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# Comparison Of Cardiovascular Endurance Vo2max During Night And Morning Exercises In Kurash Athletes In Makassar City

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**Abstract**. In this study, the cardiovascular endurance ($VO_2max$) levels of Kurash athletes who exercise in the morning and those who train at night in Makassar City will be analyzed and compared. In this work, a quasi-experimental quantitative method is used with a comparative approach. Twenty athletes made up the study sample; they were split into two groups: ten who trained in the morning (06.00–08.00 WITA) and ten who trained at night (19.00–21.00 WITA). The maximum aerobic capacity ($VO_2max$) was measured using the Bleep Test (Multistage Fitness Test). Using descriptive tests and various tests (such as the Independent Sample t-test) at a significance level of 0.05, data were analyzed using SPSS version 16.00. According to the findings, athletes who trained in the morning had an average $VO_2max$ value of 37.87 ml/kg/minute, while those who trained in the evening had an average of 36.21 ml/kg/minute. There was a significant difference between the two groups, according to the t-test results, which gave a p value = 0.00 ($p < 0.05$). Therefore, it can be said that morning training is superior to evening training in terms of improving cardiovascular endurance ($VO_2max$). This research highlights how crucial it is for athlete development programs to take training time into account, particularly when it comes to the growth of aerobic fitness and cardiovascular endurance in martial arts like Kurash.

**Kata Kunci:** $VO_2max$, morning exercise, evening exercise, and Kurash athletes,

## 1 Introduction

Exercise is a physical activity that plays a crucial role in improving physical fitness, health, and athletic performance. Regular exercise has been shown to increase the working capacity of organs, strengthen the circulatory and respiratory systems, and optimize metabolic function. One of the main components of physical fitness that significantly determines an athlete's performance is cardiovascular endurance or $VO_2max$ (Volume Oxygen Maximum), which is the body's maximum ability to utilize oxygen during high-intensity physical activity. A high $VO_2max$ indicates the efficiency of the respiratory, circulatory, and muscular systems in supporting sustained physical work (Astrand & Rodahl, 2021).

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Factors that can influence $VO_2$max include the type of exercise, intensity, duration, frequency, rest patterns, and timing of the exercise. One important variable that often overlooked in training programs is the timing of exercise—particularly the difference between morning and evening exercise. Physiologically, the human body has a circadian rhythm that regulates various biological functions such as body temperature, heart rate, blood pressure, and hormone levels (Waterhouse et al., 2023). This rhythm influences a person's physical abilities at specific times of the day, allowing physical performance to fluctuate between morning and evening.

Several studies have shown that morning exercise can increase metabolism, improve fat-burning function, and foster healthy lifestyle habits. Conversely, evening exercise often results in higher physical performance because body temperature, testosterone levels, and muscle elasticity are at optimal levels (Chtourou & Souissi, 2022). However, the specific effects of different training times on cardiovascular endurance ($VO_2$max) remain debated and require further study, particularly in sports that require a combination of aerobic and anaerobic performance. Recent research has yielded mixed results. A study by Savikj et al. (2021), titled "Morning vs. Evening Exercise Training on Glycemic Control and Serum Metabolites," reported that both morning and evening exercise significantly increased $VO_2$max, but metabolic adaptations such as insulin sensitivity and glycemic control were more pronounced in the morning exercise group (PubMed ID: 34009435). Similar findings were also described by Küüsmaa et al. (2016) in the study "Effects of Morning vs. Evening Combined Strength and Endurance Training on Physical Performance, Sleep and Well-Being", which concluded that increases in $VO_2$max occurred at both training times without significant differences, although evening training tended to have a better effect on sleep quality and psychological well-being (PubMed ID: 30950283). A more recent study by Shakoor et al. (2024) in "Differential Benefits of 12-Week Morning vs. Evening Aerobic Exercise on Sleep and Cardiometabolic Health" showed that morning training was more effective in reducing total cholesterol, triglycerides, and body fat percentage, while evening training was superior in improving vascular function and muscle perfusion (PubMed ID: 40419564). These findings confirm that training time has the potential to provide different physiological adaptations according to individual characteristics and type of exercise.

In a local context, research conducted by Nursalam (2022) at SMA Negeri 4 Makassar found that futsal athletes who trained in the morning had higher average $VO_2$max values compared to athletes who trained at night, with the difference being statistically significant (Competitor Journal, 2022). These results suggest that morning training may be more optimal for improving cardiovascular capacity, especially in intermittent sports such as futsal or Kurash.

Kurash, a rapidly growing form of martial arts in Indonesia, demands complex physical abilities, including strength, speed, agility, and high cardiovascular endurance. Kurash athletes must be able to maintain high performance throughout intense matches, where aerobic and anaerobic capacity play a crucial role in supporting endurance and energy recovery. Therefore, appropriate training timing is a strategic factor in maximizing $VO_2$max and competitive performance. Makassar, as one of the centers of martial arts development in Indonesia, has many Kurash athletes who regularly train at varying times, both morning and evening. However, to date, there has been little research specifically examining the effect of training time on cardiovascular endurance ($VO_2$max) in Kurash athletes. This situation indicates a research gap that needs to be bridged through scientifically based empirical studies.

Based on this description, this study was conducted to analyze and compare cardiovascular endurance ($VO_2max$) between evening and morning training in Kurash athletes in Makassar City. The results are expected to provide a scientific basis for determining the most effective training time to improve physical performance and future achievements of Kurash athletes.

## 2 Method

This study used a quasi-experimental design, a comparative research design, and a quantitative methodology. Comparing the cardiovascular endurance levels ($VO_2max$) of Kurash athletes who exercised in the morning vs those who trained in the evening was the main goal of this study. This method was intended to provide an empirical picture of how training duration affected the athletes' maximum aerobic capacity.

Time and Location of Research

One of the locations for Kurash athlete training activities in the region is the Kurash Training Field in Makassar City, where this study was carried out. The planning stage, testing, and data analysis of the research were scheduled to occur between August and September of 2025. The availability of suitable training facilities and the simplicity of managing training circumstances in the morning and evening were taken into consideration while choosing the research site.

Study Sample and Population

All Kurash athletes in Makassar City who actively participate in the regular training program made up the study's population. Purposive sampling, which chooses samples based on particular factors or standards pertinent to the study's goals, was used in the sampling process. The following criteria were applied for choosing the sample:

1. Kurash athletes who have actively trained at least three times a week for the past six months.
2. Be between 17 and 25 years old.
3. Not currently experiencing any physical injuries or health problems.
4. Willing to participate in all scheduled research activities and tests.

Research Instruments The main instrument used in this study was the Bleep Test (Multistage Fitness Test). This test aims to measure an athlete's maximal aerobic capacity ($VO_2max$) through a 20-meter back-and-forth run at gradually increasing speed following the beeps of an audio recording. The test procedure is as follows:

1. Each athlete runs 20 meters back and forth following the sound of a beep.
2. Running speed increases every minute in accordance with the accelerating rhythm of the beep.
3. An athlete is stopped if they fail to reach the line twice in a row before the beep.
4. The final score is determined based on the level and the number of successful final shuttle runs.
5. This score is converted to an estimated $VO_2max$ (ml/kg/min) using the standard table from Léger and Lambert (1982).

The Bleep Test was selected based on its high level of validity and reliability in measuring athletes' aerobic capacity (Léger et al., 1988). Furthermore, this test is easy to administer in the field, does not require complex equipment, and is highly relevant to the

characteristics of martial arts like Kurash, which require a combination of aerobic and anaerobic energy systems.

Techniques for Data Analysis Two methods were employed to examine the $VO_2$max measurement data:

1. Descriptive analysis, which provides a broad summary of the data, including the mean, standard deviation, maximum, and minimum values for each group.
2. To ascertain if the morning and evening exercise groups differ significantly in terms of cardiovascular endurance ($VO_2$max), inferential analysis was conducted using the Independent Sample t-test.

All analyses were conducted using the latest version of SPSS with a significance level (α) of 0.05. The test results will be used to draw conclusions regarding the effectiveness of training time on improving cardiovascular endurance in Kurash athletes from Makassar City.

## 3 Result

All of the data were processed using SPSS 16.00 statistical tests, including descriptive tests, normality tests, and hypothesis tests, in order to address the issues, accomplish the goals, and test the research's hypothesis.

Table 1. Results of descriptive analysis

| Variabel | N | Range | Minimum | Maximum | Sum | Mean | Std. Deviation | Variance |
|---|---|---|---|---|---|---|---|---|
| Morning exercise | 10 | 8.30 | 33.20 | 41.50 | 378.70 | 37.8700 | 3.12980 | 9.796 |
| Night Sports | 10 | 10.30 | 29.90 | 40.20 | 362.10 | 36.2100 | 3.41905 | 11.690 |

From the data above, it is explained as follows: Data from morning exercise data on Kurash Athlete's VO2Max obtained an N value of 10, range 8.30, minimum value 33.20, maximum 41.50 sum value 378.70, mean value (average) 37.8700 standard deviation 3.12980 and variance 9.796. and Data from evening exercise data on Kurash Athlete's VO2Max obtained an N value of 10, range 10.30, minimum value 29.90, maximum 40.20 sum value 362.10, mean value (average) 36.2100 standard deviation 3.41905 and variance 11.690.

Table 2. Results of the data influence analysis test

| Variabel | N | Mean | Sig |
|---|---|---|---|
| Morning exercise | 10 | 37.8700 | 0.00 |
| Night Sports | 10 | 36.2100 | |
| | Difference | 1.6600 | |

According to the above table, a N value of 10, a mean or average of 37.8700, and a P value of 0.00 (P <0.05) were obtained from the morning workout data on the VO2Max of Kurash athletes. Additionally, a N value of 10, a mean or average of 36.2100, and a P value of 0.00 (P <0.05) were derived from the nighttime workout data on the VO2Max of Kurash athletes.

## 4 Discussion

Physiologically, morning exercise can have a positive effect on the adaptation of the cardiovascular system and the body's metabolism. According to Chtourou and Souissi (2012), the body's circadian rhythm plays a crucial role in regulating various biological functions such as body temperature, blood pressure, heart rate, and hormone levels, all of which influence a person's physical performance. Physical activity performed in the morning can trigger increased efficiency of the respiratory and cardiovascular systems and accelerate the body's adaptation to the stress of exercise. Furthermore, morning exercise is also known to increase insulin sensitivity, improve metabolic profiles, and increase body fat burning, ultimately positively impacting aerobic capacity and increasing $VO_2$max (Hill et al., 2020).

Morning physiological conditions are also characterized by high levels of the hormone cortisol, which can aid the body's energy mobilization and metabolic adaptation. Thus, the body is better prepared for moderate- to high-intensity physical activity, including cardiovascular endurance training such as that practiced in Kurash. This adaptation gradually increases the efficiency of the oxygen transport system from the lungs to the muscles, which is a key component of increasing $VO_2$max. On the other hand, although evening training is often associated with higher physical performance due to increased body temperature, muscle elasticity, and testosterone levels (Atkinson & Reilly, 1996), the results of this study indicate that the consistency and adaptation of morning training actually provide greater benefits to improving cardiovascular endurance in Kurash athletes. This may be due to a more refreshed body condition after a night's rest, the readiness of the autonomic nervous system, and circadian adaptation to a consistent morning physical routine (Knaier et al., 2019). In addition to physiological factors, psychological and behavioral aspects also play a crucial role in supporting training effectiveness. The intensity of morning training tends to be more controlled due to the lack of external disturbances, such as fatigue from daily activities, exposure to pollution, and environmental distractions. Athletes who habitually train in the morning also demonstrate better levels of discipline, motivation, and mental readiness, as Seo et al. (2021) noted that a morning training routine can improve mood, focus, and a sense of responsibility towards the training program. The statistical results in this study support these findings. The average $VO_2$max value of Kurash athletes who trained in the morning (37.87 ml/kg/min) was higher than that of the evening training group (36.21 ml/kg/min), with a significance value of $p = 0.00$ ($p < 0.05$). This means there is a significant difference between the two groups, and morning training has been shown to have a better effect on increasing cardiovascular endurance.

These findings align with research by Moussa et al. (2019) which found that morning aerobic exercise significantly increased $VO_2$max compared to exercise performed in the evening. Another study by Blonc et al. (2018) also revealed that circadian rhythms influence aerobic capacity, where morning physical activity can increase the efficiency of oxygen use in muscles and improve cardiorespiratory capacity. Research by Al-Salem et al. (2022) in Frontiers in Physiology also found that participants who exercised in the morning showed greater improvements in aerobic fitness and endothelial function compared to the evening exercise group, although both experienced significant increases in $VO_2$max. However, several other studies such as Chtourou & Souissi (2012) and Kuusmaa et al. (2016) suggest that evening exercise can also provide temporary advantages in anaerobic performance and muscle strength,

due to higher body temperature and improved neuromuscular coordination in the afternoon and evening. Therefore, the effects of training time can vary depending on training goals, the type of sport, and the individual's adaptation to their body's biological clock.

In the context of Kurash, a martial art that combines aerobic and anaerobic work, cardiovascular endurance ($VO_2max$) is a key factor in maintaining performance during intense and repetitive matches. Athletes with a high $VO_2max$ capacity are able to recover more quickly between rounds or matches and maintain strength and speed for longer. Therefore, an optimal training time, such as in the morning, can provide significant physiological and psychological benefits for Kurash athletes. The findings of this study provide an important contribution to the development of martial arts training programs, particularly for Kurash coaches and athletes in Makassar. The results can serve as a scientific basis for determining the most effective training time to improve cardiovascular fitness and competitive performance. Morning training can be recommended as the primary training time for developing aerobic endurance, with adequate warm-up time required to achieve optimal body and muscle temperature before training. Furthermore, the results of this study also reinforce the importance of applying the principles of training periodization and individualizing training times, as physiological responses to exercise time can vary among individuals. Further research is recommended to explore the effect of training time on other physiological parameters such as maximum heart rate, blood lactate levels, and post-exercise recovery, to provide a more comprehensive understanding of the effects of circadian rhythms on martial arts performance.

## 5 Conclusion

The following conclusions can be reached in light of the data analysis and discussion: 1. According to the descriptive analysis, Kurash athletes who trained in the morning had an average $VO_2max$ of 37.87 ml/kg/minute, while those who trained in the evening had an average of 36.21 ml/kg/minute. This suggests that exercise in the morning generally improves cardiovascular endurance more. 2. A p-value of 0.00 ($p < 0.05$) was obtained from the Independent Sample t-test hypothesis test, demonstrating a significant difference between the cardiovascular endurance ($VO_2max$) of athletes who trained in the morning and those who trained in the evening. Thus, Kurash athletes in Makassar City found that morning exercise increased their VO2max more effectively. 3. The body's circadian cycle is stabilized, the cardiovascular system is more adapted, and oxygen usage is more efficient when morning training is done. Training is more effective now since the body is fresher, cortisol levels are higher, and the environment is less disturbing. 4. Kurash instructors and athletes can use these results to optimize training plans, especially in aerobic fitness improvement programs. Training in the morning is advised as the best time to build cardiovascular endurance as long as a proper warm-up and training periodization are maintained.

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