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The Effect of Swedish Massage Techniques on DOMS on the Gastrocnemius Muscle

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Abstract
Futsal is a high-intensity sport that involves explosive and repetitive activity on the leg muscles, especially the gastrocnemius muscles. This condition often triggers delayed onset muscle soreness (DOMS) which can interfere with training performance, mobility comfort, and sustainability of adolescent athletes' participation. Therefore, an effective, safe, and applicative recovery strategy is needed. Swedish massage is one of the active recovery methods that is reported to be able to accelerate muscle recovery and reduce symptoms of DOMS. This study uses a quasi-experimental design with a one group pretest–posttest approach. A total of 17 futsal players (age 15.56 ± 0.79 years, body mass 58.59 ± 14.76 kg, height 165.06 ± 4.99 cm, BMI 21.43 ± 4.96 kg/m²) were involved in the study. DOMS levels in gastrocnemius muscle were measured using a Likert scale-based questionnaire before and after the intervention. The intervention in the form of a Swedish massage is given for ±30 minutes by a certified therapist. Data were analyzed using the Wilcoxon test with a significance level of $p < 0.05$. The results showed a significant decrease in DOMS scores after the Swedish massage, from 53.41 ± 7.05 in the pretest to 25.65 ± 4.18 in the posttest. Z values = −3.523 with $p < 0.001$ showed significant differences before and after the intervention. These findings indicate that Swedish massage effectively lowers DOMS in the gastrocnemius muscles of adolescent futsal players, in line with previous research that said massage can improve blood circulation, reduce metabolite accumulation, and decrease the perception of muscle pain after intense exercise.
Keywords: *Swedish massage; Delayed onset muscle soreness (DOMS); Gastrocnemius muscle; Muscle recovery; Youth futsal players*

INTRODUCTION

Futsal is one of the sports that demands intense physical activity with a short duration but high intensity (Villanueva-Guerrero et al., 2024). Movements such as sprinting, dribbling, jumping, and sudden changes in direction put a great load on the leg muscles, especially the gastrocnemius muscle (Parmadi et al., 2022). These repetitive activities often trigger delayed onset muscle soreness (DOMS), which is muscle pain that appears 24–72 hours after exercise (McLellan, 2024). This condition is characterized by pressure pain, stiffness, and decreased muscle flexibility that can interfere with exercise performance (Almeyda & Hakim, 2022). DOMS in extracurricular futsal players is a phenomenon that often appears, especially during periods of increased training intensity, when muscle adaptation is not optimal (Teixeira et al., 2018). This complaint can reduce comfort when

carrying out daily activities and learning activities at school (Ozyemisci Taskiran et al., 2023). In addition, prolonged DOMS can decrease the motivation of young athletes to participate in regular training (Zondi et al., 2015). This phenomenon shows that DOMS problems not only have an impact on sports performance, but also on aspects of players' health and daily activities (Clemente et al., 2020).

Poorly handled DOMS issues can lead to short-term performance declines and potential long-term injuries (Dupuy et al., 2018). DOMS can inhibit movement efficiency, decrease motor coordination, and slow down the player's reaction time (Bilalić et al., 2018). To some extent, DOMS can also result in sub-optimal motion compensation that increases the risk of muscle injury, strain, or spasm (Antohe et al., 2022). In the context of extracurricular futsal training, players often rely only on passive rest as a method of recovery, even though this approach is not always effective in reducing DOMS optimally (Utami et al., 2020). This shows that there is an urgent need to implement more effective recovery methods in accordance with the principles of sports physiology (Ostojic, 2016). The lack of education about the prevention and handling of DOMS is also the cause of the high number of post-exercise pain complaints (Rahman et al., 2022). If DOMS is not properly managed, the risk of dropout or decreased exercise morale in young athletes can increase (Nobari et al., 2021). Therefore, scientifically evidence-based interventions are essential to maintain the sustainability of the training process and the health of players' muscles (Yu et al., 2021).

One potentially effective method in reducing DOMS is Swedish massage (Swedish massage), a massage technique that focuses on improving blood circulation and relaxing muscle tissue (Raditya et al., 2023). This technique involves a combination of effleurage, petrissage, friction, tapotement, and vibration that works systematically on muscle tissue to reduce tension and improve blood flow (Lubis et al., 2023). With increased blood and lymphatic circulation, metabolites that cause DOMS pain such as prostaglandins and bradykinin can be reduced more quickly (Bafadal et al., 2021). In addition, the mechanical stimulation of the Swedish massage can also reduce peripheral nerve sensitivity, thereby lowering the perception of pain after intense exercise (Holub & Smith, 2017).

Swedish massage has also been shown to improve muscle relaxation and improve joint mobility, which is an important factor in the post-workout recovery process (Weerapong et al., 2005). This technique is relatively easy to implement, safe, and does not require special equipment, making it suitable for use in a school environment (Nursiswati et al., 2023). The research conducted by (Dupuy et al., 2018) showed that massage can speed up DOMS recovery better than passive rest. With these various advantages, swedian massage is a potential alternative to be applied to extracurricular futsal players to minimize disturbances due to DOMS (Smith et al., 1994).

This study aims to determine the effect of the Swedish massage technique on DOMS on the gastrocnemius muscle of extracurricular futsal players. This study is expected to provide empirical evidence regarding the effectiveness of manual therapy in accelerating recovery from DOMS after intense physical activity. The results of the research can be the basis for recommendations for extracurricular trainers and coaches in developing a more scientific and structured recovery program. In addition, this study also aims to compare DOMS levels before and after the application of the Swedish massage technique to see the extent to which this intervention is able to reduce pain, stiffness, and limited movement. This research is also expected to enrich the literature of sports masseurs or other sports personnel, especially in the population of novice athletes. The findings of the study can be a reference in the development of more comprehensive recovery protocols in the school environment. Thus, the Swedish mass intervention can be a preventive measure against the risk of injury caused by DOMS. Finally, this research is able to contribute to efforts to create a safer, healthier, and more productive training environment for adolescent futsal players.

METHOD

Participant

A quasi-experimental study with a type of one group pretest posttest design involving 17 extracurricular futsal players from SMK Assa'ddah with characteristics (age 15.56±0.79 years, body mass 58.59±14.76 kg, height 165.06±4.99 cm, BMI 21.43±4.96 kg/m2). All samples in this study have met the

incubation criteria: 1) are members of the futsal extracurricular of SMK Assa'ddah, 2) are in good health and do not have injuries to the lower extremities, 3) have an age range of 16-18 years. As well as exclusion criteria: 1) have an injury to the gastrocnemius, 2). Have an age under 16 years old and over 18 years old.

Procedure

The research stage begins with an explanation to the sample about the objectives and benefits of the research. After that, a pretest questionnaire was filled out to measure the level of DOMS in the gastrocnemius muscle before the intervention. Furthermore, participants were given treatment in the form of the Swedish massage technique, which was carried out by a certified therapist with a duration of about 30 minutes using the Effeleurage Petrissage Tapotement Friction Vibration movement. The treatment was carried out in the futsal field area in the afternoon which tended to be shady and calm. After the treatment was completed, participants again filled out a posttest questionnaire with the same instrument to measure changes in the level of DOMS. The data from the pretest and posttest results were then compared to assess a decrease in the level of DOMS after mass administration.

The research instrument used was a muscle DOMS level questionnaire compiled based on physiological and psychological indicators related to gastrocnemius muscle DOMS levels. This questionnaire contains several statements that measure dimensions such as pain, muscle tension, heavy sensation in the legs, and comfort level after physical activity. The scoring scale used is the Likert scale of 1–5, where a low score indicates a mild level of DOMS and a high score indicates a heavy level of DOMS. The validity of the questionnaire content was tested using Pearson Correlation (r-count>r-table with a significance level of 0.05), while reliability was tested using Cronbach's Alpha test to ensure consistency between items. The questionnaire was given in two stages (pretest and posttest) to assess the changes that occurred after the intervention. Data from the questionnaire became the main source in the analysis of the effect of the Swedish massage technique on DOMS levels in gastrocnemius muscles.

Analysis and Data Collection Techniques

The research instrument used was a muscle DOMS level questionnaire compiled based on physiological and psychological indicators related to gastrocnemius muscle DOMS levels. This questionnaire contains several statements that measure dimensions such as pain, muscle tension, heavy sensation in the legs, and comfort level after physical activity. The scoring scale used is the Likert scale of 1–5, where a low score indicates a mild level of DOMS and a high score indicates a heavy level of DOMS. The validity of the questionnaire content was tested using Pearson Correlation (r-count>r-table with a significance level of 0.05), while reliability was tested using Cronbach's Alpha test (0.938) to ensure consistency between items. The questionnaire was given in two stages (pretest and posttest) to assess the changes that occurred after the intervention. Data from the questionnaire became the main source in the analysis of the effect of the Swedish massage technique on DOMS levels in gastrocnemius muscles. The data from filling out the questionnaire before and after the treatment was collected into Microsoft Excel and selected according to the criteria. Then statistical analysis was carried out using SPSS software version 26. The normality test was first performed using the Shapiro wilk test (p-value >0.05 = normally distributed data). Then the difference test was carried out using the Wilcoxon test to find out the degree of difference between the two variables. significance value (p-value < 0.05 = there is a significant difference). All data are presented in the form of a table.

RESULT AND DISCUSSION

Table 1. Questionnaire Validity Test

	R-Count (Pearson Correlations)	P-value	Remarks
Item 1	0.852	<0.001	Valid
Item 2	0.765	<0.001	Valid
Item 3	0.899	<0.001	Valid
Item 4	0.737	0.001	Valid
Item 5	0.585	0.014	Valid
Item 6	0.815	<0.001	Valid
Item 7	0.769	<0.001	Valid
Item 8	0.792	<0.001	Valid
Item 9	0.732	0.001	Valid
Item 10	0.842	<0.001	Valid
Item 11	0.794	<0.001	Valid

Item 12	0.758	<0.001	Valid
Item 13	0.585	0.014	Valid
Item 14	0.752	<0.001	Valid

Based on Table 1, the results of the instrument validity test conducted using Pearson correlation (Pearson Product Moment), the value of the correlation coefficient (r-calculus) was obtained for each variable statement item (r-calculus 0.585-0.899). All items show a positive correlation value, which indicates a unidirectional relationship between each item's score and the total score of the measured variable. In addition, significance test results show that all statement items have a p-value of <0.05, with most items showing a p-value of p<0.001. This indicates that the correlation between item scores and total scores is statistically significant at a 95% confidence level. Thus, based on the validity test criteria that state that an item is declared valid if it has an r-calculated value greater than the r-table and a significance value of less than 0.05, it can be concluded that all statement items in this research instrument are declared valid and suitable for use in the collection of research data.

Table 2 Pretest and Posttest normality test

	Mean±SD	P-Value
Pretest	53.41±7.05	<0.001
Postest	25.65±4.18	<0.001

Based on Table 2 of the results of statistical analysis, it is known that the average score of the pretest is 53.41 with a standard deviation of 7.05, while the average value of the posttest score is 25.65 with a standard deviation of 4.18. The results of the normality test showed a p-value of < 0.001, which indicated that the data was abnormally distributed.

Table 3. Test the difference between pretest and posttest data

	P-value	Z
Pretest and Postest	<0.001	-3.523

Based on Table 3, the results of the different tests using the Wilcoxon Test were obtained with a Z value of −3.523 with a p-value of < 0.001. These results

show that there is a statistically significant difference between the pretest and posttest data. Thus, it can be concluded that there is a significant change between the pre- and post-treatment values, which indicates that the interventions given in this study have a significant influence on the results of posttest measurements.

Discussion

This study shows that the administration of the Swedish massage technique has a significant effect on the reduction of the level of delayed onset muscle soreness (DOMS) in the gastrocnemius muscles of futsal players. This is evidenced by the results of the Wilcoxon test which shows a value of $Z = -3.523$ with a p-value of < 0.001, which indicates a significant difference between the DOMS score before and after the intervention. In addition, the decrease in the average value of the DOMS score from the pretest to the posttest phase showed that the intervention was able to improve the condition of muscle pain and discomfort after intense physical activity. The findings of this study are in line with the results of previous studies which stated that massage, especially Swedish massage, is effective in accelerating muscle recovery and reducing symptoms of DOMS compared to passive rest (Visconti et al., 2020). Research from (Bafadal et al., 2021) It is also said that Swedish massage is able to significantly lower the perception of muscle pain after strenuous exercise through increased blood circulation and stimulation of mechanoreceptors. Thus, the results of this study strengthen the empirical evidence that the Swedish massage technique is an effective recovery method in the context of high-intensity sports such as futsal (Nemčić & Calleja-González, 2021). The consistency of the results of this study with previous findings suggests that the effect of Swedish massage on the reduction of DOMS is not a stand-alone phenomenon, but part of a consistent pattern of scientific findings.

The findings in this study are in line with previous studies that confirmed the effectiveness of Swedish massage in reducing the rate of delayed onset muscle soreness (DOMS) after intense physical activity (Guo et al., 2017). Swedish massage is also able to accelerate the recovery process of muscles compared to passive rest, especially through the mechanism of improving blood circulation, reducing the accumulation of metabolites, and stimulating mechanoreceptors that

play a role in modulating pain perception (Kafrawi et al., 2023). Research by (Andersen et al., 2013) said that giving massage after strenuous exercise can significantly reduce the intensity of muscle pain and improve movement comfort in athletes. The results of this study reinforce these findings, which are shown by a significant decrease in DOMS scores from pretest to posttest phase in the gastrocnemius muscles of futsal players. Thus, this study not only confirms the consistency of the results of previous studies, but also provides additional evidence regarding the effectiveness of Swedish massage as a relevant and applicable recovery method in the context of high-intensity sports, particularly in adolescent athletes (Avandi et al., 2024). Based on the alignment between the results of this study and previous research, further discussion is needed regarding the practical implications and direction of future research development.

Research on post-workout recovery needs to be directed at a multidimensional approach that combines manual interventions, active recovery exercises, and athlete education on muscle fatigue management (Ivan, 2023). Swedish massage has the potential to be part of standard recovery protocols in school sports training programs as well as early age athlete coaching (Best & Crawford, 2017). Overall, the study showed that the Swedish massage technique significantly lowered DOMS levels in the gastrocnemius muscle, which is reflected in the difference between pretest and posttest scores. These findings confirm the important role of massage interventions as part of intense post-exercise recovery strategies (Gholami, 2023). This research can be an initial reference in the development of scientific evidence-based recovery protocols in adolescent athletes. The data obtained can also be used as a foundation for advanced experimental research with a stronger control design, longer duration of interventions, as well as measurements of additional physiological variables such as muscle strength and flexibility. Although it provides significant results, this study has several limitations, including a relatively small sample size, a research design without a control group, and the use of subjective questionnaire-based measurement instruments. In addition, the study focused on only one muscle group and one type of intervention, so generalization of results needs to be done carefully. Therefore,

further studies are recommended to use a randomized controlled trial (RCT) design, involving a larger sample, and combining subjective and objective measurements.

CONCLUSION

This study showed that the application of the Swedish massage technique significantly reduced the rate of delayed onset muscle soreness (DOMS) in the gastrocnemius muscles of futsal players. A decrease in DOMS scores between pretest and posttest indicates that Swedish massage is an effective active recovery method in reducing muscle pain and discomfort after intense physical activity. These findings are consistent with previous research that confirms the role of massage in accelerating the muscle recovery process through increased circulation and modulation of pain perception. Therefore, Swedish massage has the potential to be integrated as part of a scientifically evidence-based recovery protocol in school sports training programs, especially for adolescent athletes.

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