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Physiology in Sports Achievement: Literature Review

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Abstract: This study discusses the role of exercise physiology in improving athlete achievement. Exercise physiology, as a branch of the science of physiology, studies the physiological changes that occur in the body during physical activity. This study uses literature review and quantitative methods, with data collection through questionnaires distributed to futsal and football athletes in Blitar Regency. The results of the analysis show that understanding the function of the body's organs and the changes that occur due to exercise can help in designing a more effective exercise program. Regular and planned physical exercise can improve the efficiency of heart work, vascular elasticity, lung capacity, and muscle and bone strength. This study emphasizes the importance of applying exercise principles that are in accordance with the physiological characteristics of individuals to achieve optimal results in sports performance. It is hoped that the results of this study can be a guideline for coaches and athletes in formulating better training programs based on a deep physiological understanding.

Keywords: Exercise Physiology; Peak Achievement; Physical Activity

1. Introduction

Sports achievement is the end result of various factors that support each other, where science plays a central role in optimizing athletes' abilities (1). One of the branches of science that contributes greatly to the improvement of athletes' performance is sports physiology, which studies the structure, function, and work of the body's organs in depth (2). Through the science of sports physiology, coaches and athletes can understand in detail how the body adapts and responds to physical exercise, so that the preparation of training programs can be carried out more effectively and efficiently to reach the peak of achievement.

Sports physiology itself examines the changes that occur in the body's organs, both acute and chronic, due to regular physical activity (3). Studies on changes in the function of organs such as the heart, lungs, blood vessels, muscles, bones, ligaments, and joints are crucial in supporting the improvement of physical ability, endurance, and preventing injuries in athletes (4). Thus, an in-depth understanding of the physiological response to different types of exercise such as aerobic and anaerobic exercise is needed so that the exercise program can be tailored to the individual characteristics of the athlete.

Changes that occur due to physical exercise include increased cardiac work efficiency, blood vessel elasticity, lung capacity, strength and endurance of muscles and bones, and thermal adaptation to heat (5). Each of these changes

not only has a positive impact on improving performance, but also plays a role in maintaining the long-term health of athletes (6). The selection of the type of exercise and the adjustment of its intensity must take into account the physiological characteristics of each individual, for example related to the dominance of type I or II muscle fibers, so that the adaptation obtained becomes more optimal.

The importance of integrating sports physiology in the world of coaching requires a comprehensive data-based study and in-depth analysis. Literature studies and quantitative research involving athletes directly can provide a clear picture of the relationship between the application of sports physiology and the improvement of athlete achievement, especially in the sports of futsal and football. With the support of a strong scientific understanding, training programs can be made more targeted and evidence-based, so that it is expected to be able to become a guideline for coaches and athletes in achieving maximum achievement in a healthy and sustainable manner.

2. Materials and methods

This research method uses a mixed approach between literature review of various relevant national sources and quantitative methods through surveys. Data was collected by distributing questionnaires in the form of Google Form to all futsal and football athletes in Blitar Regency through the WhatsApp application. After a one-week filling period, the researchers conducted in-depth interviews to enrich the quantitative data that had been collected. All respondents were selected athletes in the accuracy sports branch in the region. The collected data were then analyzed descriptively quantitatively to illustrate the role of sports physiology in improving athletes' performance and their level of discipline, with the measurement results categorized based on the average score of each aspect observed. This research procedure is carried out systematically and structured from the design of the instrument to the data analysis stage, while maintaining the confidentiality of the data and only being used for research purposes.

3. Results and Discussion

3.1 Sports Physiology

In physiology, what is studied is not the parts or structures of the body of living creatures, but the function and working of the body organs of living creatures, so that as a whole we can interpret physiology as a science that studies the function and working of the body organs and the changes that occur due to influences from inside and from outside the body. In general, we can see the meaning of sports as a series of movement skills or playing objects, which are arranged in a structured and systematic manner using certain rules in their implementation (7). From the above understanding, we can see that, in sports there is definitely physical activity in the form of movement and exercise, so in relation to studying sports physiology we will look at sports from the point of view of movement activity in the process of training and competition. From the study of physiology and exercise above, we can make the relationship between the study of physiology and exercise theory into a new theoretical study of exercise physiology. Where the theoretical study of sports physiology discusses the working functions of the body organs and the involvement of human

organs in movement activities. So the definition of sports physiology is a part or branch of science from Physiology that specifically studies the function or how the organs of the body work and the changes that can occur both momentarily and permanently due to a physical activity (movement) or physical exercise. In this case, of course, an assessment of how the change occurs and what needs to be done to get changes in the function of the organs of the body with physical exercise programs carried out to get changes in the function and work of the organs of the body effectively and efficiently.

3.2 Changes Due to Sports

By exercising, there will be changes in the body according to the type, duration, and intensity of exercise carried out (8). In general, exercise that is carried out regularly with sufficient doses will cause the following changes:

3.2.1 Changes in the Heart

The heart will get bigger and stronger so that the capacity is large and the pulse is strong, both of these things will increase the efficiency of the heart's work. With high work efficiency, the heart does not need to beat too often. In people who did not exercise, the average heart rate was 80 times per minute, while in people who exercised regularly, the average heart rate was 60 times per minute. Thus in one minute 20 pulses are saved, in one hour 1200 pulses, and in one day 28,800 pulses. These savings make the heart durable, and can be expected to live longer with a high level of productivity.

3.2.2 Changes in Blood Vessels Elasticity

Reduced fat deposits and more muscle contractions of the blood vessel walls will result in an increase in blood vessels. Blood flow will be facilitated and hypertension will be avoided by blood vessels with high flexibility. Not only will blood vessels grow more elastic, but capillaries, which are tiny blood vessels, will also get denser. This mechanism of transformation has the potential to prevent and cure coronary heart disease. A speedy recovery from weariness can be anticipated because smooth blood flow would help hasten the clearance of worn-out materials like charred residues.

3.2.3 Changes in the Lungs

The potential to create de-flated will also increase as the lungs' suppleness increases. Regular exercise will also increase the amount of active (open) alveoli. The blood's ability to store and deliver oxygen will rise as a result of the two aforementioned factors. Deeper breathing occurs at a lower frequency. The delay in weariness is caused by all three, as well as alterations in the heart and blood vessels.

3.2.4 Changes in Muscles

There will be an increase in muscle endurance, strength, and flexibility. This is because muscle fibers are getting bigger and the muscles' energy supply system is getting bigger. Furthermore, these muscle alterations will improve movement agility and reaction time, which can help prevent accidents in various situations.

3.2.5 Changes in Bones

In addition to halting bone loss, adding enzyme activity to bones will improve their size, strength, and density. With constant muscular tugging, the bone surface will also grow.

3.2.6 Changes in the Ligaments and Tendo

The strength of the ligaments and tendons will increase, as will the attachment of the tendons to the bones. This condition will make the ligaments and tendons able to withstand heavy loads and are not easily injured.

3.2.7 Changes in Joints and Cartilage

Regular exercise can cause the thickness of cartilage in the joints so that it can be a shock absorber and protect bones and joints from the danger of injury.

3.2.8 Changes in Acclimatization to Heat

Acclimatization to heat involves adjusting the faali that allows a person to withstand working in hot places. The increase in acclimatization to heat is caused by an increase in heat on the body and skin when doing exercise. The same situation will occur when a person works in a hot place.

3.3 Physical Exercise

Physical exercise is a systematic sports activity over a long period of time, progressively and individually improved which leads to the functional and psychological characteristics of human beings to achieve predetermined goals. Through physical exercise a person to achieve a certain goal. It is hoped that the recommendations from the training results that have been obtained by athletes can be applied to the training process to formulate a training program. So that athletes must also improve their skills continuously, as a form of professionalism of an athlete (10). In physiological terms, a person pursues the goal of improving the organism's systems and their functions to optimize their sports performance and performance(11). Sports training is a systematic process of training that is carried out repeatedly using the principle of adding weight (12). The principle of adding weight is a progressive increase in load, aiming to increase the efficiency of the body's faal. The application of this discipline is based on the condition of each individual, because no burden is exactly the same for each person. Proper physical exercise will increase the work performance of the body's faal. The increase in work performance depends on the type of training, training intensity, frequency, length of training, and basic principles of physical exercise. In addition, variations in training also need to be considered. If this can be carried out properly, it can be said that the training followed is of high quality.

3.4 Type

Certain body faals are affected by particular activity styles. This sort of aerobic exercise is more important for developing myoglobins, aerobic capacity, the number and size of mitochondria in cells, muscle glycogen stores, and the concentration of oxidative enzymes in athletes. Conversely, the type of anaerobic workout is more important in raising athletes' anaerobic glycolysis, ATP-PC energy system, and anaerobic capability. While anaerobic activity will increase the size and quantity of fast-twitch fiber muscles, aerobic exercise can also increase the size and number of slow-twitch fiber muscles. (13).

The muscle fibers that build the human skeleton (slow twitch fiber/type l and fast twicth fiber/type ll), have different characteristics. In l-type fibers, there will be many levels of hemoglobin, fat reserves, glycogen reserves, oxidative enzymes, and insensitivity to fatigue. When anatomically reviewed, l-type fibers consist of small fibers and have many capillary vessels while type ll fibers, have a lot of glycogen reserves, glycolytic enzymes, and are very sensitive to fatigue.

Anatomically, these type ll muscle fibers are made up of large fibers and have few capillaries (14). The suitability of the type of training for athletes who have dominant muscle fibers between the two types of muscles, will promise optimal results, compared to the application of the type of training type of exercise that is of equal nature. Athletes who predominantly have l-type muscle fibers will be more promising if given aerobic training. On the other hand, anaerobic exercise is very appropriate given to athletes who predominantly have type ll muscle fibers. The placement of athletes in sports must be based on the condition of the dominant type of muscle fibers they have.

3.5 Intensity

Exercise intensity is tailored to each person based on their physical capabilities, and its execution necessitates constant supervision to ensure that the intensity truly reaches the predetermined level. Exercise intensity can be described in relative terms (e.g., maximal heart rate, METs, VO2 max, and RPE/Rating of Perceived Exertion) or in absolute terms (e.g., watts) (15). The thing to note is that a person's ability to maintain a certain intensity of exercise is different from that of another person. This difference is mostly due to differences in exercise intensity where there is an onset of blood lactate accumulation (15). The difference in endurance in running this level of training intensity is something that must be considered in compiling a training program.

In general, the intensity of training starts at 40 to 85% of the fungdional capacity. In people with heart problems, the intensity of exercise can be set between 40 and 60% of functional capacity. The duration of the exercise can be set according to a person's response to the exercise. For example, a person should already feel recovered within an hour of training (16)Regardless of the intensity setting technique and intensity level chosen, the intensity of the exercise is an intensity that can be done for 15 to 60 minutes. Basically, the ultimate goal of determining the amount of training intensity is to provide instructions for a person about the intensity of training that can provide maximum benefits for him while minimizing the risk of injury.

3.6 Duration

Core exercise lasts anything from 15 to 60 minutes. This amount of time is required to improve the body's ability to function. The length of time spent exercising is inversely correlated with its intensity. Short workout durations and high-intensity activities produce the same physiological response as long-duration, low-intensity workouts. Cardiovascular work can be enhanced by 5–10 minutes of exercise at 90% of the body's functional capability. However, most people cannot benefit from high-intensity, short-duration workouts, so a moderately intense, longer-duration exercise regimen is advised (17). The program is recommended because it has a low risk of injury and the potential to produce a high total calorie output. For people who are used to low activity, the recommended duration is 20 to 30 minutes with intensity (40 to 60% functional capacity). Adjustments to exercise duration and intensity are based on the individual's physiological response to exercise, health status and exercise goals (e.g., weight loss). In general, in the initial phase, the duration of the exercise can be gradually increased from 20 minutes to 45 minutes.

3.7 Frequency

The length and intensity of the workout determine how frequently you should train. Exercise frequency can range from multiple times per day to five times per week, contingent on the sort of exercise, physical condition, and goal. Exercises involving 3 METs of intensity for 5 minutes can be performed multiple times a day by those in poor physical condition. One to two times a day is sufficient for an individual with a functional capacity of three to five METs. It is recommended that people with physical capacities greater than 5 METs workout three times a week on alternating hars. On alternate days, people who lift weights should also practice three times a day. Intensive frequency training should also be done with alternating types of weight and non-weight training. The thing to avoid is weight training that is done more than 5 times a week. This type of exercise with high frequency increases the risk of orthopedic injury.

Excessive exercise can cause menstrual cycle disorders. Heavy physical fatigue can cause disturbances in the physiology of the menstrual cycle. (Asmarani, 2010). The sports design should follow the training principles that have been put forward by several experts, and can be briefly broken down into:

3.8 Principle of Overload

With overload, it forces the muscles to contract to the maximum, thereby stimulating physiological adaptations that will develop strength and endurance. With a good recovery, the body will return to a higher fitness condition than before the workout.

3.9 Progressive Detention Principle

The more advanced, the more the load is increased. In this way, the muscles always work in the overload zone. Any fitness and conditioning training program will be very effective if you regularly exercise to gain weight every week or two. This principle is based on the fact that the body will always adapt to new circumstances or stresses.

3.10 Principles of Exercise Structure

Larger muscle groups should be trained before smaller muscle groups. Smaller muscles tend to get tired more quickly, so to ensure that excess load occurs on large muscles, they must be trained before the smaller muscles get tired. For example: the leg and pelvic muscles must be trained before the arm muscles. To guarantee recovery time, there should be no sequential exercises involving the same muscle group.

3.11 Principle of Specificity

O'Shea's SAID (Specific Adaptation to Improve Demand) theory says that the body only adapts specifically to the load it is given. Thus the weight of the exercise must be adjusted to the goal.

3.12 Principle of Return to Origin

The effect of the exercise will disappear if the exercise is irregular or even stopped. Aerobic endurance will decrease after one week of no training, while muscle strength will decrease after one month of no training.

3.13 Principle of individuality

Basically, the weight of the exercise must be given according to a person's abilities and limitations. Thus, conducting preliminary examinations and measurements is an absolute necessity.

3.14 Diverse Principles

Boredom in training is the phenomenon that is most often complained about by athletes. It is necessary to vary in the type of training, method and practice atmosphere. Music can make the workout atmosphere fun.

3.15 The Relationship between Physiology and Achievement

Every physical exercise will cause a response or response from the body's organs to the dose or load of exercise given, this is an effort to adjust oneself in order to maintain a stable environmental balance or it can also be called homeostasis . Exercise is one of the physical stressors that can disrupt homeostasis balance, therefore, the use of exercise packaged in the form of physical exercise requires proper dose measurement, thus providing an opportunity to form a disease mechanism (coping) that is able to turn stressors into stimulators. The dose of exercise given is not right, then the stressor will disrupt the balance (homeostasis) in the body and can cause biological or pathological problems

The need to equip students with sports experience in physical education scientifically and universally is the main capital in the formation of physical and physiological components to achieve sports achievements. All physical activity is a stressor for the body. If the body is given a stressor that is carried out continuously, continuously and accompanied by the right exercise program, then the body will adapt by forming a coping mechanism that is able to turn stressors into stimulators. The application of weight to the exercise will be responded to by the body in the form of a response, if the dose given is right it will produce a good adaptation process. The right training program or dosage must pay attention to several elements of training, namely frequency, intensity, duration, and set in training. In carrying out activities/exercises, there will be several physiological changes, including cardiac responses, respiration, and other body biochemistry. The heart's response to exercise gives a positive response. This means that if we start training, the heart will beat as well as the pulse faster and work with greater force, so that more blood is pumped out with each beat. The respiratory response in the case of lung ml is useful for providing a source of oxygen and blood to remove the CO2 taken up and the active cells to work. The volume of air coming out and the lungs are in a normal state at rest 5 liters. During exercise exercises, the amount of air exhaled by the lungs can rise to 100 liters for the average person, while trained athletes can reach up to 200 liters per minute. The feeling of shortness of breath when we do sports is a blood supply problem, not a respiratory problem.

now there is a growing opinion that high cardiopulmonary endurance can improve the ability to achieve. Endurance training in general, cardiopulmonary endurance is an exercise that aims to increase the ability of the whole body to always move at a moderate to fast tempo, which is quite long. So what is meant by endurance is the ability of a person to carry out movements with his whole body, in a long time and with a moderate to fast tempo without suffering severe pain and fatigue. For an athlete or coach who wants to increase endurance, they must know that what needs to be improved is the ability to work the circulatory heart system.

Thus, the heart system - good blood circulation, the body's biological needs during rest and exercise will be smoothed. This smoothness is possible because the blood-filled circulatory apparatus that provides nutrients and O2 that are indispensable for body tissues, can carry out their functions perfectly. The functioning of these tools will be more perfect and efficient, so that you can get exercises with the right and right dosage. Likewise, several changes occur in the muscles so that the body gets adequate performance (George Cunningham, 2010). These body changes include an increase in the capacity of

skeletal muscles to burn glucose and fat for energy during exercise. These changes make it healthy for the person concerned to be able to train for a longer time without experiencing fatigue, this can certainly improve the performance of athletes. There are many factors that affect the improvement of an athlete's performance. One of the factors is: the amount of exercise or the dose of exercise. But of course there are many other factors that affect athlete performance.

4. Conclusions

Optimal sports achievement is achieved, if the training process is applied systematically. Training load management should be the focus of attention. Errors in applying the principle of overload and progressive load increase will always have a negative impact. Information from the characteristics of athletes is the starting point in making a training program. To improve sports performance, we should pay attention to the energy we use to carry out training. Of course, during the exercise, there are several important things, including the amount of training that must be met. both intensity and frequency. Some observations, there are still many of our athletes who train with insufficient and sufficient doses, especially the intensity measures do not reach the training zone. As a result, performance is difficult to develop, even if the frequency of training is sufficient. even more. To get high achievements, practice by fulfilling the three types of measurements described earlier, so as not to waste a lot of time and money on exercises. The descriptions above clearly show the role of sports physiology can help improve athlete achievement.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Li N, Yang Y, Zhao X, Li Y. The relationship between achievement motivation and college students' general self-efficacy: A moderated mediation model. Front Psychol. 2023;13.
2. Dellsén F. Scientific progress: By-whom or for-whom? Stud Hist Philos Sci. 2023;97.
3. Gabriel BM, Zierath JR. The Limits of Exercise Physiology: From Performance to Health. Vol. 25, Cell Metabolism. 2017.
4. Pias SC. How does oxygen diffuse from capillaries to tissue mitochondria? Barriers and pathways. Vol. 599, Journal of Physiology. 2021.
5. Nystoriak MA, Bhatnagar A. Cardiovascular Effects and Benefits of Exercise. Vol. 5, Frontiers in Cardiovascular Medicine. 2018.
6. Chen H, Chen C, Spanos M, Li G, Lu R, Bei Y, et al. Exercise training maintains cardiovascular health: signaling pathways involved and potential therapeutics. Vol. 7, Signal Transduction and Targeted Therapy. 2022.
7. Chatzipanteli A, Adamakis M. Social Interaction Through Structured Play Activities and Games in Early Childhood. In 2022.
8. Hughes DC, Ellefsen S, Baar K. Adaptations to endurance and strength training. Vol. 8, Cold Spring Harbor Perspectives in Medicine. 2018.
9. Hegde SM, Solomon SD. Influence of Physical Activity on Hypertension and Cardiac Structure and Function. Vol. 17, Current Hypertension Reports. 2015.
10. Abraham A, Collins D. Effective skill development: how should athletes' skills be developed? In: Performance Psychology: A Practitioner's Guide. 2011.

11. Silverman MN, Deuster PA. Biological mechanisms underlying the role of physical fitness in health and resilience. Vol. 4, Interface Focus. 2014.
12. Eijsvogels TMH, George KP, Thompson PD. Cardiovascular benefits and risks across the physical activity continuum. Vol. 31, Current Opinion in Cardiology. 2016.
13. Plotkin DL, Roberts MD, Haun CT, Schoenfeld BJ. Muscle fiber type transitions with exercise training: Shifting perspectives. Vol. 9, Sports. 2021.
14. Baumann H, Jäggi M, Soland F, Howald H, Schaub MC. Exercise training induces transitions of myosin isoform subunits within histochemically typed human muscle fibres. Pflugers Arch. 1987;409(4–5).
15. Cerqueira É, Marinho DA, Neiva HP, Lourenço O. Inflammatory Effects of High and Moderate Intensity Exercise—A Systematic Review. Front Physiol. 2020;10.
16. Heinrich KM, Patel PM, O'Neal JL, Heinrich BS. High-intensity compared to moderate-intensity training for exercise initiation, enjoyment, adherence, and intentions: An intervention study. BMC Public Health. 2014;14(1).
17. Atakan MM, Li Y, Koşar ŞN, Turnagöl HH, Yan X. Evidence-based effects of high-intensity interval training on exercise capacity and health: A review with historical perspective. Vol. 18, International Journal of Environmental Research and Public Health. 2021.