Bravo's: Journal of Physical Education and Sport Science
Volume 13 Issue 1, February 2025, pp: 96-105
E-ISSN: 2597-677X; P-ISSN: 2337-7674
DOI: http://dx.doi.org/10.32682/bravos.v13i1/115

The influence of recovery management post exercise on leg muscle power in extracurricular students basketball

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Abstract

This study aims to analyze the Influence of post exercise recovery management after training on increasing leg muscle power in extracurricular basketball students. This research method uses One-Group Pre-test Post-test Design with an experimental design research design using a quantitative descriptive research approach. The sampling technique uses total sampling of athletes who participated in the DBL (Developmental Basketball League) competition totaling 24 students consisting of 12 boys and 12 girls. The instrument used in this study was the measurement of leg muscle power using the MD jump test tool. From the results of the study and discussion, it can be concluded that the leg muscle power test using the MD jump test shows that female students get a significant value (p value = 0.031) while male students get a significant value (p value = 0.015). So it can be concluded that this study has a significant effect in recovery using the post exercise recovery management method on the leg muscle power of the female and male teams at SMAN 8 Malang City.

Keywords: *basketball, leg muscle power, recovery management*

Received: 07-02-2025 Revised: 15-02-2025 Accepted: 20-02-2025

Authors' Contribution: A – Conceptualization; B – Methodology; C – Software; D – Validation; E - Formal analysis; F – Investigation; G – Resources; H - Data Curation; I - Writing - Original Draft; J - Writing - Review & Editing; K – Visualization; L – Supervision; M - Project administration; N - Funding acquisition.

INTRODUCTION

Sport has a very important role both physically and mentally. One area that has received special attention by the government is achievement sports. According to Pranata, (2022), participating in sports is very important for all groups and communities to maintain physical health. One of the popular sports is basketball. According to Nugroho & Gumantan, (2020), basketball is a game activity carried out with the dominant ability of the hand, aiming to enter as many balls as possible into the opponent's basket and maintain or defend their own basket from enemies who have the same goal. In basketball games have complex movements, namely a combination of several movements such as walking, running to and doing several other movements jumping.

According to Tan et al., (2020) wrote that basketball sports are required to have good physical and psychological conditions because in basketball games athletes are required to run and jump repeatedly with a long duration of play. Basketball is a high-intensity team sport played between two teams with short rest intervals. Each player must be in good physical

condition to perform to the best of his ability throughout the game. A player needs a combination of high physical abilities, including strength, speed, and endurance (Nugroho & Yuliandra, 2021). One of the techniques in the game of basketball that plays a very important role in helping the game of basketball is the jumping technique. Jumping is an inseparable part and mastery of individual techniques in basketball games, the physical aspect that supports the performance of basketball players is leg muscle power.

In participating in prestigious basketball competitions specifically for high school students, namely DBL (Developmental Basketball League) students are faced with physical demands, a busy training schedule and additional mental fatigue caused by lessons or an altered sleep quantity/quality ratio that leads to poor performance in subsequent competitions due to insufficient recovery time. To maintain good physical condition, it is also necessary to pay attention to how to perform recovery management after training. Recovery management is very important to be applied among high school students or adolescents who are active in sports, because they are prone to injury (Palmi et al., 2021). This is one of the factors that need to be considered for students or athletes to be able to reach their peak performance to support their achievements. Intense training without good recovery management can increase the risk of injuries such as sprains, muscle strains, and tendonitis. Given the importance of the application of recovery, not many studies have examined the Influence of recovery management on leg muscle power, especially in extracurricular students at SMAN 8 Malang City.

Recovery management post exercise aims to accelerate muscle recovery and minimize the risk of injury, so that students can maintain maximum performance. In improving physical performance, an effective training program and the right recovery method are needed, one of which is by using the recovery management post exercise method. Recovery management post-exercise is a recovery that includes various strategies aimed at returning the body to its pre-exercise state, improving performance, and preventing injury. This multifaceted approach includes nutritional interventions, physical recovery techniques, and monitoring methods to optimize recovery results. In recovery management post exercise, there are several recovery methods, namely cold water immersion, foam rolling, leg elevation, and Proprioceptive Neuromuscular Facilitation (PNF).

Cold Water Immersion is a method by means of soaking using cold temperature water with vertical body position (Kurniawan & Sifaq, 2018). Cold water immersion, or cold water soak therapy, is a therapeutic method that involves immersing the body, partially or completely, in ice water with a low temperature (usually between 10° C to 15° C) for a duration of 10-20 minutes provides the best results in terms of reducing muscle pain. This method is used to

facilitate the body's recovery after intensive physical activity or injury (Fengping et al., 2023). Scientific studies often examine the use of cold water immersion in the context of sports, injury rehabilitation, and general health. The results show that cold water immersion is effective for reducing delayed onset muscle soreness (DOMS), accelerating muscle recovery, and improving a sense of freshness after exercise. However, its effectiveness may vary depending on the duration, temperature and specific conditions of the individual.

In addition, the foam rolling recovery method is a tool used to massage muscles by the person himself or better known as the myofascial release method, by moving the foam rolling at that time the athlete will also get pressure on the soft tissue from his own body weight (Drinkwater et al., 2019). Self-myofascial release (foam rolling) is a term that describes the use of a tool to massage muscles and connective tissue with a rolling motion. The goal is to reduce muscle tension, increase flexibility, and speed up post-exercise recovery. recovery foam rolling a self-treatment that uses a tool in the form of a dense foam tube (foam roller) to apply pressure to muscle tissue (connective tissue surrounding the muscles), foam rolling helps relieve muscle stiffness and increase muscle tissue flexibility. By relieving muscle tension, foam rolling helps reduce post-workout muscle soreness.

Another recovery method called leg elevation is a recovery technique that involves raising the legs to a position higher than the heart to utilize gravity to improve blood flow and reduce pressure on the circulatory system. This technique is often used as part of the post-exercise recovery process to reduce swelling and muscle tension (Hasanin et al., 2017). Smooth blood return to the heart supports the process of removing metabolic products, such as lactic acid, from the muscles (Salafi et al., 2022). The technique helps reduce inflammation, muscle fatigue or swelling in the legs.

The Proprioceptive Neuromuscular Facilitation (PNF) stretching method is used to increase flexibility and range of motion of muscles and increase muscle strength. It is generally considered as one of the most effective forms of muscle stretching (Malani & Patil, 2024). PNF stretching is a flexibility training method that can reduce hypertonus, allowing muscles to relax and lengthen. It is generally considered to be one of the most effective forms that serve for muscle stretching (Kaya, 2018). PNF exercises are very well used to train movements that are limited due to stiffness in the joints, balance disorders, and slow rhythm of movement.

Based on the explanation above, this study examines the Influence of recovery management post exercise on leg muscle power. By understanding how recovery management post exercise can affect leg muscle performance, and it is hoped that this research can make a real contribution in improving training programs and recovery after training or matches for

students who are active in extracurricular basketball at SMAN 8 Malang City. Researchers are interested in conducting research with the title "The Influence of Recovery Management Post-Exercise on Leg Muscle Power in Basketball Extracurricular Students at SMAN 8 Malang City."

METHOD

The research design used the One-Group Pre-test Post-test Design method with an experimental research design using a quantitative descriptive research approach. Using the One-Group Pretest-Posttest Design because there is before treatment and after treatment and the results of the treatment can be known more accurately because it can be compared with the situation before treatment. This research design can be described as follows:

Table 1. Research Design One-Group Pre-test Post-test Design.

Subject	*Pre-test*	Treatment	*Post-test*
R	O_1	X	O_2

Source: (Sugiyono, 2013)

Description:

R : Basketball extracurricular students of SMA Negeri 8 Malang City

O_1 : Pre-test score before treatment

X : Treatment using recovery management post exercise

O_2 : Post-test value after treatment

In the One-group pre-test post-test design research design, researchers will first conduct an initial test to the experimental group using the MD jump test to determine the results of the leg muscle power test before being treated. After conducting an initial test, the researcher will provide post exercise recovery management treatment to provide treatment to the experimental group. This research was conducted for 1 month intensively with a total of 18 meetings, including pre-test and post-test (Yudiana et al., 2012). Total sampling is a sampling technique in this study, all members of the population, namely the men's and women's basketball teams of SMAN 8 Malang City totaling 24 athletes, consisting of 12 boys and 12 girls.

The test used is the MD jump test, which measures leg muscle power. The test norm is as follows:

Table 2. MD Jump Test Norms for Men and Women

No.	Norm	Score	Men (cm)	Women (cm)
1.	Very good	5	> 73	> 50
2.	Good	4	60 – 72	39 – 49

No.	Norm	Score	Men (cm)	Women (cm)
3.	Medium	3	50 – 59	31 – 38
4.	Less	2	39 – 49	23 – 30
5.	Very less	1	< 39	< 23

Source: (Sepdanius et al., 2019)

Data analysis in this study requires several prerequisite tests that must be met using univariate analysis, namely the normality test of the data analyzed using the Shapiro-Wilk Test technique with the criteria if the p value> alpha (0.05), and bivariate by looking for the Paired Sample T-test. Paired Sampele T-test is used to compare the average of two sets of data (data before and after treatment). Data analysis results are said to be significant if p>0.05.

RESULT

The results of this study are determined based on data that has been collected through pre-test and post-test regarding the Influence of recovery management post exercise on leg muscle power in extracurricular basketball students at SMA Negeri 8 Malang City with the following data results:

Tabel 3. Respondent Characteristics Based on Age

Characteristics	Mean	Minimal	Maximal	Std. Deviation
Age	15,86	15.00	17.00	0.86887

The average age of basketball extracurricular students at SMAN 8 Malang City is 15.86 years old, with the youngest age being 15 years old and the oldest being 17 years old.

Tabel 4. Respondent Characteristics Based on Gender

Characteristics	n	%
Gender		
Females	12	52.2
Males	11	47.8

Respondents in this study were 12 girls and 11 boys. In this study one of the male students could not continue the treatment and assessment due to injury, so the male students who participated in the study became 11 students.

Tabel 5. Characteristics of Respondents Based on MD Jump Test Values

MD Jump	n	Mean	Min-Max	Std. Deviation
Females				
Pre-test	12	39.16	33 - 47	3.785
Post-test	12	41.91	36 - 47	2.906
Males				
Pre-test	11	58.09	47 - 70	8.251
Post-test	11	61.72	54 - 71	5.569

Table 5 shows the results of the MD jump test of basketball extracurricular students pre-test and post-test values. The average value of the MD jump test results of the women's team before being given treatment was 39.16 with the highest 47 test results and the lowest 33. After being given treatment, the average value of the test results is 41.91 with the highest test result 47 and the lowest 36. In addition, the average value of the MD jump test results of the men's team before being given the treatment was 58.09 with the highest 70 test results and the lowest 47. After being given the treatment, the average value of the test results was 61.27 with the highest 71 test results and the lowest 54.

Based on the table below, before conducting a comparative analysis, it is necessary to analyze the prerequisite test for data normality using the Shapiro Wilk Test technique to determine the statistical test. The results of the normality test can be explained in the table below as follows:

Tabel 6. Normality Test Result

Variables	Normality Test Results	Descriptions
MD Jump Test		
Females		
Pre-test	0.878	Normal data distribution
Post-test	0.514	Normal data distribution
Males		
Pre-test	0.396	Normal data distribution
Post-test	0.658	Normal data distribution

Table 6 shows the results of the data normality test on the MD jump test variable on the pre-test and post-test values of the women's team and the men's team with normal data distribution. It is concluded that the pre-test post-test results are more than $\alpha = 0.05$.

Comparison of MD Jump Before and After Intervention on the Women's Team

Tabel 7. Comparison of MD Jump Test Before and After Treatment

Variable		Mean	95% CI	Mean Difference	P value
MD Jump Test	Pre-test	39.16	-5.19 – -0.30	-2.09	0.031*
	Post-test	41.91			

*) p value < α; α = 0.05 with *Paired-T test*

Based on table 7, it is found that there is an average MD jump test result, from 39.16 before treatment to 41.91 after treatment. The results show that there is an average difference in the MD jump test score of -2.09. In addition, the statistical test results showed a significant difference between the MD jump test before and after treatment (p value = 0.031).

Comparison of MD Jump Before and After Intervention on the Men's Team

Tabel 8. Comparison of MD Jump Test Before and After Treatment

Variable		Mean	95% CI	Mean Difference	P value
MD Jump Test	Pre-test	58.09	-6.41 – -0.86	-3.63	0.015*
	Post-test	61.72			

*) p value < α; α = 0.05 with *Paired-T test*

Based on table 8, it is found that there is an average MD jump test result from 58.09 before treatment to 61.72 after treatment. The results show that there is an average difference in the MD jump test score of -3.63. In addition, the statistical test results showed a significant difference between the MD jump test before and after treatment (p value = 0.015).

DISCUSSION

Based on the results of data analysis, the results of this study indicate that students have an average age of 15.86 years, are in the adolescent phase which is important for physical and mental development with an almost balanced gender composition of 52.2% female and 47.8% male, allowing for adjustment of training programs. The results of the leg muscle power test using the MD Jump Test of the women's basketball team at the time of the pre-test showed an average value of 39.16, while at the time of the post-test the average value was 41.91. The significant value (p value = 0.031) for the MD Jump Test there is a significant effect in recovery using the recovery management post exercise method on leg muscle power of the women's basketball team at SMAN 8 Malang City.

While the results of research on the men's basketball team showed that leg muscle power using the MD Jump Test at the time of the pre-test showed an average value of 58.09, while at the time of the post-test it was 61.72. The significant value (p value = 0.015) for the MD Jump Test there is a significant effect in recovery using the recovery management post exercise method on the leg muscle power of the men's basketball team at SMAN 8 Malang City. This shows that the Influence of recovery management on leg muscle power is able to restore the athlete's physical condition and improve athlete performance on the men's and women's basketball teams at SMAN 8 Malang City.

The research findings show that cold water immersion is generally used to accelerate recovery after exercise and reduce muscle pain that often occurs after heavy exercise. According to Fatoni & Nugroho, (2019) the Influence on leg muscles showed a decrease in pain perception but did not show significant changes in muscle power after recovery with cold water immersion at either 15ºC or 25ºC. This shows that although cold water immersion is effective for reducing pain. In the study Pernigoni et al., (2023) also explained that recovery

using foam rolling was generally ineffective for improving post-exercise recovery in female basketball players, and showed limited benefit to recovery in muscle strength. Another study by Afonso et al., (2021) also explained that the legs elevation technique and PNF stretching were effective in reducing muscle soreness and restoring muscle strength more quickly after intensive training sessions. However, these techniques are also combined with other methods, such as foam rolling or active cooling, in order to get more comprehensive recovery results.

Recovery methods each have important benefits in aiding recovery in athletes after intense exercise, such as in basketball players. By combining several of these methods, athletes can achieve more optimal recovery according to their body's needs after intense physical activity. With high intensity athletes must utilize optimal recovery strategies so as to avoid muscle fatigue resulting from competition and training. In the context of basketball, the application of effective recovery strategies is essential to maintain athletes' physical performance, especially for extracurricular basketball students at SMAN 8 Malang City with high training intensity.

As for the limitations in the study, first, the limited water pool caused a waiting time lag when respondents took turns soaking, which might affect the results of the study. Second, the researcher did not use a temperature measuring device (thermometer) to accurately confirm the water temperature. Third, the number of respondents soaking in the water pool varied, which could be a factor affecting the results of the study.

CONCLUSION

Based on the results of data analysis, this study shows that Recovery Management Post-Exercise has a significant influence on leg muscle power on the men's and women's basketball teams at SMAN 8 Malang City. This study underscores the importance of structured recovery methods, such as cold water immersion, foam rolling, leg elevation, and PNF. In accelerating muscle recovery, reducing post-workout soreness, and increasing muscle explosive capacity for activities such as jumps and sprints.

The recovery methods applied in this study have different but complementary benefits. The combination of these methods accelerates muscle tissue recovery and maintains muscle elasticity, allowing athletes to maintain optimal performance despite intense training. Effective recovery strategies are essential to support endurance and leg muscle power quality, especially in sports such as basketball that demand explosive movements.

The results of this study are expected to make a significant contribution in the development of integrated, innovative, and applicable recovery strategies. In addition, this

study can also be a guide for coaches in designing more effective training and recovery programs for students at SMAN 8 Malang City.

ACKNOWLEDGMENTS

I would like to thank Mrs. Prisca Widiawati, S.Pd., M.Pd and Mr. Muhammad Putra Ramadhan, S.Kep, Ns., M.Kep, Sp.Kep.M.B who have provided their support and contributions so that this article can be completed. Thank you to my family, friends, and coworkers for their motivation and inspiration. Also, I would like to thank the readers who have taken the time to read this article. Hopefully this article will provide benefits and new insights.

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