kg/m ²)	21.1 (4.5)	18.3 (4.1)	18.8 (4.3)
PSLR D (degrees)	70.1 (4.1)	70.2 (3.8)	70.7 (4.2)
PSLRND (degrees)	69.0 (4.5)	69.2 (4.0)	68.1 (4.4)

PSLRD – Passive straight leg raise test dominant side,
 PSLRND – Passive straight leg raise test non dominant side,
 PIR – Post isometric relaxation, SS – Static stretching, CG – Control group.

Table 2: Pre and Post intervention mean and SD of all three groups for passive straight leg raise test score dominant side

Study Groups	Pre-Test, Mean (SD)	Post-Test, Mean (SD)
PIR group	70.1 (4.1)	81.2 (4.2)
SS group	70.2 (3.8)	76.8 (3.9)
Control group	70.0 (4.2)	70.4 (3.9)

PIR- post isometric relaxation group, SS- static stretch group, CG- control group

Table 3: Pre and Post intervention mean and SD of all three groups for passive straight leg raise test non-dominant side

Study Groups	Pre-Test, Mean (SD)	Post-Test, Mean (SD)
PIR group	69.0 (4.5)	79.8 (4.3)
SS group	69.2 (4.0)	75.5 (4.2)
Control group	69.1 (4.4)	69.4 (4.1)

PIR- post isometric relaxation group, SS- static stretch group, CG- control group

As seen in Table 2, The post hoc results by Bonferroni adjustments show that PIR group had significantly higher gains in PSLRD scores compared to SS with mean difference (MD= 4.4, $p < 0.01$) and CG (MD = 10.8, $p < 0.01$). Also SS group (MD = 6.4, $p < 0.01$) showed significant improvement than the CG group. Furthermore, there was significant difference seen in PSLRD scores between the three groups at the end of six weeks intervention, $F(2, 110) = 69.5$, $p < 0.01$, $\eta^2 = 0.55$. In table 3, the post hoc results by Bonferroni adjustments indicates that PIR group had significant higher gains in PSLRND scores than the SS group (MD = 4.3, $p < 0.05$) and CG (MD = 10.4, $p < 0.01$). There was statistical significant difference in BSSR ND scores between the three groups at the end of six weeks intervention, $F(2,110) = 58.6$, $p < 0.01$, $\eta^2 = 0.51$.

Hamstring flexibility scores at the end of six weeks in the three groups showed statistically significant gain within the PIR group with a mean difference of 11.1 at the end of six weeks, $p < 0.01$. Similarly SS group had a significant increase score 6.6, $p < 0.01$. In the control group there was no significant difference on the dominant side with time the mean difference was 0.40, $p > 0.05$. There was a statistically significant gain in the scores on the non- dominant side in the PIR group with mean difference of 10.8 at the end of 6 weeks, $p < 0.01$. The SS group also had a significant increase in

PSLRND score 6.3, $p < 0.01$. In the control group there was no significant difference in the PSLRND scores 0.30, $p > 0.05$.

iv. Discussion

The aim of the present study was to compare the effects of post isometric relaxation (PIR) and static stretch (SS) training among young healthy children who are not athletes. Previous studies have found that static stretching is effective in improving hamstring flexibility [19, 20]. Similarly PIR has shown to be effective in improving HF among different age groups [21]. Certain studies have found that PIR and SS have similar effects and one is not superior to the other [22, 23]. The difference in findings may be attributed to the differences in age group, anthropometry, environment and lifestyle of subjects of different countries. Also, the results may be different due to the differences in the duration, frequency and type of stretch techniques utilized and the measurement methods used.

The present study showed PIR group had significantly higher improvements than static stretching on hamstring flexibility when measured by passive straight leg raise test. In addition, both intervention groups had significant gains than the control group.

This knowledge can help and guide physical education teachers and school administration to include the better stretching methods as part of their regular program for the benefit of children who are apparently asymptomatic for hamstring tightness in maintaining and improving hamstring flexibility and thus, prevent the ill-effects and consequences of tight hamstrings.

Conclusion

It was concluded that PIR obtained higher gains than static stretching in improving hamstring flexibility. Both of these stretching methods were effective and obtained better gains in flexibility as compared to the control group. There was a significant increase in hamstring flexibility with time in the two intervention groups. However, there was no significant change in hamstring flexibility with time in the control group.

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