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RESEARCH ARTICLE

Impact of Massage Gun on Rating of Perceived Exertion (RPE) in Soccer Players

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Abstract
This study aims to determine the effect of using massage gun media on RPE (Rated Perceived Exertion) in soccer players. The method used is an experimental approach with a one-group pretest-posttest model design. The research instrument used is RPE. The population of this study consisted of 30 athletes from Persib Bandung Academy who were around sixteen years old and attended intensive training four times a week. Using a purposive sampling approach, 18 athletes were selected as research subjects. To determine the RPE scale, subjects underwent high-intensity training using the Yo-Yo Intermittent Recovery Test. After the exercise, a 15-minute massage was performed using a massage gun, and then RPE was measured again. The results of data analysis showed that the massage method using a massage gun had a significant impact on reducing RPE, with a value of p=0.000. This indicates that the use of massage guns can significantly reduce the fatigue level of athletes after intensive training. In conclusion, a massage gun effectively reduces fatigue as measured by RPE. Nevertheless, improving the quality of research is still needed by increasing the number of participants and developing a more structured training program both in time and day.

Keywords
Football athlete, RPE, Massage Gun, Sport Massage

INTRODUCTION

The level of training with increasing intensity can cause physical fatigue and reduce the level of recovery in athletes (Selmi et al., 2022). This has a negative impact on a soccer athlete, because it can reduce the quality of training and competition. According to (Dambroz et al., 2021) physical fatigue felt by soccer players will have a negative impact such as reducing sprint capacity and also reducing technical performance performance such as passing and dribbling. Therefore, rehabilitation or rest is necessary for an athlete to get perfect training results.

An athlete is very susceptible to muscle injury due to high training intensity. According to (Zhao, 2022), muscle injury in an athlete often occurs because the training period is quite consistent and its high intensity makes the muscles work extra. When the muscle works excessively, the sarcomere spasm becomes non-uniform, causing some sarcomeres to be extended beyond the active filament overlap range. This can position certain sarcomeres at a higher risk of structural failure. This means that eccentric contractions in stressed muscles cause more severe tissue damage than in muscles with low tension. This is because high muscle tension increases the risk of injury when the muscle changes in length (Kalkhoven & Watsford, 2020).

A common quantitative indicator of perceived exhaustion during physical activity is the Rating of Perceived Exertion (RPE), which is measured on a scale from 0 to 10 (Ferreira et al., 2023a). According to recent research, RPE remains a critical metric for understanding internal response

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processes, with advancements highlighting its role in various contexts. For instance, the application of differential ratings of perceived exertion (dRPE) has been explored to provide a more sensitive measure of internal training load in team sports, although it may have limitations depending on the exercise or population being studied (Pitt, 2021). Additionally, the relationship between RPE and metabolic as well as hemodynamic responses in high-intensity interval exercise (HIIE) for individuals with type 2 diabetes has been shown to be effective in self-regulation and prescription of exercise (Viana et al., 2019). In addition to its use in quantifying effort and energy expenditure, weariness, and shortness of breath, RPE is highly relevant for health and safety in both work and sport environments. Recent studies have demonstrated that RPE can effectively measure the internal training load and provide insights into fatigue, making it a valuable tool for managing workload and preventing overtraining in athletes (Pind et al., 2021). Moreover, RPE has been shown to correlate with heart rate and oxygen uptake, thereby providing a reliable measure of exercise intensity and helping to ensure safe exercise practices (Losnegard et al., 2021). This is a very basic list of numbers. Participants were asked to rate their exertion during the activity on a scale that took into consideration all physical weariness and symptoms. This number lets the athlete adjust how hard they are working out and allows them to go more quickly or more slowly (Xie et al., 2023a). This scale can be used once or more, requires only a few seconds to complete, and can be self-administered (Vealey et al., 2019). Coaches can now more easily determine whether their athletes are fatigued or still require additional time to recover. Recent studies have highlighted the importance of using subjective and objective measures to monitor athletes' fatigue and recovery status. For instance, the use of perceived exertion scales, heart rate variability, and other biometrics can provide coaches with accurate insights into the athletes' physical condition, helping to optimize training loads and recovery strategies (Kósa et al., 2023).

Recovering means going back to your regular routine and exercising (Daud et al., 2023). Recuperation is necessary for training. Athletes have been presented with a variety of methods and strategies to enhance muscular function following exercise, aside from complete rest along with passive recovery (Turnagöl et al., 2022).

Syarifudin and Roepajadi's (2020) research indicates that local massage therapy applied to the lower extremities can hasten the recovery of leg muscles following exercise. In addition, Ayu et al.'s (2022) study discovered that localized lower extremity massage accelerated the recovery of leg muscles in comparison to passive recovery, which involves simply resting after exercise (Valenzuela et al., 2019). The aforementioned viewpoint states that the quadriceps, hamstrings, gastrocnemius, soleus, and gluteus are among the lower body muscles employed in soccer (Bartolomé et al., 2021). Thus, in order to avoid exhaustion, these muscles need to be strengthened.

The study investigated the utilization of massage bullets as an alternative massage medium to local or manual massage. Massage guns have the ability to enhance muscle flexibility, accelerate the recovery of muscle performance, and alleviate discomfort (Haider et al., 2018). Massage guns also enhance blood circulation, leading to delayed onset muscular soreness or DOMS (Romero-moraleda et al., 2019). Lakhwani & Phansopkar (2022) suggest that employing a massage device post-exercise can enhance the pace of muscular recuperation.

Based on previous research, the author of this study introduces new innovation, one of which is the use of recovery techniques. Passive recovery is achieved through massage using a Massage Gun device. This can serve as one method for muscle fatigue recovery. Gun massage provides significant benefits in reducing pain and speeding up the recovery process (Silva et al., 2023).

Recent studies have shown promising results regarding the contribution of using the Massage Gun tool for recovery from fatigue, as indicated by the Rating of Perceived Exertion (RPE), among football athletes. Research has demonstrated that electric auto-massage therapy can effectively reduce exercise-induced fatigue by enhancing heart rate variability and reducing perceived exertion, making it a valuable tool for post-training recovery (Xie et al., 2023). Additionally, a systematic review found that massage guns can help improve flexibility and reduce muscle stiffness, contributing to faster recovery times (Ferreira et al., 2023b). However, there is no research that examines specifically on soccer players. Based on the description above, the researcher has chosen the title "The Influence of Massage Gun Media on RPE (Rating of Perceived Exertion) in Football Athletes.

MATERIALS AND METHODS

This research was carried out in January 2024. Research ethical approval was obtained from the Ministry of Education and Technology, Universitas Pendidikan Indoensia with project number 1319/UN40.A6/KP/2024. Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Design

This study employs a quantitative approach with a descriptive method using the one group pretest-posttest design. The experimental method is chosen to evaluate the treatment due to its effectiveness in assessing changes before and after an intervention within the same group. This design is commonly used in clinical and educational research to measure the impact of interventions on a single group of subjects, thereby providing a controlled environment to observe specific outcomes. According to (Knapp, 2016), the one-group pretest-posttest design, despite its criticisms, remains a widely used method in clinical research for its simplicity and utility in evaluating treatment effects.

Participants

The population of this study consists of 30 athletes from the Persib Academy, all of them are 16 years old.This population was selected due to the intensive and regular training provided, with training sessions conducted four times each week. The sample used consisted of 18 individuals, selected using the purposive sampling technique.

Purposive sampling is a sampling technique that involves selecting certain samples based on predetermined criteria, as defined by Thomas (2021). The reason for using purposive sampling technique is because it allows researchers to intentionally select subjects that best match the objectives of the study, thereby enhancing the rigor and trustworthiness of the data and results, which is particularly useful for studies that do not involve generalization (Campbell et al., 2020). This technique is suitable for quantitative research where specific characteristics of the sample are critical to addressing the research questions effectively (Andrade, 2021).

The following are the inclusion criteria for obtaining samples: Samples are athletes who regularly train for a period of 6 months or more. The sample is in good health with no injury problems in their health history for the last two months, and they have been selected to be part of the core team to participate in the upcoming competition. Further information can be seen in the Table 1.

Table 1. Demographic characteristics of the participants

Demographic		n	%
Gender	Male	18	100
Age	16 Years old	18	100
Height	150-160	3	16.7
	161-170	7	38.9
	171-180	7	38.9
	181-190	1	5.6
Weight	50-60	12	66.7
	61-70	4	22.2
	71-80	2	11.1
BMI (kg/m2)	18.5-24.9	18	100
Injury History in the Last 2 Months	No Injuries	18	100
Training Period	Athletes who have trained for more than 6 months	18	100
Prepared for Upcoming Competition/Tournament		18	100

Exercise Program

The training program will be conducted four times a week, focusing on different aspects of physical fitness. The first session is an interval running workout aimed at improving aerobic and anaerobic capacity, as measured by the Yo-Yo Intermittent Recovery Test, a widely used and valid field test to evaluate aerobic and anaerobic capacity

in sports such as soccer (Zerf et al., 2021). It involves sprinting for 30 to 60 seconds followed by 1 to 2 minutes of light jogging or active rest, repeated multiple times based on the athletes' fitness levels. The second session focuses on endurance training, consisting of continuous running at moderate intensity for 20 minutes to enhance the body's oxygen utilization efficiency and sustain performance over longer periods. The third session is agility training using cones with exercises like zig-zag runs, figure-8 runs, and shuttle runs, aimed at improving agility, coordination, and quick directional changes essential for avoiding opponents and controlling the ball in soccer. The fourth session targets strength development with plyometric and core-strengthening exercises, including box jumps, split squat jumps, and other explosive movements, along with core exercises such as planks, sit-ups, and Russian twists. This comprehensive program provides adequate variety and focuses on different components of physical fitness such as aerobic capacity, endurance, agility, and strength to optimize soccer players' performance. For more details, see Table 2.

Table 2. Training program at each training session

Session	Type Of Training	Description
Session 1	Interval Training	Sprint for 30-60 seconds, followed by 1-2 minutes of light jogging or active rest. Repeat several times based on fitness level.
Session 2	Endurance Training	Continuous running at a moderate intensity for 20 minutes.
Session 3	Agility Training	Agility drills using cones, including zig-zag runs, figure-8 runs, and shuttle runs.
Session 4	Strength Training	Plyometric exercises like box jumps and split squat jumps, along with core exercises such as planks, sit-ups, and Russian twists.

Instrument

The instrument used in this study is Rated Perceived Exertion (RPE) (Zhao et al., 2022). RPE is a subjective scale used to measure the level of fatigue or effort felt over an individual's perception of the intensity of work performed. In determining the RPE scale, researchers use high-intensity exercise activity training using the Yo-Yo Intermittent Test Recovery Test .

The Borg's Rating of Perceived Exertion (RPE) CR-10 scale is a psychophysical rating scale that allows individuals to subjectively rate their perceived physical exertion during exercise (Borg, 1998). It is a valid and reliable tool to quantify exercise intensity based on the physical sensations experienced by the individual during the exercise bout.

The RPE CR-10 scale ranges from 0 to 10, where 0 represents "no exertion at all" and 10 signifies "maximal exertion". Numerical values are complemented with verbal anchors describing the level of effort along the continuum (e.g. 0.5 = "very, very light", 4 = "hard", 7 = "very strong") (Table 3). This dual coding enables individuals to accurately communicate their internal sensations through mapping it onto a standardized scale.

Table 3. RPE (Rated Percived of Exertion)

Score	Level of Exertion
0	No exertion at all
0,5	Very, very light
1	Very light
2	Light
3	Somewhat hard
4	Hard
5	Somewhat strong
6	Strong
7	Very strong
8	Very, very strong
9	Very tough
10	Maximal exertion

(Zhao et al., 2022)

Proper familiarization of the scale anchors and instructions is important prior to its usage. Participants are advised to focus only on sensations arising from the exercising muscles when providing RPE, while disregarding other external factors. RPE can be taken at specific time-points or after completion of exercise sets.

Validity evidence demonstrates strong relationship between RPE and physiological measures like heart rate, blood lactate levels and oxygen consumption. It provides an easily

applicable, inexpensive yet reliable proxy of exercise intensity that can assist exercise prescription and monitoring of training adaptations over time.

Data Collection Technique

The data collection process in this study was organized into three main phases: pre-experiment preparation, intervention implementation, and post-intervention assessment.

The main focus of this study was to evaluate the effect of gun massage therapy on the rating of perceived exertion (RPE) of soccer athletes from Persib Academy. This study used a purposive sampling to select 18 healthy and fit participants. In the pre-experiment preparation stage, the researcher determined the experimental group and ensured all participants fully understood the research procedures and intervention schedule. An initial RPE test was conducted using the Borg CR-10 scale to obtain baseline data for each participant. After that, participants took the Yo-Yo Intermittent Recovery Test, which aimed to measure their physical fitness level before the intervention. The intervention phase involved the application of massage therapy using a massage gun, which focused on the lower extremities for 15 minutes. After the intervention, a subsequent RPE test was conducted to measure changes in perceived fatigue levels, followed by a final Yo-Yo Test to assess changes in physical fitness. The post-intervention assessment phase was dedicated to analyzing the collected data through statistical methods, which allowed for a close examination of the effect of massage therapy on athletes' RPE and physical performance. The findings from this analysis were crucial for drawing conclusions regarding the research hypotheses.

Research Procedure

At the pre-experiment stage, the population and sample assigned to the experimental group are carefully identified. This stage is very important as it is conducted prior to the study and serves as the preparatory phase for the administration of the treatment. During this stage, participants were given an in-depth understanding of the research methodology and the schedule of the treatment.

The research procedure began by conducting a pretest before massage therapy using a massage gun. After that, the Yo-Yo Intermittent Recovery Test was conducted to assess the athletes' physical fitness level. The RPE (Rating of Perceived Exertion) test was also performed as part of the pretest to obtain baseline data.

After the pretest stage was completed, the treatment phase began, where the experimental group underwent a 15-minute massage therapy session focused on the lower extremities using a massage gun. After the treatment, a post-test was conducted by repeating the baseline assessments, namely the Yo-Yo and RPE tests.

The final stage of the research procedure involved thoroughly evaluating the treatment results. This assessment included statistical analysis of the data obtained in the pretest and post-test phases to determine the effectiveness of the massage therapy. This analysis was then used to test the research hypothesis.

Data Analysis

This study utilized descriptive analysis, normality testing, and paired sample t-tests to evaluate the impact of a massage gun intervention on the Rating of Perceived Exertion (RPE) among soccer athletes. Data collection began with a descriptive analysis of RPE data, which was recorded using the Borg scale before (pre-test) and after (post-test) the massage gun intervention. Descriptive statistics, such as the mean and standard deviation, were calculated to provide an overview of athletes' exertion levels at both stages.

The One-Sample Kolmogorov-Smirnov Test was used to determine if the RPE data were normally distributed for normality testing. This test considers the data normally distributed if the Asymp Sig (2-tailed) value exceeds the alpha level of 0.05 (5%). Establishing normality was essential to deciding whether to use parametric or non-parametric statistical methods for further analysis.

Since the data followed a normal distribution, a paired sample t-test was applied to compare the average RPE scores before and after the massage gun intervention. This test was appropriate for evaluating the same group of athletes under different conditions and provided a p-value to indicate the statistical significance of any observed changes.

These steps ensured a robust analysis of the data, allowing researchers to draw meaningful conclusions about the effectiveness of the massage gun in reducing athletes' perceived exertion levels.

RESULTS

The Sig value was determined from the results of the data processing test to determine the effect using a paired sample t-test. The p-value of 0.000, when compared to the alpha value of 0.05, indicates that we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_a). It can be inferred that Massage Gun Media has an impact on the Rating of Perceived Exertion (RPE) in football athletes.

One of the interesting points shown (Figure 1) is that Sample K gets the highest score after treatment which is 9, but in RPE after training he gets a score that is above average as well which is 6. While samples F and G, after training are far below average with a score of 3, but also in RPE after treatment using a massage gun get a low score which is below average which is 6. Sample R gets a balanced score where he gets after treatment and after training is 7. Next, proceed with doing descriptive statistical analyses to determine the mean, minimum, maximum, and standard deviation of the research data. According to the data presented (Table 4), the lowest RPE test score prior to treatment is 3, while the highest score is 8, with a standard deviation of 1.676. After receiving treatment, the RPE test shows a minimum value of 0 and a maximum value of 7, with a standard deviation of 1.756.

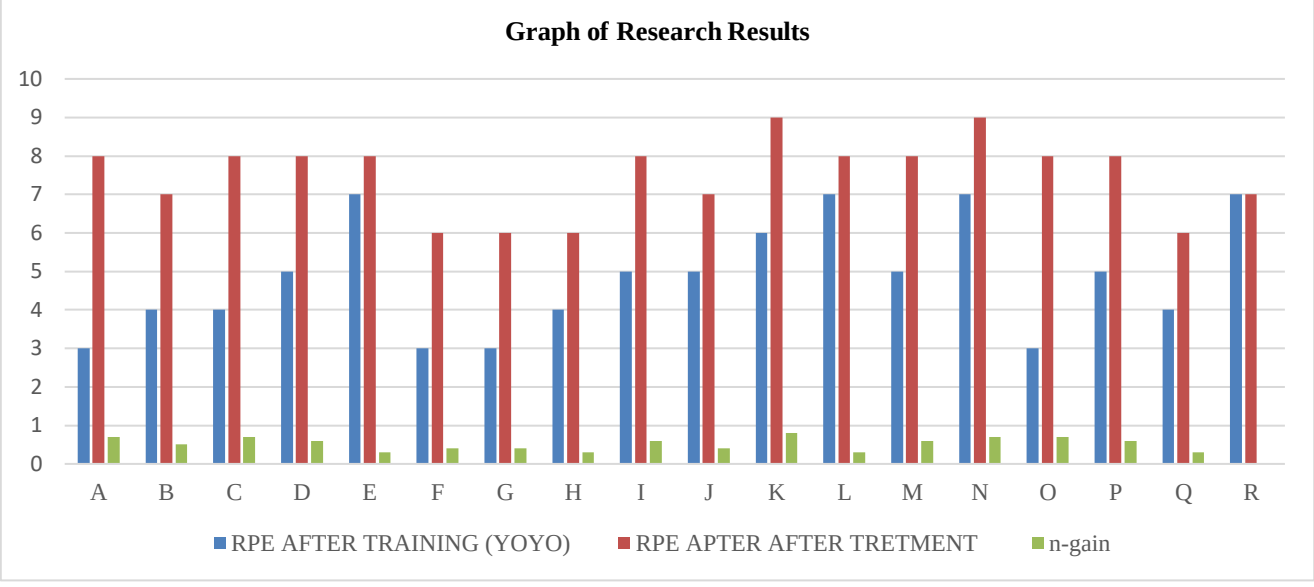

Figure 1. The average difference between the initial test score and the final test RPE (Rated Perceived Exertion)

Tabel 4. Descriptive Statistical Test

	N	Min.	Max.	M	SD
RPE after Yoyo Test	18	3	8	5.11	1.676
RPE after *massage gun*	18	0	7	1.86	1.756
Valid N (listwise)	18				

Std. Deviation (SD), Mean (M), Maximum (Max), Minimum (Min)

The One Sample Kolmogorov-Smirnov Test method was employed to conduct this normalcy test. A test is considered to be normally distributed if the resulting Asmp Sig (2-tailed) value is higher than the alpha value, which is typically set at 0.05 (5%). The results of normalcy testing are displayed (Table 5).

Based on the data in table 5, it can be inferred that the normality test results for the RPE data after the Yoyo Test and RPE after the massage gun were both 0.11. Both variables exceeded the alpha value of 0.05. Both datasets exhibit a normal distribution.

The Sig value was determined from the results of the data processing test to determine the effect using a paired sample t-test. The p-value of 0.000, which is less than the alpha value of 0.05, leads us to reject the null hypothesis (H_0) and accept the alternative hypothesis (H_a). It can be inferred that Massage Gun Media has an impact on the Rating of Perceived Exertion (RPE) in football athletes (Table 6).

Tabel 5. One-Sample Kolmogorov-Smirnov Normality Test

		Unstandardized Residual
N		18
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	1.39779482
Most Extreme Differences	Absolute	.233
	Positive	.229
	Negative	-.233
Test Statistic		.233
Asymp. Sig. (2-tailed)		.011[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Tabel 6. Paired Sample t Test

	Mean	Tcount	Ttable	Sig. (2-tailed)
RPE after YOYO tes - RPE after massage gun	3.25	9.031	2.1098	0.000

DISCUSSION

Fatigue is typically characterized by a decline in muscular function, accompanied by a sensation of weariness throughout the body. Fatigue refers to the diminished ability of muscles to sustain their level of power output (McAllister et al., 2023). Anwar et al., (2023) assert that the accumulation of lactic acid in the tissues leads to weariness. This is because the body is unable to eliminate lactic acid efficiently, which is not proportional to the quick dispersion of lactic acid that is produced as a result of intense physical activity. Fatigue symptoms manifest as diminished work capacity resulting from psychological and physiological factors. These symptoms affect the muscles, leading to muscle contractility impairment, decreased work capacity, and reduced overall physical endurance (Altarriba-Bartes et al., 2021). muscular tiredness hinders muscular performance. Muscle tiredness is present in sports that primarily rely on endurance and high intensity, even if just for a brief duration (Haller et al., 2022).

In measuring the scale of an athlete's fatigue level, recent studies have examined the benefits of massage devices and sports massage. Studies have shown that post-workout muscle massage significantly aids the recovery of muscle strength and endurance compared to passive rest. For example, a systematic review by (Ferreira et al., 2023b) concluded that massage devices are effective in reducing muscle stiffness and improving recovery-related outcomes such as range of motion and strength. However, their effect on performance measures such as power and agility is limited. In this line, Ambarawati et al., (2021) examined the differential Test of Lactic Acid Level Reduction after treatment in between the Two Periods with Paired sample t-test showed p=0.00 ($p<0.05$), which means that the two periods have a significant difference. When viewed from the average difference before and after sports massage treatment was 4.1000 ± .77763 mmol/L, while the difference before and after active resting treatment was 2.8828 ± .53714 mmol/L. It can be concluded that the sport massage treatment is more effective in reducing levels of lactic acid compared to active rest.

Health is the main goal in the medical field. A study by (Wang et al., 2022) explains that the use of a massage gun is also beneficial in accelerating blood flow and providing flexibility to the muscles. The most important effect of high vibration in the use of massage guns is that it can provide both physical and psychological benefits. In the psychological realm, massage guns provide good benefits due to the impact of vibrations that reduce stress levels through the sensation of relaxation (Lurie et al., 2018). Therefore it can be concluded that the use of massage guns has an impact both physically, psychologically, and in relaxing the muscles to be more flexible and also smooth in blood circulation.

Conclusion

Based on the results of the hypothesis test conducted, it can be concluded that the use of Massage Gun has a significant effect in reducing fatigue in soccer players, as indicated by a lower Rating of Perceived Exertion (RPE) value after massage gun treatment. However, the results will be more accurate if the respondents are more participants and the training program is more structured in terms of time and day.

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Conflicts of Interest

The authors declare no conflict of interest.

Ethical Statement

This research was carried out in January 2024. Research ethical approval was obtained from the Ministry of Education and Technology, Universitas Pendidikan Indoensia with project number 1319/UN40.A6/KP/2024.

Author Contributions

All authors RM, DR, K, MM contributed to study design and data collection. Data interpretation was performed by RM and DR. Literature search was conducted by RM. All authors have read and approved the final manuscript.

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