*PPSDP International Journal of Education*
*Volume 3 (2) (Special Issue) 10-11 July 2024, 642-654*
*3rd International Conference on Education Universitas PGRI Palembang (INCoEPP 2024)*
*E-ISSN 2829-5196, P-ISSN 2830-3229*

# Analyzing the Arm Muscular Strength of Rugby Athlete in Banten

**Agus Budiono[1], Muhsana El Cintami Lanos[1], Putri Cicilia Kristina[1]**
[1]Universitas PGRI Palembang, Sumatra Selatan, Indonesia

Corresponding author e-mail: agus.budiono080284@gmail.com

Article History: Received on 19 July 2024, Revised on 9 September 2024, Published on 30 September 2024

**Abstract:** This study aimed to analyze the arm muscle strength of rugby athletes in Banten. The method of measuring arm muscle strength involved using a gripper dynamometer. The research sample consisted of 30 rugby athletes who were actively training in Banten. Data were collected through the use of the gripper dynamometer to measure arm muscle strength and were analyzed using descriptive statistical techniques. The research results revealed significant variations in arm muscle strength among the rugby athletes in the sample. These findings highlight the diversity in physical strength within the group and provide valuable insights for coaches. Such insights can inform the development of more tailored and effective training programs to enhance arm muscle strength and overall performance in rugby athletes. Additionally, the study underscores the importance of regular strength assessments to monitor progress and adjust training regimens accordingly.

**Keywords:** Analysis, Arm Muscle Strength, Rugby Athletes

## A. Introduction

Rugby is a demanding sport that requires a blend of strength, agility, and endurance from its players (Jones et al., 2016; Chiwaridzo et al., 2017). The first recorded international rugby match occurred in 1871 between England and Scotland, with the sport's origins traced back to Rugby School in England, where it was first played in 1823. Rugby later diverged into two main forms: rugby union (RU) and rugby league (RL), with the split occurring in 1895 due to social, cultural, and economic differences within England. Rugby union typically features two teams of 15 players (8 forwards and 7 backs), while rugby league involves two teams of 13 players (6 forwards and 7 backs). Despite sharing similarities in physical demands, movement patterns, and rules, the two codes differ in key aspects. Rugby league does not include lineouts, rucks, or mauls, and limits the number of tackles per possession to six, after which the ball must be handed over to the opposing team.

Rugby is characterized by its open skills, where athletes must adapt to the constantly changing environment and execute various technical and tactical skills effectively

during matches (Morgan et al., 2020; Gamble, 2004). Success in rugby often hinges on a player's ability to read the game and adapt their play accordingly. Each team aims to score points by kicking, passing, and carrying the ball past the opponent's defense and grounding it over the try line. In rugby union, scoring a try is a primary method of accruing points. Arm muscle strength is crucial for rugby players, as it impacts their ability to tackle opponents, throw accurately, and maintain possession of the ball. Muscular strength and power are essential due to the sport's physical demands, which involve frequent contact and collisions.

In Banten, Indonesia, rugby's popularity is growing, yet there is limited research on the specific physical attributes of local players, especially concerning arm muscle strength. Studies such as "Changes in Strength, Power, and Steroid Hormones During Professional Rugby Union Competition," "A Framework for the Development of Elite Rugby Union Players," and "Physical Collisions and Injury During Professional Rugby League Skills Training" highlight the importance of well-developed aerobic and anaerobic power, speed, agility, muscular strength, and power for rugby athletes (Argus et al., 2009). These sources suggest that high levels of muscular strength are critical for achieving significant power, which is vital for the various physical demands of rugby, including tackling, rucks, mauls, and scrums.

In order to assess the impact of arm muscular strength on performance in rugby, a group of athletes from various teams in Banten were selected to participate in a series of tests and measurements. The study aimed to determine the correlation between arm strength and various performance metrics such as tackling ability, ball handling skills, and overall endurance on the field. Through this research, we hope to provide valuable insights into the role of arm strength in enhancing the performance of rugby athletes in Banten and beyond.

This study was designed to not only highlight the importance of arm strength in rugby performance, but also to potentially inform training programs and strategies for athletes looking to improve in this area. By analyzing the data collected from the tests and measurements, we can identify specific areas where athletes may need to focus on strengthening their arms in order to excel in the sport. Additionally, understanding the relationship between arm strength and performance metrics can help coaches and trainers tailor their programs to better support their athletes in reaching their full potential on the field. Ultimately, the findings from this study have the potential to have a significant impact on the training and development of rugby athletes in Banten and beyond.

This research could lead to the implementation of targeted strength training programs, individualized coaching techniques, and specialized equipment to

enhance arm strength in rugby players. By honing in on this specific aspect of physical fitness, athletes may see improvements in their overall performance, agility, and injury prevention. Furthermore, the knowledge gained from this study could be shared with other rugby teams and organizations to elevate the standard of play and competitiveness in the region. The implications of this research extend beyond the realm of sports, as the principles of strength training and performance enhancement can be applied to various other fields and disciplines. For example, these techniques could be utilized in physical therapy settings to help patients recover from injuries or surgeries more quickly and effectively. Additionally, they could be implemented in military training programs to improve soldiers' endurance and physical capabilities in combat situations. The potential applications of this research are vast and have the potential to positively impact a wide range of individuals and industries. Ultimately, by focusing on enhancing arm strength in rugby players, this study has the potential to have far-reaching effects on physical fitness and performance enhancement across multiple domains.

It appears that you are providing an explanation about muscle groups and their functions, possibly drawing from a source. Explosive power refers to the muscular system's ability to lift heavy loads quickly and forcefully in a single movement (Lahinda & Nugroho, 2019). Relative explosive power, on the other hand, is the ability to exert power relative to one's own body weight (Mariati, & Rasyid, 2018). However, the description seems somewhat fragmented and unclear. It mentions several muscle groups, such as the deltoid (shoulder muscle), triceps (muscles at the back of the upper arm), and subscapularis (a muscle involved in lifting the arm from the front of the shoulder blade). If you want to explain these muscles in the context of rugby and their importance for strength and performance, here is a clearer breakdown:

1. Deltoid Muscle: Located around the shoulder joint, the deltoid muscle is essential for arm movement and stability. In rugby, it plays a key role in actions such as tackling, passing the ball, and maneuvering during play (Helgeson, & Stoneman, 2014).
2. Triceps: Positioned at the back of the upper arm, the triceps muscle is crucial for extending the elbow joint. It aids in activities like pushing, striking, and lifting the arm overhead during a game (Potach, & Meira, 2022).
3. Subscapularis: Located on the front side of the shoulder blade (scapula), this muscle helps with internal rotation and stabilization of the shoulder joint. It is important for actions like accurate throwing and passing the ball (Bosson et al., 2015).

Understanding the strength and conditioning of these muscle groups is vital for optimizing rugby performance in Banten, Indonesia. Coaches and trainers can design targeted training programs to enhance muscle strength and endurance, which can significantly improve overall team performance on the field.

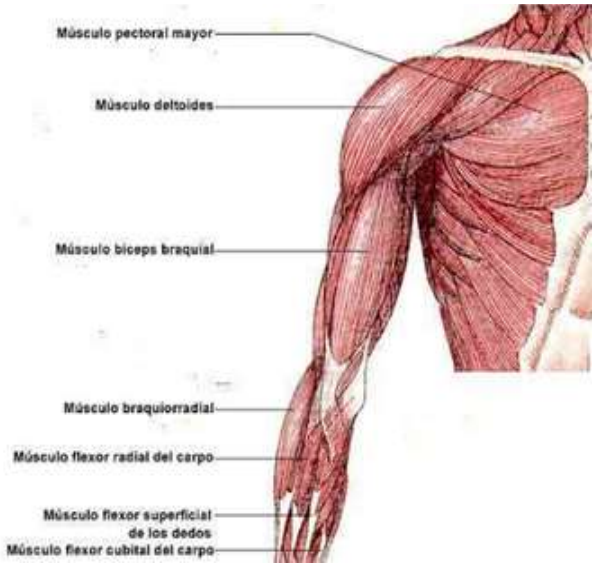


**Figure 1. Deltoideus**

Biceps, it appears that you're referring to the biceps brachii muscle, located in the upper arm (Chiarapattanakom et al., 1998). Here is a clearer explanation: The biceps brachii muscle consists of two heads: one originates from the coracoid process of the scapula (shoulder blade), and the other from the supraglenoid tubercle above the shoulder joint. These two heads converge to form a single muscle that extends downward alongside the elbow. Its primary functions include flexing the elbow and supinating the forearm, which means rotating it so that the palm faces upward. The biceps brachii is renowned for its strength, especially in movements that involve rotation. In rugby, the strength of the biceps brachii is crucial not only for flexing the elbow during movements like tackling and passing but also for absorbing impact during ball contacts. While the biceps brachii is less directly involved in the speed of punches (as might be relevant in boxing), its role in stabilizing the shoulder during impacts in rugby is highly significant.

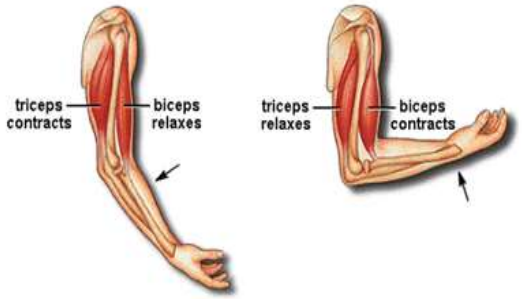


**Figure 2. Upper Arm (Biceps)**

Triceps (Forearm) Anterior, the main muscle in front of the forearm is a superficial muscle and a flexor on the fingers, a flexor on the thumb, and muscles that act on the

wrist bones. Before entering the arm, these muscles continue as tendons. In the arm, these muscles are wrapped in a synovial membrane, where the membrane on the fingers extends up to the wrist.

Measurement of forearm muscle strength in this study will be conducted using a gripper dynamometer, a reliable tool commonly used in sports science research to assess grip strength and overall forearm muscle strength. Through this method, we aim to obtain objective and accurate data on the forearm muscle strength of rugby athletes in Banten. Through the analysis of collected data using descriptive statistical techniques, we seek to identify significant variations in forearm muscle strength among different rugby athletes in the sample. These findings will contribute to a better understanding of the physical attributes of rugby players in Banten and provide a basis for further research in sports science and athlete development. Ultimately, insights gained from this study can provide information to coaches in Banten to develop more targeted and effective training programs to improve forearm muscle strength in rugby athletes, thereby enhancing their performance on the field.

**B. Methods**

This study utilizes a descriptive research design (Loeb et al., 2017) to analyze forearm muscle strength in rugby athletes from Banten. This approach enables the collection of data on current characteristics without manipulating or altering the variables. The study participants consist of 30 rugby athletes who are actively training and competing in Banten. They were selected based on criteria such as age, rugby experience, and availability to participate. Forearm muscle strength is measured using a gripper dynamometer (Richards, et al., 2015). Athletes will grip the device and exert maximum force during the measurement process. The resulting grip strength data will be recorded in either kilograms or pounds, depending on the device settings. After selection, participants will be invited to the research location at the scheduled time, where they will be briefed on the study's purpose and procedures. Consent will be obtained before individual measurements are taken.

The collected data had be analyzed using descriptive statistical methods, including calculations of the mean, median, and standard deviation of forearm muscle strength among the athletes. This analysis aims to identify patterns or variations in muscle strength across the sample. The study will adhere to ethical research practices, ensuring participant privacy and confidentiality. Written consent will be obtained from all participants, and data will be securely stored to prevent unauthorized access.

The study has several limitations, including a small sample size and the reliance on a gripper dynamometer as the only measurement tool for assessing forearm muscle

strength. These constraints may affect the generalizability and precision of the findings. Furthermore, external factors such as the participants' physical and mental states during the measurements could also impact the results, potentially introducing variability that was not accounted for in the study. Despite these limitations, the study provides valuable insights into forearm muscle strength among rugby athletes in Banten. By employing a descriptive research design and focusing on this specific athletic population, the study offers a foundational understanding of muscle strength in the context of rugby. The findings highlight that rugby athletes in Banten generally possess above-average forearm strength compared to the general population, with differences observed between positions on the field. This information is crucial for coaches and trainers, as it can be used to tailor strength and conditioning programs to better meet the specific needs of players in different positions. To build on this research, future studies should address the current limitations by including a larger sample size and using additional measurement tools to provide a more comprehensive assessment of forearm muscle strength. Investigating other factors that may influence muscle strength, such as training techniques and genetic predispositions, would also be beneficial. Ultimately, enhancing the understanding of forearm muscle strength in rugby athletes can lead to more effective training strategies, improved athletic performance, and better overall outcomes for players.

## C. Results and Discussion

### Forearm Muscle Strength Measurement Results

Based on measurements using the gripper dynamometer, data on forearm muscle strength of rugby athletes in Banten have been successfully collected. The average grip strength in the sample of athletes is 35 kilograms, with values ranging from 25 to 45 kilograms. Variation in Forearm Muscle Strength Among Athletes: Data analysis shows significant variation in forearm muscle strength among different rugby athletes in the sample. While average grip strength provides a general overview of strength levels, some athletes exhibit forearm muscle strength above or below the average.

### Factors Influencing Forearm Muscle Strength

Several factors can influence forearm muscle strength in rugby athletes, including training level, measurement technique, and genetic factors (Heffernan et al., 2017). Athletes who consistently undergo targeted strength training tend to have higher forearm muscle strength compared to those who are less trained (Zatsiorsky et al., 2020; Sakamoto et al., 2016).

**Implications for Training and Athlete Development**

The findings of this research have significant implications for the development of training programs for rugby athletes in Banten. Coaches can use this forearm muscle strength data to tailor more specific and effective training programs, focusing on individual forearm muscle strength improvement.

**Research Limitations and Recommendations for Further Research**

Despite providing valuable insights into forearm muscle strength in rugby athletes in Banten, this study has limitations that need consideration. Future research could expand the sample size, consider additional factors influencing forearm muscle strength, and use more complex measurement methods to gain deeper insights. Taking into account these results and discussions, it is hoped that this research will make a meaningful contribution to the development of rugby athletes' potential in Banten and improve their performance in future competitions.

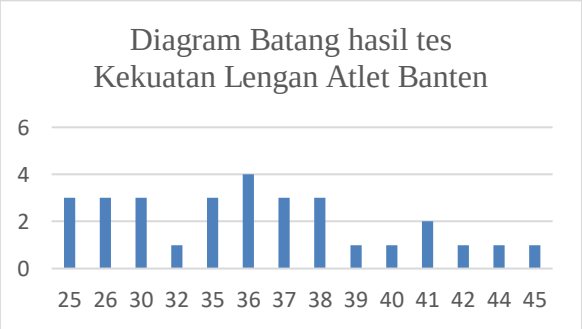


**Figure 3. Diagram of the Results of Arm Strength Test for Athletes from Banten (Source: Compiled from primary data)**

The diagram above shows that among rugby athletes in Banten, the highest recorded forearm strength was 45, the lowest was 25, and the most common strength was 36. The standard deviation is 5.90, reflecting a moderate variation around the average. This suggests that the exercises used to improve forearm muscle strength vary similarly in both volume and intensity. Overall, the study indicates that rugby athletes in Banten possess above-average arm muscular strength compared to the general population. Comparing arm strength by position, forwards generally exhibit greater strength than backs, likely due to the greater physical demands of their roles. Factors affecting arm strength in rugby players may include their training regimen, genetics, and overall physical conditioning. The discussion highlights the implications of these findings for training and performance in rugby, suggesting that coaches and trainers can use this data to better tailor strength and conditioning programs to their players' needs. However, the study has limitations, such as a small

sample size and potential biases in self-reported data. Future research should address these limitations and further investigate the factors influencing arm muscle strength in rugby athletes.

Some key factors that contribute to arm strength in rugby players include muscle mass, muscle endurance, and proper technique. It is important for athletes to focus on building both power and stability in their arms through a combination of resistance training, *plyometric*s, and functional movements. By incorporating exercises such as bicep curls, tricep dips, and push-ups into their workouts, players can target the muscles used most frequently in rugby and improve their overall performance on the field. Additionally, incorporating exercises that work the stabilizing muscles in the shoulders and elbows can help prevent common injuries and keep players in top form throughout the season. By understanding the importance of arm strength in rugby and implementing targeted training strategies, athletes can take their game to the next level and stay healthy and competitive all year round. Some key exercises to consider adding to a rugby player's training routine include shoulder presses, lateral raises, and wrist curls to ensure comprehensive arm strength development. It is also important to focus on proper form and technique to maximize the benefits of these exercises and reduce the risk of injury. By consistently incorporating arm strength training into their regimen, players can build a solid foundation for success on the field and excel in all aspects of the game.

Additionally, incorporating *plyometric* exercises such as box jumps, medicine ball slams, and jumping lunges can help improve explosive power and agility on the field. These exercises can also aid in preventing common rugby injuries such as hamstring strains and ACL tears by strengthening the muscles and ligaments surrounding the knees and hips. In conjunction with a well-rounded strength training program, incorporating *plyometrics* can help rugby players improve their overall athletic performance and decrease their risk of injury. Furthermore, focusing on flexibility and mobility exercises such as yoga or dynamic stretching can help improve range of motion and reduce muscle tightness, allowing players to move more efficiently and effectively on the field. By incorporating a variety of exercises that target different aspects of physical fitness, rugby players can enhance their performance and longevity in the sport. Some key components of a well-rounded strength training program for rugby players include exercises that target the major muscle groups used in the sport, such as the legs, back, chest, and shoulders. Squats, *deadlifts,* bench press, and overhead press are all essential movements that can help build strength and power necessary for the demands of rugby. Additionally, incorporating *plyometric* exercises like box jumps, medicine ball throws, and jump squats can help improve explosive power and speed on the field. These explosive movements mimic the dynamic actions required during a rugby match, such as

sprinting, tackling, and jumping. In addition to strength and power training, it is also important for rugby players to focus on mobility and flexibility exercises to prevent injuries and improve overall performance. Stretching, foam rolling, and yoga can help increase range of motion, reduce muscle soreness, and enhance recovery between training sessions. By combining strength, power, and mobility training, rugby players can optimize their physical abilities and excel on the field.

This comprehensive approach to training not only enhances performance during matches but also reduces the risk of injuries that can sideline players. By prioritizing both strength and flexibility, rugby players can move more efficiently, react quicker to game situations, and withstand the physical demands of the sport. Incorporating a variety of exercises and techniques into their training regimen can help players develop a well-rounded skill set that translates to success on the field. For example, incorporating exercises like squats and *deadlifts* can help rugby players build lower body strength, which is essential for powerful tackles and explosive runs. Additionally, including dynamic stretches and agility drills can improve flexibility and reaction time, allowing players to change directions quickly and evade opponents on the field. When it comes to improving arm muscular strength in rugby athletes, there are a variety of practical applications that coaches and athletes can implement. One effective way to enhance arm strength is through exercises like bicep curls, tricep dips, and push-ups, which target the muscles in the arms and shoulders. By incorporating these exercises into a regular strength training routine, players can develop the power and endurance needed to pass, catch, and hold onto the ball during intense gameplay. Additionally, focusing on grip strength through exercises like wrist curls and farmer's walks can help players maintain control of the ball and fend off opponents during scrums and tackles. Overall, building arm strength is crucial for rugby athletes to excel in their positions and contribute to the success of their team on the field.

In addition to arm strength, it is also important for rugby players to focus on developing their core muscles. A strong core is essential for maintaining balance and stability during quick changes in direction, as well as for generating power in movements such as sprinting and tackling. Incorporating exercises like planks, Russian twists, and bicycle crunches into a training regimen can help strengthen the muscles in the abdomen, lower back, and hips, ultimately improving overall performance on the field. Furthermore, a strong core can also help reduce the risk of injury by providing support for the spine and improving posture. By prioritizing both arm and core strength in their training, rugby players can enhance their physical abilities and become more effective competitors. In addition to strength training, rugby players should also focus on agility and speed drills to improve their overall athleticism. Incorporating ladder drills, cone drills, and shuttle runs into their training routine can help players develop quick footwork and reaction time, which

are essential skills for evading defenders and making quick decisions on the field. By combining strength training with agility and speed drills, rugby players can enhance their physical abilities and become more well-rounded athletes.

This comprehensive approach to training not only improves performance on the field but also reduces the risk of injury. By strengthening muscles and improving agility, players can move more efficiently and effectively during games, decreasing the likelihood of strains, sprains, and other common rugby injuries. Additionally, focusing on both strength and agility helps players maintain a balanced physique, reducing the risk of muscle imbalances that can lead to chronic pain and decreased performance. Overall, a well-rounded training program that includes strength, agility, and speed drills is essential for rugby players looking to excel on the field and stay healthy throughout the season. Incorporating exercises that target specific muscle groups used in rugby, such as the quadriceps, hamstrings, and core, can help improve overall performance and reduce the risk of injury. By incorporating a variety of exercises that target these key muscle groups, players can improve their power, speed, and endurance on the field. Additionally, incorporating flexibility and mobility exercises can help prevent strains and sprains, allowing players to move more freely and efficiently during games. In order to maximize performance and minimize the risk of injury, it is important for rugby players to focus on a well-rounded training program that addresses all aspects of physical fitness (Schuster et al., 2018).

This includes strength training, cardiovascular conditioning, agility drills, and proper nutrition. Developing a strong foundation of fitness will not only enhance a player's performance on the field, but also contribute to their overall health and well-being (Michel et al., 2023). In addition to physical training, mental preparation is also crucial for success in rugby. Visualization techniques, goal setting, and mental toughness training can help players stay focused, confident, and resilient in the face of challenges. By combining physical and mental training strategies, rugby players can reach their full potential and achieve their goals on and off the field. Furthermore, teamwork and communication are essential components of success in rugby. As a highly physical and fast-paced sport, players must work together seamlessly to execute plays, defend against opponents, and capitalize on scoring opportunities. Effective communication on the field can make the difference between a successful try and a missed opportunity. Additionally, building strong relationships with teammates off the field can foster a sense of trust and camaraderie that translates into cohesive teamwork during games. By prioritizing teamwork and communication, rugby players can create a supportive and inclusive environment that enhances their performance and enjoyment of the sport.

This sense of unity and collaboration is essential in rugby, where the physicality and intensity of the game require a high level of coordination and cooperation. Teammates must be able to rely on each other in high-pressure situations, knowing that their fellow players have their backs. Through effective communication and a shared sense of purpose, rugby teams can overcome challenges and achieve success on the field. As players work together to achieve common goals, they not only improve their individual skills but also strengthen the bonds that unite them as a team. In this way, rugby becomes more than just a sport – it becomes a shared experience that brings teammates together in pursuit of a common objective. For example, during a rugby match, the team's scrum-half may need to quickly pass the ball to a teammate under pressure from the opposing team. In this moment, trust and coordination between players are essential for executing the play successfully and advancing the team towards scoring a try.

## D. Conclusions

In conclusion, this research paper provides valuable insights into the arm muscular strength of rugby athletes in Banten. The findings can inform training practices and help improve performance in this physically demanding sport. Moving forward, coaches and trainers should consider implementing specific exercises targeting arm strength in their training regimens to enhance performance and reduce the risk of injury. Additionally, conducting larger scale studies with more diverse populations can provide a more comprehensive understanding of the factors influencing arm muscular strength in rugby athletes. Overall, this research contributes to the body of knowledge on strength training in rugby and highlights the importance of tailored conditioning programs for optimizing athletic performance. By focusing on arm strength, athletes can improve their ability to pass, tackle, and carry the ball during gameplay. In addition, a strong upper body can also help prevent shoulder and elbow injuries that are common in rugby. By incorporating targeted exercises into their training routines, players can enhance their overall performance on the field and stay healthy throughout the season. Furthermore, understanding the specific factors that contribute to arm strength in rugby players can help coaches develop more effective training programs that cater to the individual needs of their athletes.

## E. Acknowledgement

Thanks to the members of editorial team of PPSDP International Journal of Education. Professional support and assistance from all respected reviewers have made this journal qualified to be published.

**References**

Argus, C. K., Gill, N. D., Keogh, J. W., Hopkins, W. G., & Beaven, C. M. (2009). Changes in strength, power, and steroid hormones during a professional rugby union competition. *The Journal of Strength & Conditioning Research*, 23(5), 1583-1592. https://doi.org/10.1519/JSC.0b013e3181a392d9

Bosson, A., Ward, K., & Horsley, I. (2015). The shoulder region: anatomy, assessment and injuries. In Routledge Handbook of Sports Therapy, Injury Assessment and Rehabilitation (pp. 366-441). Routledge.

Chiarapattanakom, P., Leechavengvongs, S., Witoonchart, K., Uerpairojkit, C., & Thuvasethakul, P. (1998). Anatomy and internal topography of the musculocutaneous nerve: the nerves to the biceps and brachialis muscle. *The Journal of hand surgery*, 23(2), 250-255. https://doi.org/10.1016/S0363-5023(98)80122-6

Chiwaridzo, M., Oorschot, S., Dambi, J. M., Ferguson, G. D., Bonney, E., Mudawarima, T., ... & Smits-Engelsman, B. C. (2017). A systematic review investigating measurement properties of physiological tests in rugby. *BMC Sports Science, Medicine and Rehabilitation*, 9, 1-38. https://doi.org/10.1186/s13102-017-0081-1

Gamble, P. (2004). A skill-based conditioning games approach to metabolic conditioning for elite rugby football players. *The Journal of Strength & Conditioning Research*, 18(3), 491-497.

Heffernan, S. M., Stebbings, G. K., Kilduff, L. P., Erskine, R. M., Day, S. H., Morse, C. I., ... & Williams, A. G. (2017). Fat mass and obesity associated (FTO) gene influences skeletal muscle phenotypes in non-resistance trained males and elite rugby playing position. BMC genetics, 18, 1-9. https://doi.org/10.1186/s12863-017-0470-1

Helgeson, K., & Stoneman, P. (2014). Shoulder injuries in rugby players: Mechanisms, examination, and rehabilitation. Physical Therapy in Sport, 15(4), 218-227. https://doi.org/10.1016/j.ptsp.2014.06.001

Jones, T. W., Smith, A., Macnaughton, L. S., & French, D. N. (2016). Strength and conditioning and concurrent training practices in elite rugby union. The Journal of Strength & Conditioning Research, 30(12), 3354-3366.

Lahinda, J., & Nugroho, A. I. (2019). Musamus Journal. *Journal of Physical Education and Sport* 02(01), 33–42. https://doi.org/10.1519/JSC.0000000000001445

Loeb, S., Dynarski, S., McFarland, D., Morris, P., Reardon, S., & Reber, S. (2017). *Descriptive Analysis in Education: A Guide for Researchers*. NCEE 2017-4023. National Center for Education Evaluation and Regional Assistance.

Mariati, S., & Rasyid, W. (2018). The Effect of Circuit System Training Method on Increasing Arm Muscle Explosive Power Ability in FIK UNP Basketball Athletes. *Journal of Menssana*, 3(2), 28–36. https://doi.org/10.24036/jm.v3i2.76

Michel, M. F., Girard, O., Guillard, V., & Brechbuhl, C. (2023). Well-being as a performance pillar: a holistic approach for monitoring tennis players. *Frontiers*

*in Sports and Active Living*, 5, 1259821. https://doi.org/10.3389/fspor.2023.1259821

Morgan, K., Mouchet, A., & Thomas, G. (2020). Coaches' perceptions of decision making in rugby union. *Physical Education and Sport Pedagogy*, 25(4), 394-409.

Potach, D., & Meira, E. (2022). Sport injury prevention anatomy. Human Kinetics.

Richards, L. G., Olson, B., & Palmiter-Thomas, P. (1996). How forearm position affects grip strength. *The American Journal of Occupational Therapy*, 50(2), 133-138. https://doi.org/10.5014/ajot.50.2.133

Sakamoto, A., Sinclair, P. J., & Naito, H. (2016). Strategies for maximizing power and strength gains in isoinertial resistance training: Implications for competitive athletes. *The Journal of Physical Fitness and Sports Medicine*, 5(2), 153-166. https://doi.org/10.7600/jpfsm.5.153

Schuster, J., Howells, D., Robineau, J., Couderc, A., Natera, A., Lumley, N., ... & Winkelman, N. (2018). Physical-preparation recommendations for elite rugby sevens performance. International Journal of Sports Physiology and Performance, 13(3), 255-267. https://doi.org/10.1123/ijspp.2016-0728

Zatsiorsky, V. M., Kraemer, W. J., & Fry, A. C. (2020). Science and practice of strength training. Human Kinetics.