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Influence Nordic Hamstring Exercises on Increasing Hamstring Muscle Flexibility in Athletes Jakarta State University Futsal

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Abstract: Flexibility muscle hamstrings for futsal athletes have role important to support performance physique like acceleration and running fast , and prevent injury . This study aims to determine influence Nordic Hamstring exercises against improvement flexibility hamstring muscles in futsal athletes at Jakarta State University. This study used approach *one group test - posttest design.* A total of 15 samples study get treatment exercise *Nordic hamstring s* as many as 16 meetings. To find out influence from exercise *nordic hamstring* against improvement flexibility hamstring muscles using instrument *sit and reach* with tool *flexometer.* Research results disclose there is significant difference in a way statistics on flexibility hamstring muscles before and after do exercise *Nordic hamstring* ($p = 0.001$ or $p < 0.05$). With thus can concluded that exercise nordic hamstring effect positive to improvement flexibility hamstring muscles in futsal athletes at Jakarta State University. This study recommends use exercise *Nordic hamstring* as part from exercise programs for flexibility extremities down and up performance in futsal athletes.

Keywords: *Futsal Athletes, Flexibility, Nordic Hamstring*

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INTRODUCTION

Flexibility interpreted as ability muscles and connective tissue to stretch or move on a joints or a group joints (Pillsbury et al., 2013)Flexibility including part from component fitness that has role important, because to fulfill demands various activity muscle must flexible (Wilson & Lichtwark, 2011). Such as case in point in futsal sport. Flexibility good hamstring muscles in futsal players besides can increase performance also reduces risk relatively tension muscles and injuries knee (Ayala et al., 2012). Because, the branch futsal is a sport dynamic sport, where the players required to always move, run, dribble the ball, and kick the ball into the goal against so that need strength muscle, agility and flexibility good muscles (Dial, 2019). In line with statement that, in deceleration during walking, running, and change direction speed tall hamstring muscles play role key (Potosí-Moya et al., 2025).

Meanwhile, the branch futsal is a sport branch sport with level incident injury sufficient hamstring muscles often happened. Incident injury hamstring muscle was 0.81 per 1,000 hours, representing 10% of all over branch injury sport team based field like football, rugby, hockey pitching, Gaelic football, hurling, and Australian football (Maniar et al., 2023). In line with study previously stated that sport involving run and kic, like soccer, basketball, American football, rugby, and athletics, are reason main injury hamstring (Sulaiman et al., 2024) muscle. Incident injury thighs in amateur futsal players

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reached 29.41% (Fernández-Galván et al., 2024)and hamstring tears reached burden injury (lost 14.4 days /1,000 hours) (Ruiz-Pérez et al., 2019).

Hamstring injuries require time longer recovery and if no handled with Good can cause injury repeat, even effect worst can result in the end career as athlete (Wan et al., 2017). Reason hamstring injury hypothesized happen when the hamstring is in position contraction and stretching eccentric (Sulaiman et al., 2024), or when the hamstring experiences cycle stretching-shortening (van de Hoef et al., 2019). Remember characteristics many futsal games involving running and kicking, and deceleration during walking, running, and change direction speed height, futsal athletes need increase flexibility hamstring muscles to fulfill guidance physique from futsal sports and reduce risk hamstring injury.

Stretching is method general to improve flexibility (Sulaiman et al., 2024). However, in a number of year final Nordic hamstring exercises are type popular exercises No just to improve strength but also to improve flexibility hamstring muscles. Nordic hamstring exercises through contraction eccentric capable increase flexibility hamstring muscles through change in strength eccentricity caused existence improvement excitability muscle. (Gérard et al., 2020)Nordic hamstring training has become a physiotherapy program and routine training to improve strength eccentric and prevent hamstring (Potosí-Moya et al., 2025; van de Hoef et al., 2019) injury. Research previously state that, eccentric hamstring exercises produce improvement great hamstring flexibility (Vatovec et al., 2021).

Based on description above, where enough futsal athletes risky experience hamstring injury . For reduce prevalence Hamstring injuries in futsal athletes , prevention strategies Special exercises that focus on the hamstring muscles are recommended . With consider usefulness from exercise nordic hamstring and ease exercise nordic hamstring for combined in the futsal training program as well can done in a way independently by athletes . With Thus , research This aim For know influence from exercise nordic hamstring against improvement flexibility hamstring muscles in futsal athletes at Jakarta State University.

METHOD

This research is a pre-experimental research with use approach *One group pretest-posttest design*. Research sample is team the main futsal team of Jakarta State University, consisting of 15 athletes. The determination sample based on criteria that have been set in this research, namely: 1) no currently experience injury, 2) member active in the Jakarta State University Futsal club, 3) type sex male, 4) aged 18-23 years, 5) willing follow and do series study namely running a training program Nordic hamstring. The sample that has been fulfil criteria furthermore follow series research. Stage first, do test flexibility hamstring muscles to obtain initial data (pretest). Stage second, carry out an exercise program nordic hamstring given researchers during 16 meetings. Training program Nordic hamstring exercise in a way in pairs and supervised by researchers to ensure quality. The exercises focus on the use of deep hamstring muscles withhold movement fall forward in position kneeling. Stage third, do test flexibility hamstring muscles after finished running a training program *nordic hamstring* from researchers *(posttest)*. This research has get permission study from Faculty Knowledge Sports of Jakarta State University with number 21801/UN39.12/KM/2025.

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Instruments used to measure flexibility hamstring muscles using test *sit-and-reach*, which has own validity for estimating extensibility hamstring (Mayorga-Vega et al., 2014) muscles. Test *sit-and-reach* is performed with make a foot line on the floor use tape or duct tape white. Then, sit with outstretched leg position straight ahead, and make sure your feet are straight be on the edge of the tape line. Slowly bend your body with position hand straight ahead Then place end finger from second hands on the tape line or as far as possible for at least one second (Mulia et al., 2024.). Successful distance achieved noted as results measurement flexibility hamstring muscles.

Research data that has been obtained, next analyzed use device soft *Statistical Package for the Social Sciences* (SPSS) version 27.0. Variable quantitative like Age, height, weight, BMI, and pretest and posttest results of hamstring flexibility were reported. with average, minimum, maximum, and standard values deviation. Test the normality of the data using Shapiro Wilk, as prerequisites for conducting a parametric test. Sample t-test pair up to find out difference pretest and posttest scores.

RESULTS

A sample of 15 people participated in this study. The average age is 19.2 years , with age youngest 18 years old and age oldest 21 years old . The average height is 170.4 cm, with The lowest height is 160 cm and the highest is 181 cm. The average body weight is 61.13 kg, with The lowest weight was 52 kg and the highest was 81 kg. Meanwhile , the average Body *Mass Index* (BMI) was 21, with mark lowest 18.9 and highest 24.7. Characteristics table sample study presented in table 1.

Table 1Characteristics of the Research Sample

Characteristics	Average	Minimum	Maximum	Standard Deviation
Age (years)	19.2	18	21	0.96
Height (cm)	170.4	160	181	7.79
Body Weight (kg)	61.13	52	81	7.74
Body Mass Index (kg/m ^{2})	21	18.9	24.7	1.89

Flexibility *pretest* data muscle *hamstring* strain average value of 12.53 and standard deviation of 3.11. Flexibility results muscle maximum *hamstring* strength achieved of 19 and a minimum of 8. *Posttest* flexibility data muscle *hamstring* strain average value of 16.53 and standard deviation of 2.84. Flexibility results muscle maximum *hamstring* strength achieved of 23 and a minimum of 13. Flexibility *pretest* and *posttest* data table hamstring muscles are presented in table 2.

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Table 2. Flexibility Data Results Hamstring Muscle

	Pretest	***Posttest***
Mean	12.53	16.53
Minimum	8	13
Maximum	19	23
Standard deviation	3.11	2.84

On table 3 below, value significance for flexibility data *pretest* hamstring muscle is 0.619 and for the posttest it is 0.174. Because both greater value from 0.05, then the data meets assumptions normality. Furthermore, the t-test can done with parameter testing use *Paired Samples t-Test*.

Table 3. Flexibility Data Normality Test Hamstring Muscle

	Shapiro-Wilk	
	Sig.	**Information**
Pretest	0.619	Normal
Posttest	0.174	Normal

The results of *the Paired Samples t-Test* in Table 4 show that Sig. value (2-tailed) is 0.001 < 0.05, then there is significant difference between the average flexibility hamstring muscles *pretest* and *posttest* . That is , the exercise nordic hamstring effect significant to improvement flexibility hamstring muscles in futsal athletes at Jakarta State University.

Table 4. *Paired Samples t-Test Results for* Flexibility Data Hamstring Muscle

Data	**Sig.(2-tailed)**	**Information**
Pretest- Posttest	0.001	Significant

DISCUSSION

From the results study This obtained that there is improvement flexibility muscle *hamstring* after it is done exercise *Nordic hamstring* in futsal athletes at Jakarta State University. Improvement flexibility hamstring muscles after do exercise Nordic hamstring can associated with increase long fascicles caused by addition sarcomere in fiber muscle (Sulaiman et al., 2024).Increased fascicle length will help increase ability muscle For stretch and reduce tension in the sarcomere when the hamstring is active stretch during exercise intensity height that is done at intervals (Gérard et al., 2020). In line with results research , that elongation fascicle influence connection force and speed as well as style and length , which in turn direct influence performance muscle (speed muscle in contract will increase) (Nunes et al., 2024).

The sport of futsal involves activity with intensity tall like run fast , deceleration during walking , and change direction speed high , where movement the need system neuromuscular. Nordic hamstring training has show positive results For improvement

flexibility hamstring muscles . Flexibility hamstring muscles can produce strain highest in the hamstring muscles when move (Wan et al., 2017). Therefore , good flexibility in futsal athletes supports during movements in futsal . Research evidence show flexibility good hamstring muscles in futsal players besides can increase performance also reduces risk relatively tension muscles and injuries knee (Ayala et al., 2012).

Findings This show that , practice Nordic hamstring stretch is useful for interventions that target the hamstrings such as increase flexibility hamstring muscles and helps reduce risk hamstring injury . Limitations This research is namely, measurement flexibility hamstring muscles only depend on One tool measuring namely the sit and reach test. Research furthermore can combine a number of tool measuring flexibility hamstring muscles to provide clear and complete picture from results measurement flexibility hamstring muscles. Apart from that, there are limitations in this research is use limited sample, only totaling 15 athletes from One futsal club, so that results this research has not been Can generalized to all futsal athletes in general wide.

CONCLUSION

Nordic hamstring exercises provided during 16 meetings influential to improvement flexibility *hamstring* muscles in futsal athletes at Jakarta State University. Therefore, this study recommends use exercise nordic hamstring as part from the training program to improve flexibility extremities lower specifically hamstring muscles and increase performance in futsal athletes.

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