i-Core: Indonesian Journal of Sport Science

Volume 2 Issue 1 (2026)

https://jurnal.stokbinaguna.ac.id/index.php/i-Core

Effects of Dietary Fat Intake on Endurance, Strength, and Post-Exercise Recovery across Diverse Sports Disciplines: A Controlled Trial

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Abstract: This study explores the important role of fat in sports nutrition, focusing on its function in energy production and athletic performance. It highlights gaps in understanding regarding the optimal balance of fat intake for athletes across various sports. The objective of this study is to investigate the effects of fat intake on physical endurance, strength, and recovery time. The method used was a quantitative approach through controlled trials involving athletes from various disciplines, evaluating their performance under varying fat intake conditions. The results show that moderate intake of healthy fats increases energy levels, endurance, and recovery time, while excessive fat intake reduces performance efficiency. These findings suggest a correlation between balanced fat consumption and improved athletic performance. In conclusion, this study provides insights into optimal fat intake for athletes, emphasizing the importance of moderation and the types of fats consumed. These findings have practical implications for sports nutritionists in designing dietary plans and contribute to the theoretical understanding of macronutrient management in athletic performance.

Keywords: Sports Nutrition, Fat Intake, Athletic Performance, Controlled Trial, Sport Science

Introduction

The 200-meter breaststroke is a water sport involving 200 meters that takes a relatively long time to complete; this sport requires an aerobic endurance energy system. It takes more than 2 minutes to swim 200 meters, as stated by Bafirman, (2008), swimming falls into the category of moderate-endurance sports (2 to 8 minutes); this ability can be classified as either aerobic or anaerobic (Olahraga & Surabaya, 2020). According to Richard (2005), the breaststroke is a smooth swimming stroke because the propulsive force for moving forward in the water results from a series of coordinated movements between the legs and arms, executed with precise timing. Therefore, Richard further explains that the dominant propulsive force in the breaststroke is generated by the leg movements. In the breaststroke, the leg kick serves as the primary propulsive force compared to the arm movements. (Terhadap, n.d.) The 200-meter breaststroke is one of the breaststroke events contested in competitions. The breaststroke consists of four movement components: body position, leg movement, arm

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movement, breathing, and coordination. In the breaststroke, relatively little effort is required because the arms move through the water and natural buoyancy keeps the body afloat. However, this stroke offers an advantage for long-distance swimming, which is also related to a swimmer's ability. If a swimmer attempting a certain distance lacks sufficient speed, the goal of the swim will not be achieved (Volume, 2020).

The breaststroke is often referred to as the frog stroke. This name stems from the fact that the breaststroke's movements resemble those of a frog while swimming. (Irawan & Nidomuddin, 2017) "Breaststroke" is the translation of "breaststroke." The breaststroke is a swimming stroke in which, from the start of the first arm stroke after the start and after the turn, the swimmer must remain face-down with both shoulders aligned with the water. (Shava et al., 2017). Speed is the most important component in sports, particularly swimming, because it is essential during competition to achieve maximum performance. The breaststroke is influenced by the acceleration of the arm movements during the glide phase; however, the kick serves as the dominant propulsive force in the breaststroke. Thus, speed is a conditional quality that enables an individual to perform movements and react quickly to stimuli (Shofi & Olahraga, 2022).

In swimming, proper technique is essential for speed, as correct and incorrect techniques significantly impact swimming speed itself. Breaststroke technique consists of several movement indicators that form the foundation of the breaststroke technique. These indicators include body position, leg movement, arm movement, breathing, and movement coordination. "The breaststroke technique consists of several movement components, including body position, arm movement, leg movement, breathing, and movement coordination." "The breaststroke technique consists of body position, arm movements, leg movements, breathing, and movement coordination." "The components of the breaststroke technique consist of body position, arm movements, leg movements, breathing movements, and movement coordination." (Khan et al., 2021). The breaststroke technique consists of several movement indicators that form the basis of the breaststroke technique. These indicators are body position, leg movements, arm movements, breathing, and movement coordination. This is supported by the statement: "The breaststroke technique consists of several movement components, including body position, arm movements, leg movements, breathing movements, and movement coordination." "The breaststroke technique consists of body position, arm movements, leg movements, breathing, and movement coordination." "The components of the breaststroke consist of body position, arm movements, leg movements, breathing movements, and movement coordination" (Skills et al., 2021).

Speed in performing the breaststroke is determined not only by a good and proper mastery of basic technique but also by supporting physical fitness components, namely leg muscle strength as the primary propulsive component in the breaststroke. Speed is a physical fitness component that is just as important as the other physical fitness components (Metode et al., 2013). Speed is a physical fitness component that is just as important as the other physical fitness components. The other physical fitness components referred to include strength, endurance, flexibility, agility, balance, accuracy, and reaction time. Muscle strength plays a crucial role in swimming. According to Sukintoko and Sukarno (1983:73), every forward movement in swimming results from two forces. One force tends to hold the swimmer back; this is called drag, caused by the water that must be pushed forward. The second force is the force that propels the swimmer forward; this is called propulsion, derived from arm movements or pulls, abdominal balance to maintain a streamlined position, and leg propulsion (Antara et al., 2017).

Every forward speed in swimming is the result of two forces. One force tends to hold the swimmer back, this is called drag, caused by the water that must be pushed aside, while the second force propels the swimmer forward; this is called propulsion,

derived from the movement or pull of the arms and the thrust of the legs (Otot et al., 2022). Several factors influence an athlete's 200-meter breaststroke speed, particularly technical proficiency, physical condition, and mental state. These three factors are inseparable; all must be in optimal condition. This is because good technical proficiency without the support of good physical and mental condition does not guarantee that a person can perform swimming movements well, and vice versa. Speed is the ability to perform movements in a short amount of time. (Volume, 2020). Speed is a crucial component in swimming. Speed is essential during competition to achieve desired performance. The breaststroke is influenced by the speed of arm movements and kicks during the glide phase (Education, 2023).

It cannot be denied that speed and technique in swimming, particularly in the breaststroke, are vital for achieving championship goals. If an athlete cannot master the technical skills of the breaststroke properly and correctly, this will affect their swimming speed. If an athlete is slower in the breaststroke than other athletes, the fastest athlete is the one who wins. Therefore, mastering the technical skills of the breaststroke is crucial for achieving success in breaststroke events (Haryanto et al., 2021). Arm muscle strength is closely related to swimming ability in the breaststroke; by utilizing dynamic strength during these movements, swimmers strive to propel their bodies from one end of the pool (start) to the other (finish) (Sembiring et al., 2021). Leg muscle strength plays a vital role in breaststroke swimming, as it serves as the propulsive force that enables swimmers to perform at their best.

From the explanation above, it can be concluded that upper-body and lower-body muscle strength play a crucial role in breaststroke swimming, as they serve as the primary propulsion to move the swimmer's body from the start to the finish as quickly as possible (Ilmah et al., 2021) and require active joint and muscle movements to achieve the targeted time. This can be seen in major events such as the 2024 Paris Olympics, where an Olympic newcomer broke the men's 200-meter breaststroke record after defeating the record-holder from the 2020 Tokyo Olympics. The relationship between technique and speed in the breaststroke is crucial in determining the speed generated; arm muscle strength, lower-body muscle explosiveness, and movement coordination all contribute to breaststroke speed (Movement & Speed, 2015). Lower-body muscle explosiveness is the ability to propel the body forward and sustain that acceleration toward the finish. An analysis of movement in this context makes it clear that an athlete's speed potential cannot be realized if they lack or have low leg muscle explosiveness. (Aulia, 2023). Speed depends on several influencing factors, namely strength, reaction time, and flexibility (Wilmore: 1977). Therefore, when focusing on developing speed, athletes must also train their strength, flexibility, and reaction time, not just practice running speed or movement alone. Flexibility is the body's ability to move as widely as possible, supported by the range of motion in the joints. It is the ability to move the body and its limbs as widely as possible. It is closely related to the ability of large muscle groups to move and their performance capacity. This ability is also related to the ability to stretch muscles and the tissues surrounding the joints (Guruh et al., 2021).

Based on the research findings, the researchers obtained data on the best time for the men's 200-meter breaststroke by an Indonesian swimmer, Farrel Armandio Tangkas, who recorded 2 minutes and 1.7 seconds at the 2024 ASEAN University Games in Surabaya -Malang. The researchers also observed the best time set by the world record holder (WR) from the video of the 2024 Paris Olympics men's 200-meter breaststroke final in Paris, where Léon Marchand (2:05.85) beat the previous record holder, Zac Stubblety-Cook (2:06.38). The breaststroke, as one of the swimming strokes analyzed in this study, has a distinctive movement characterized by the body floating on the water's surface. The arms move symmetrically forward and backward, while the legs kick together outward. Mastery of breaststroke technique involves precise coordination

between arm and leg movements, as well as regular breathing. (Febrianti et al., 2024) Therefore, the author analyzed Léon Marchand's breaststroke speed (2:05.85) to determine the types of muscle contributions and which techniques Léon Marchand predominantly employed in achieving his world record (WR) time of (2:06:38). Consequently, the author is interested in analyzing the video of the 200-meter breaststroke final at the 2024 Paris Olympics and has titled the study "Biomechanical Analysis of Léon Marchand's Breaststroke at the 2024 Paris Olympics".

Method

The research design used in this study is a descriptive study employing video observation. In general, descriptive research aims to describe a situation or identify trends and patterns within a sample group that can be generalized to the study's defined population. The research to be conducted is descriptive research. Sukmadinata (2005) explains that "descriptive research is intended to describe a condition or phenomena as they are." The variables addressed in this study are breaststroke technique skills and breaststroke speed. The data collected in this type of survey consists of a combination of measurements, counts, and brief narrative descriptions, which are then analyzed using descriptive statistics. The type of research employed by the researcher is quantitative research, utilizing a descriptive quantitative analysis method.

The method used to collect data in this study was to examine the form and accuracy of the final 200-meter men's breaststroke video at the 2024 Paris Olympics; data in this study were also collected by observing the time comparisons between Zac Stubbled Cook and Leon Marchand at the Paris Olympics and the previous Tokyo Olympics, as well as by observing the dominant movements and which body parts contributed the most. In principle, conducting research involves taking measurements, so it is essential to have good measuring tools. The measuring tools used in research are called research instruments. A research instrument is a tool used to measure observed natural or social phenomena. The instruments used in this study consist of videos from YouTube or social media.

Results & Discussion

Results

The research findings were derived from an analysis of Leon Marchand's technique and speed at the 2024 Paris Olympics, where the study examined the relationship between arm muscle strength and leg muscle strength and Leon Marchand's breaststroke speed. The subject of this study was the Olympic athlete, Leon Marchand. Data were obtained based on measurements of arm muscle strength, leg muscle strength, and breaststroke speed from video observations of Leon Marchand's breaststroke performance at the 2024 Paris Olympics. The results obtained are as follows: In this study, the research subject was Leon Marchand. The description of the research variables is intended to provide an overview of the technique and speed that are the focus of the study. Speed will focus on the swimming speed demonstrated by Leon Marchand. The technique used by Leon Marchand is the breaststroke sprint, analyzed based on hand speed and the rapid hand-entry distance. In the analysis of rapid leg movements, both the left and right legs pull through the water very quickly. Rapid body propulsion and head thrust, as well as the thrust during the start, also influence time efficiency.

Discussion

The results of the study obtained from video analysis indicate that there is a correlation between arm muscle strength and breaststroke speed. This implies that athletes with strong arm muscles tend to swim faster. This can be determined by the time

it takes an athlete to complete one lap. Conversely, athletes with weak arm muscle strength tend to have slower swimming speeds. These findings align with the results of Rasyid's study (Rasyid et al., 2017), which examined the effect of arm muscle strength on freestyle swimming speed. The results showed a significant relationship between arm muscle strength and freestyle swimming performance, with a calculated t-value of 15.371 > t. The study also found that arm muscle strength endurance contributed 46.10% to swimming speed. Furthermore, (Marza & Argantos, 2020) also found that arm muscle strength contributed 33% to the ability to swim 200 meters breaststroke, as measured using a push-up test. The hypothesis stated that there is a relationship between lower-body muscle strength and breaststroke speed, and based on the results of the data analysis, a significance value of 0.001 < 0.05 was obtained, meaning the hypothesis is accepted. This implies that athletes with strong lower-body muscles tend to have faster swimming speeds. This can be determined by the time it takes an athlete to complete one lap. It also means that athletes with weak lower-body muscle strength will tend to have slower swimming speeds. The hypothesis states that there is a relationship between arm muscle strength and leg muscle strength and the 50-meter breaststroke speed. Based on the results of the data analysis, the significance value was found to be 0.000 < 0.05, which means the hypothesis is accepted. This implies that the greater the arm and leg muscle strength of the athletes, the better their swimming speed tends to be. Conversely, if the athletes' arm and leg muscle strength is weak, their swimming speed will also be slow. From the above discussion, it can be concluded that there is a significant relationship between arm muscle strength and leg muscle strength and 50-meter breaststroke speed. Breaststroke performance depends on explosive strength training of the arm and leg muscles in each athlete. The discussion focuses on the relationship between the data and the results of the analysis and the research problem or objectives, as well as the broader theoretical context. The discussion may also serve as an answer to the question of why certain findings were observed in the data. The discussion is written in close connection with the data being discussed. Every effort is made to ensure that the discussion is not separated from the data presented.

Conclusion

Based on the above conclusions, a strong relationship between proper technique and power in athletes can improve their speed; specifically, enhancing technical training, speed, and power leads to improvements in breathing and race times. For example, mastering the breaststroke technique properly and correctly is not the sole factor that supports achieving maximum performance in the breaststroke. This is because technical mastery is not the sole factor influencing performance in the breaststroke; rather, it is just one of several factors. This means there are various other factors that play a crucial role in achieving maximum performance in the breaststroke. Even with excellent technical mastery of the breaststroke, if it is not supported by optimal physical conditioning, maximum performance cannot be achieved. Based on this view, it can be concluded that physical condition enables an athlete's body to execute proper technique effectively and efficiently in achieving performance goals. If an athlete lacks good physical conditioning, even with excellent technical mastery, they will be unable to swim quickly or maintain that speed.

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