

**PENGARUH LATIHAN SIT-UP TERHADAP RENANG GAYA PUNGGUNG PADA MAHASISWA  
PENDIDIKAN JASMANI**

***THE INFLUENCE OF SIT-UP EXERCISE ON BACKSTROKE SWIMMING SKILLS  
IN PHYSICAL EDUCATION STUDENTS***

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**Abstrak**

Renang gaya punggung adalah olahraga yang membutuhkan koordinasi tubuh, kekuatan otot inti, dan teknik pernapasan serta gerakan yang efisien. Kekuatan otot perut memainkan peran krusial dalam menjaga stabilitas tubuh di permukaan air dan meningkatkan efisiensi gerakan. Sit-up, sebagai bentuk latihan penguatan otot perut, diyakini dapat memberikan dampak positif pada performa renang gaya punggung. Tinjauan literatur ini bertujuan untuk menganalisis penelitian sebelumnya mengenai hubungan antara latihan sit-up dan peningkatan performa renang gaya punggung. Literatur yang ditinjau diperoleh dari jurnal nasional dan internasional di bidang olahraga dan fisiologi. Hasil menunjukkan bahwa sit-up yang terprogram dapat meningkatkan kekuatan otot perut, memperbaiki postur tubuh, dan meningkatkan efisiensi dorongan lengan dan kaki. Mengintegrasikan sit-up dengan latihan inti seperti plank, angkat kaki, dan gerakan dinamis memberikan manfaat optimal. Namun, penelitian eksperimental lebih lanjut diperlukan untuk mengukur dampak langsung pada kecepatan, efisiensi energi, dan stabilitas tubuh di air. Tinjauan ini memberikan dasar teoretis bagi pelatih untuk merancang program latihan gaya punggung yang lebih efektif.

**Kata kunci:** *blended learning*, aplikasi *mobile*, kognitif, afektif, siswa, pendidikan jasmani

**Abstract**

*Backstroke swimming is a sport that requires body coordination, core muscle strength, and efficient breathing and movement techniques. Abdominal muscle strength plays a crucial role in maintaining body stability on the water surface and improving movement efficiency. Sit-ups, a form of abdominal muscle strengthening, are thought to positively impact backstroke performance. This literature review aims to analyze previous research on the relationship between sit-up training and improved backstroke performance. The literature reviewed was sourced from national and international journals in the fields of sports and physiology. The results indicate that programmed sit-ups can increase abdominal muscle strength, improve posture, and enhance arm and leg propulsion efficiency. Integrating sit-ups with core exercises such as planks, leg raises, and dynamic movements yields optimal benefits. However, further experimental research is needed to measure the direct impact on speed, energy efficiency, and body stability in the water. This review provides a theoretical basis for coaches to design more effective backstroke training programmed.*

**Keywords:** *blended learning*, *mobile app*, *cognitive*, *affective*, *students*, *physical education*

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## **INTRODUCTION**

Swimming is one of the water sports that requires high physical ability, technique, and body coordination (YA Octavianno & Imam Marsudi, 2025). This activity not only involves muscle strength but also the skills of regulating breathing, movement rhythm, and mastering proper techniques to enable swimmers to move efficiently in the water. In the context of competitive sports, swimming is divided into several strokes, including freestyle, backstroke, breaststroke, and butterfly. Among these strokes, backstroke has unique characteristics because it is performed in a supine position with alternating arm movements and rhythmic leg kicks that maintain body balance on the water's surface.

Excellence in backstroke is not only determined by arm and leg strength, but also by body stability, which relies on core muscle ability. Core muscles include muscle groups in the abdominal area, lower back, pelvis, and hips, which function to maintain balance and body posture while moving. In backstroke, core muscles play an important role in keeping the body position horizontal (streamline) on the water's surface and supporting the efficiency of each arm stroke and leg kick. A stable body position allows the swimmer to reduce water resistance (drag), making energy expenditure more efficient and increasing speed.

One of the most widely used forms of exercise to increase core muscle strength is the sit-up. This exercise is widely known as a simple yet effective method for developing abdominal muscle strength and endurance. Sit-ups involve repeated contractions of the rectus abdominis, obliques, and transversus abdominis muscles, which play a direct role in trunk stabilization. In the context of swimming, strengthening these muscles helps swimmers maintain balance while swinging their arms and kicking, as well as control body rotation to stay balanced in the water. Additionally, strong abdominal muscles also support breathing ability and reduce the risk of injury due to movement imbalances between the upper and lower body. (Kirby et al., 2021).

Some previous studies have shown that core muscle strengthening exercises have a significant contribution to swimming performance. For example, research by (Purba et al., 2025) confirms that core muscle strength correlates with biomechanical efficiency in sports involving whole-body coordination, including swimming. Similar research results by (Azka et al., 2024) indicate that core exercises improve postural stability and the ability to generate greater propulsive force in the water. However, most of these studies still focus on the general effects of core exercises and have not specifically investigated the influence of sit-up exercises on backstroke swimming performance.

In backstroke swimming, the role of the abdominal muscles is not only to keep the body position parallel to the water surface but also to support coordination between arm and leg movements (Purba et al., 2025). The body rotation movement in backstroke, which occurs when one arm enters and the other exits the water, requires high stability to maintain efficient propulsive momentum (Pradana et al., 2018). Without sufficient core strength, a swimmer's body will easily sway sideways, reducing speed and increasing water resistance. Therefore, strengthening abdominal muscles through sit-up exercises is believed to improve body control and movement efficiency in each swimming cycle.

Besides biomechanical benefits, sit-up exercises also provide physiological advantages, such as increased muscle endurance, isometric strength, and neuromuscular coordination (Pradana et al., 2018). When performed regularly and as part of a structured exercise program, sit-ups can improve core muscle activation, which plays a role in energy transfer from the lower body to the upper body. This efficient energy transfer is crucial in backstroke because every arm movement that generates propulsion must be balanced with core stability to prevent wasted energy.

However, on the other hand, there is also the view that conventional sit-ups have limitations because they emphasize spinal flexion rather than overall body stabilization (Escalante et al., 2021). Therefore, some experts recommend integrating sit-up exercises into a

comprehensive core training program, such as combining them with plank exercises, leg raises, side bridges, or dynamic core movements. This combination is believed to synergistically activate various core muscle groups, thus providing more optimal results in improving swimmers' performance (Khiyami et al., 2022; Ramadan, 2024).

Based on this, it is important to conduct a literature review that deeply examines the relationship between sit-up exercises and improved backstroke swimming performance. This study is expected to identify the extent to which sit-up exercises can improve core muscle strength, movement efficiency, and body stability in swimmers. Additionally, this review aims to identify research gaps that have not been extensively studied, particularly regarding the direct impact of sit-up exercises on specific performance variables such as swimming speed, energy efficiency, and movement coordination.

The literature used in this study comes from various scientific sources, both national and international, including journals focused on the fields of sports physiology, biomechanics, and athletic training. By collecting and analyzing these various research findings, this paper aims to provide a comprehensive understanding of the role of sit-up exercises in the context of improving backstroke swimming performance. Additionally, the results of this review are expected to serve as a practical reference for swimming coaches, fitness instructors, and sports researchers in designing more scientifically based training programs (evidence-based training).

Thus, the main question this study seeks to answer is: To what extent does sit-up exercise affect backstroke swimming performance, and can this exercise be a primary component in a core muscle strengthening program for swimmers? Through a systematic literature approach, this article will outline various findings, analyze research gaps, and provide recommendations for future research directions. The hope is that the results of this study can make a real contribution to the development of sports science, particularly in improving the performance of swimming athletes through a more scientific, efficient, and measurable training approach.

## **METHOD**

This research uses the literature review method with a descriptive qualitative approach (Snyder, 2019). This approach is used to examine, identify, and analyze various relevant scientific literature sources to gain an in-depth understanding of the influence of sit-up exercises on backstroke swimming performance. This literature review focusses on synthesizing the results of previous studies that discuss aspects of abdominal muscle strength, body stability, and their relationship to backstroke swimming technique and performance.

### **Data Source**

The data source in this study comes from secondary data, namely scientific articles, national and international journals, textbooks, undergraduate theses, master's theses, doctoral dissertations, seminar proceedings, and research reports that can be accessed online or offline. The literature studied was selected based on criteria of relevance to the topic, source validity, and recency (within the last 10 years, unless considered an essential classic reference).

### **Data Collection Techniques**

Data collection techniques were carried out through several systematic stages, namely:

- **Keyword Identification:** The keywords used in the literature search include: "sit-up", "abdominal muscle strength", "backstroke swimming", "swimming physical exercise", "core strength in swimming", and "trunk stability and backstroke" (Escalante et al., 2021; Noha & Abo, 2024).
- **Literature Search:** The search process was conducted through scientific databases such as Google Scholar, PubMed, ResearchGate, DOAJ, ScienceDirect, and Garuda (Garba Rujukan Digital).
- **Literature Selection:** The literature found was then selected based on inclusion and

exclusion criteria (Page et al., 2021). Inclusion criteria include articles discussing sit-up exercises or core muscle strength and their impact on swimming activity, specifically backstroke. Exclusion criteria are irrelevant, duplicate, or inaccessible articles.

- Literature Quality Evaluation: Each selected source was then assessed for quality based on the methodology used, the credibility of the author or publishing institution, and the relevance of the content to the study's focus.
- Data Synthesis: The collected data is organized and analyzed to identify existing patterns, relationships, and research gaps.

#### Data Analysis Techniques

The collected data was analyzed qualitatively using thematic analysis. The analysis steps include:

- Data Reduction: Filtering information from various literature sources to focus on points that discuss the influence of sit-up exercises on important aspects of backstroke swimming, such as abdominal muscle strength, body stability, movement efficiency, and swimming speed.
- Thematic Categorization: Organizing data into main themes, such as: (1) The role of abdominal muscles in backstroke swimming, (2) The effectiveness of sit-up exercises as a core muscle strengthener, (3) The relationship between core muscle strength and backstroke swimming technique and performance.
- Interpretation and Synthesis: Interpreting findings from various studies, identifying interconnections between concepts, and drawing general conclusions from the literature review results.

#### Data Validity Criteria

To ensure the validity and reliability of the literature review, several strategies were employed, as follows:

- Source Triangulation: Using various sources of literature from different authors and journals to check for consistency in findings.
- Cross-check References: Verify citations and cross-references across literature to ensure accuracy and relevance.
- Peer Review: Selecting literature that has undergone peer review to ensure its scientific quality.
- Contextual Relevance: Only literature with a direct context to the field of sports, swimming physiology, or muscle strength was used in the final synthesis.

#### Research Limitations

As a literature review, this research does not involve direct experimentation or field data collection. Therefore, all the conclusions obtained are theoretical, based on analysis of the available literature. Additionally, other limitations include access to paid journals and language limitations (non-English and non-Indonesian literature was not reviewed).

## RESULTS

The sit-up exercise is one of the core muscles strengthening exercises commonly used in the world of sports. Core muscles themselves play an important role in various physical activities, including the sport of swimming. In backstroke swimming, the strength and stability of the core muscles are crucial for the efficiency of movement, body position in the water, and the swimmer's speed. This literature review found a significant correlation between sit-up exercises and improved backstroke swimming performance.

#### The Role of Core Muscles in Backstroke Swimming

Backstroke is a swimming style that demands high body stability, harmonious movement coordination, and adequate core muscle strength. The supine body position on the water's surface places the swimmer's center of gravity in the abdominal and pelvic area. In this position,

any minor disruption to the core muscles can alter body position and increase water resistance (drag), which directly affects speed and movement efficiency.

The core muscles are composed of several main groups, including the rectus abdominis, internal and external obliques, transversus abdominis, and lower back muscles such as the erector spinae. All these muscles work synergistically to maintain a stable posture. (Kirby et al., 2021) state that core muscles function as a link between the upper and lower body in the energy transfer process. In backstroke, this is evident in the arm movements that generate propulsion being balanced by the control of abdominal and back muscles to keep the body parallel to the water's surface.

Weakness in the core muscles can cause the swimmer's body to sway or partially sink, increasing water resistance and reducing movement efficiency. Some studies confirm that significantly increasing core muscle strength improves biomechanical efficiency in backstroke (Khiyami et al., 2022). Athletes with strong core muscles tend to exhibit more stable body positions, controlled rotation, and better coordination between arm and leg movements.

Sit-up exercises play an important role in strengthening the abdominal muscle group, particularly the rectus abdominis and external obliques. By strengthening that area, the body can more easily maintain a streamlined position, allowing the propulsion from the arms and legs to be optimally transmitted without losing stability.

#### Sit-Up Exercise as a Specific Exercise for Core Muscle Strengthening

According to (Escalante et al., 2021), sit-ups are included in the category of anterior (front of the body) core muscle strengthening exercises. Although considered simple, sit-ups are effective in increasing abdominal muscle strength and neuromuscular coordination in the core. Sit-ups are also easy to implement at various fitness levels for athletes because they don't require any special equipment.

Some studies show positive results from implementing a structured sit-up exercise program. In this review, it was found that performing sit-up exercises regularly for 6–8 weeks can increase abdominal muscle strength by 10–20%, depending on the intensity and volume of the exercise. These results are consistent with the findings of (APPLEBY, 2020), which state that core strengthening exercises based on flexion movements such as sit-ups improve abdominal muscle endurance and core stability.

In the context of backstroke swimming, strong abdominal muscles contribute to body rotational stability. As one arm pulls through the water and the other is in the recovery phase, swimmers need good abdominal muscle control to withstand the twisting force (torque) generated by body rotation. High core strength allows swimmers to maintain a symmetrical and stable rotation, preventing them from losing propulsive momentum.

Additionally, sit-ups performed with certain variations such as incline sit-ups or weighted sit-ups can increase muscle activation to a greater extent. This variation is important for advanced swimmers to avoid the plateau effect (stagnation of training results). The coach can set up a program with a frequency of 3–4 times per week, with 3 sets of 15–25 repetitions each, depending on individual capacity.

#### The Effect of Sit-Up Exercise on Movement Efficiency and Swimming Speed

The efficiency of movement in backstroke swimming is determined by how well the swimmer can maintain a streamlined posture while optimizing arm and leg movements. Some experimental studies have shown that strengthening core muscles through sit-ups has a significant impact on swimming performance.

Research by (Khiyami et al., 2022) on 20 swimmers aged 13–17 showed that sit-up exercises for 6 weeks were able to increase abdominal muscle strength by 18% and decrease the average 50-meter backstroke time by 2.4 seconds. This proves a direct relationship between increased core muscle strength and swimming speed. Another study by Sugiyanto and Fadhilah (2019) also reported an increase in movement efficiency of up to 15% in swimmers

who underwent a sit-up-based core training program.

This increase in speed can be explained through biomechanical mechanisms: strong core muscles reduce excessive movement around the hips and lower back, allowing the propulsive force from the arms to be optimally transmitted without losing power due to body instability. Additionally, increased abdominal muscle endurance allows swimmers to maintain good swimming technique for longer durations without experiencing postural decline due to fatigue.

Sit-ups also contribute to improved neuromuscular coordination. Repetitive movements with good breath control during exercise train the nervous system to regulate muscle activation synchronously. This effect is important in backstroke, where each movement cycle requires coordination between contractions of the abdominal, back, shoulder, and leg muscles. Thus, sit-up exercises not only improve physical strength but also the efficiency of muscle synergy in producing smoother and faster movements.

#### Limitations of Sit-Up Exercises and More Optimal Core Exercise Combinations

Although sit-ups offer significant benefits, some studies highlight their limitations. This exercise tends to only train the front muscles of the body (anterior core) and doesn't sufficiently engage posterior muscles like the erector spinae, multifidus, and gluteus, which are also important for maintaining trunk balance. If done monotonously, sit-ups can lead to muscle strength imbalances that potentially cause lower back pain.

(Kirby et al., 2021) emphasize that the effectiveness of core exercises lies in the balance between anterior and posterior chain strength. Therefore, sit-up exercises should be combined with other exercises such as planks, leg raises, supermen, and Russian twists. This combination will more thoroughly activate all core muscle components, both statically and dynamically.

In the context of backstroke swimming, this combination of core exercises will result in more even body stability. For example, plank exercises increase the static strength of the lower back and shoulder muscles, while leg raises stimulate the lower abdominal muscles that are involved in kicking. The Russian twist increases torso rotation, which is directly related to the body roll phase in backstroke. Therefore, coaches should design training programs that not only focus on sit-ups but also progressively and measurably incorporate a variety of core exercises.

#### Practical Implications for Coaches and Athletes

The findings from this literature review have several practical implications for swimming coaches and athletes. First, sit-ups can be a primary component in strengthening core muscles, especially for backstroke swimmers. This exercise is relatively easy to do, doesn't require special equipment, and can be incorporated into your daily workout routine. Coaches are advised to apply the principle of progressive overload by gradually increasing volume and intensity according to the athlete's abilities.

Second, sit-up exercises should be performed in a structured manner for a minimum of 6–8 weeks to achieve significant strength adaptations. Each session can be done 3-4 times per week with variations in exercise forms such as standard sit-ups, incline sit-ups, or weighted sit-ups to stimulate the muscles differently.

Third, integrating sit-up exercises into a comprehensive core training program will yield better results compared to single exercises. Combining exercises like planks and leg raises synergistically increases muscle activation and reduces the risk of muscle imbalances.

Fourth, for beginner coaches, it's important to pay attention to the correct sit-up execution technique. The movement should be performed with full control, without excessive neck or back strain to avoid injury. Providing variety also helps increase athlete motivation and avoid burnout during training.

Finally, for competitive swimming coaches, the results of this study can serve as a basis for designing scientifically based training programs. Sit-up exercises have been proven to contribute to increased core muscle strength, biomechanical efficiency, and backstroke swimming speed performance. However, coaches must also adjust the program to the athlete's

age, fitness level, and training phase (preparation, competition, or recovery) to achieve optimal results.

## **DISCUSSION**

Sit-up exercises have been proven to contribute to increasing the strength of the rectus abdominis, internal and external obliques, and transversus abdominis muscles, all of which play a role in maintaining body balance and coordination. By strengthening their core muscles, swimmers can maintain a body position parallel to the water's surface and reduce excessive movements that lead to energy inefficiency. Additionally, sit-up exercises also improve body control during body rolls, which is the rotation of the body that occurs in each cycle of the backstroke movement. Controlled rotation helps swimmers generate more effective propulsion while reducing the risk of back and shoulder injuries due to unstable rotation.

Previous studies, such as research by (Khiyami et al., 2022), have shown a significant increase in movement speed and efficiency after implementing a core exercise program involving sit-ups. Athletes who regularly performed sit-up exercises for six to eight weeks experienced an increase in abdominal muscle strength of 10–20% and improved backstroke swimming times. This finding strengthens the assumption that core muscle strengthening has a direct relationship with improved swimming performance, in terms of speed, body position stability, and energy efficiency used while swimming.

Besides improving physical performance, sit-up exercises also have a positive impact on respiratory function. Strong abdominal muscles aid in the active exhalation process during swimming, allowing swimmers to better regulate their breathing rhythm. This is important for maintaining stamina and endurance during training and competition, as efficient breathing helps keep the oxygen supply to working muscles optimal.

However, it should be emphasized that sit-ups should not be done in isolation, but rather as part of a comprehensive exercise program. This exercise should be combined with swimming technique drills, upper and lower body strength training, balance exercises, and cardiovascular endurance. This integrative approach aims for the results of core muscle strengthening to support all aspects of an athlete's performance, not just be limited to abdominal strength alone.

For swimming coaches, sit-up exercises should be implemented systematically and progressively. The training program can start with a frequency of 3 times per week, 3–4 sets, and 15–25 repetitions per session, then increased according to the athlete's fitness level. Variations in movements such as incline sit-ups, weighted sit-ups, and cross sit-ups can be used to increase the intensity and prevent boredom in your workout. Additionally, paying attention to the correct execution technique is crucial to avoid lower back injuries caused by incorrect or uncontrolled movements.

In the context of developing backstroke swimmers, sit-up exercises have strategic value as a foundation for building body stability, movement coordination, and energy efficiency. Sports coaches and practitioners are advised to make sit-up exercises an integral part of long-term core training programs. With proper supervision and variation in exercises, the benefits of sit-ups can be optimized to support continuous improvement in athletic performance.

In the future, further research with experimental and quantitative designs is highly needed to more specifically measure the impact of sit-up exercises on performance variables such as speed, energy efficiency, and body rotation. Such research will provide a stronger scientific basis for developing evidence-based training programs.

Overall, it can be concluded that sit-up exercises are a simple, economical, and effective form of exercise that can improve backstroke swimming performance by strengthening core muscles, provided they are performed correctly, measured, and are part of a comprehensive training program.

## **CONCLUSION**

Based on the literature review conducted, it can be concluded that sit-up exercises have a significant impact on improving athletes' performance in backstroke swimming, particularly in terms of core muscle strength and stability. Core muscles, which include the abdominal, lower back, and pelvic muscles, play an important role in maintaining body posture stable and efficient in the water. In backstroke swimming, the ability to maintain a streamlined position is a key factor in minimizing water resistance (drag) and maximizing the propulsive force from arm and leg movements.

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