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Article

The Difference Between Night and Morning Exercise in the Running Community to Physiologycal Recovery

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A B S T R A C T

This study aimed to examine the difference between morning and evening training sessions on physiological recovery among members of a running community in Surabaya. A quantitative approach with a descriptive retrospective design was applied. Twenty participants were divided into two groups: morning runners and evening runners. Data were collected through an online questionnaire including the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality, the Profile of Mood States (POMS) to evaluate mood state, and Resting Heart Rate (RHR) measurement as an indicator of physiological recovery. Data were analyzed using the independent samples t-test to compare both groups. The results revealed no significant difference between morning and evening runners in terms of sleep quality (p=0.978), mood state (p=0.784), and resting heart rate (p=0.819). These findings suggest that training time does not directly influence physiological recovery as long as the exercise is performed consistently and supported by a healthy lifestyle. Therefore, body adaptation to exercise is more affected by sleep habits, stress levels, and consistent training routines rather than the timing of the activity.

Keywords: *Morning Training, Evening Training, Physiological Recovery, Sleep Quality, Running Community*

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INTRODUCTION

The recovery process differs depending on the time of its implementation. Circadian rhythms affect the body's readiness for physical activity, such as heart rate, body temperature, and hormone secretion, which impacts the effectiveness of exercise and recovery (Arifudin Rafi'ud, 2016; Yuniar, 2019). Some studies show that morning exercise improves metabolic readiness, while nighttime exercise tends to provide more optimal muscle performance, but can affect sleep quality (Andriana & Ashadi, 2019). This makes training time an important factor that needs to be considered by the running community in achieving maximum performance without interfering with the physiological recovery process (Ambarwati & Setiowati, 2023; Zulfa et al., 2023).

The physiological recovery process involves the restoration of nervous system function, reducing lactic acid levels, and restoring body fluid balance after exercise. Nighttime exercise has the potential to slow down the recovery process due to increased physiological stress and impaired sleep quality (Ambarwati & Setiowati, 2023; Arifudin Rafi'ud, 2016). Research by Candra et al., (2016) suggests that measured aerobic exercise can significantly lower lactic acid levels, while according to Purnomo (2011) emphasizing the importance of the active recovery phase in accelerating the body's adaptation. *Active recovery* such as light jogging is effective in lowering fatigue and accelerating physiological recovery in runners (Ambarwati & Setiowati, 2023).

Based on the context of the running community in Indonesia, the habits and timing of training vary greatly depending on social and work routines. Study by Seno Nugroho (2018) The Playon Jogja running community shows that most runners train at night due to the time factor, although this can affect the quality of recovery. Suwarna H. A. (2020) Finding that there is a difference in sleep patterns between trained and untrained individuals that has implications for the body's recovery process. Therefore, it is important for the running community to adjust the timing of training with effective recovery strategies, such as stretching and active cooling, so that the body's physiological balance is maintained after intensive training (Ambarwati & Setiowati, 2023; Purnomo, 2011).

Choosing the right workout time not only affects performance, but is also closely related to long-term physiological adaptation (Reilly et al., 2017). For example, a study in Indonesia found that sports activities and circadian rhythms have a significant relationship with stress levels in college students, where poor circadian rhythms are associated with higher stress responses (Poluakan et al., 2020). In addition, research shows that regular physical activity correlates with better sleep quality, which is a key aspect of the body's physiological recovery and long-term adaptation to exercise (Iqbal, 2017). In addition, studies comparing morning and evening exercise show that exercise implementation time can have an impact on sleep quality and an individual's biological rhythm, so consistency of exercise time is an important strategy in planning exercise programs based on exercise physiology (Andriana & Ashadi, 2019).

In addition to the strategy of the time of exercise implementation, the intensity of exercise, and the duration of the exercise also play a major role in determining the effectiveness of the body's physiological adaptation (ACSM, 2018; Kraemer et al., 2017). Research by Candra et al., (2016) shows that moderate-intensity aerobic exercise can lower lactic acid levels and accelerate the physiological recovery process. Similar findings were put forward by Yamaguchi & Rochmania, (2022) Who compares *active recovery* and *passive recovery* In futsal players, where the active recovery method is more effective in lowering lactic acid levels and accelerating muscle adaptation to high-intensity exercise. In addition, it was found that nighttime exercise tends to decrease sleep quality and prolong physiological recovery time due to increased levels of physiological stress and disruption of athletes' circadian rhythms (Arifudin Rafi'ud, 2016). Therefore, proportionally regulating the intensity, duration, and timing of exercise is an important factor to maintain the effectiveness of the body's adaptation to the exercise load and prevent physiological fatigue (Haff & Triplett, 2016; Reilly et al., 2017).

Not only internal factors such as hormones and metabolism, but external factors such as ambient temperature, light, and air humidity also greatly affect the body's physiological adaptation process after exercise. High ambient temperatures can increase core body temperature and accelerate fatigue, so adaptation strategies are needed to maintain performance stability during outdoor training (Mintarto & Fattahilah, 2019). The body also needs time to adapt to exercise in hot and cold weather so that the cardiovascular and metabolic response remains optimal, and the risk of injury can be minimized (Graha, 2010). Moreover Sandi et al., (2021) It found that environmental conditions and training media such as light intensity and air humidity affect endurance as well as hydration levels of athletes, which has implications for the effectiveness of post-workout physiological recovery. Thus, training time planning needs to consider external factors so that the physiological balance and performance of the running community can be optimally maintained.

Previous research has tended to focus on the internal physiological adaptations of runners, thus creating a gap in understanding the dynamic interactions between runners' bodies and changing environmental conditions. The novelty of this study is that it systematically integrates internal data of runners with dynamic external variables (such as air quality and temperature) to produce an adaptive training planning framework. The main objective is to identify, quantify, and model the influence of external factors on the runner's physiological balance indicators in order to formulate a real-time adaptive running protocol. The resulting benefits are significant, optimizing performance and improving the safety of members of the running community by minimizing the risk of injury and overtraining due to environmental stress, while providing valuable data-driven decision-making tools for coaches and running organizations.

METHOD

This study uses a quantitative method of survey the habits of research subjects (running community), which aims to analyze the difference in night and morning exercise on physiological recovery in members of the running community. The research subjects were members of the running community in the city of Surabaya who actively participated in training according to a routine schedule. The criteria for this research sample are individuals who are members of the running community, actively train regularly according to schedule, and are willing to be research subjects.

The selection of research subjects was carried out by purposive sampling technique, because the researcher deliberately chose subjects that were in accordance with the research criteria. The number of samples was 20 people who were divided into two training groups, namely the morning runner group and the night runner group. Both groups had a consistent exercise routine in their implementation time.

Table 1. Classification of Research Subjects

	Training Activities	Session	Number of Samples
Group 1	Run	Morning	10 people
Group 2	Run	Night	10 people

Data collection was carried out through an online questionnaire (Google Form) designed to contain questions about running training activities, both in the morning and evening sessions, as well as the physiological recovery conditions experienced by the subjects after training. The questionnaire consisted of three main instruments, namely *the Pittsburgh Sleep Quality Index* (PSQI), *Profile of Mood States* (POMS), and Basal Heart Rate *(RHR) measurement* using each respondent's personal smartwatch. The instrument was chosen because it was in accordance with the retrospective research design, where the researcher did not provide a special treatment, but only collected data based on direct experience reports from respondents regarding their routine activities.

Sleep Quality

The *Pittsburgh Sleep Quality Index* (PSQI) instrument was used to assess sleep quality subjectively over a period of one month. PSQI consists of seven components, namely subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disorders, sleep drug use, and daytime dysfunction. Each component is scored 0–3 so that the overall total score is in the range of 0 to 21.

The basic principles of PSQI measurement were developed through preliminary research that addresses the relationship between sleep quality and individual psychic health (Buysse et al., 1989). The validity of this instrument was then strengthened through advanced psychometric tests that showed high reliability and validity in various populations (Carpenter & Andrykowski, 1998). Further testing of the diagnostic validity of PSQI in detecting sleep disorders also showed significant results in a wide range of age groups and clinical conditions (Nishiyama et al., 2014).

Table 2. Sleep Quality Assessment Norms on the PSQI Questionnaire

PSQI Score	Category
≤ 5 points	Good quality sleep
> 5 points	Poor quality sleep

The higher the PSQI score, the lower the quality of a person's sleep. This score is widely used in sports physiology research because it can describe how optimally the body undergoes physiological *recovery* after physical activity, both in the morning and at night. This measurement is crucial for analyzing the relationship between exercise time and circadian recovery rhythms.

Mood

The Profile of Mood States (POMS) instrument was used to assess the emotional state of the research subjects after performing exercise activities. POMS consists of 65 question items representing six dimensions of mood, namely tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue, and confusion. Each item is graded using a Likert scale of 0–4.

The final score is converted to Total Mood Disturbance (TMD), which is calculated by adding up the five negative dimensions and subtracting them by *the vigor* score. The higher the TMD score, the more negative a person's mood will be after exercise. Therefore, TMD is a sensitive psychological indicator of fatigue due to differences in training times.

Table 3. Mood Assessment Norms
Based on TMD Score (POMS) (McNair et al., 1971)

TMD Score	Category
≤ 0 points	Very positive/calm
1 – 20 points	Positive/balanced
21 – 40 points	Tend to be negative/mildly depressed
> 40 points	Negative/high stress

This instrument is widely used to evaluate emotional balance in athletes and physical activity actors. The use of POMS as a psychological measuring tool has also been shown to be effective in assessing emotional state and physiological adaptation to high-intensity exercise exercise.

Denyut Nadi Basal (*Resting Heart Rate* / RHR)

Basal pulse was measured using each subject's smartwatch in the morning shortly after waking up. These measurements aim to assess the physiological condition of the body and the recovery rate after exercise. A low basal pulse value indicates good cardiac work efficiency and fitness, while a high value indicates physiological fatigue.

Athletes generally have lower RHR than non-athletes due to cardiovascular adaptations that occur during training (Biswas, 2020). RHR is also negatively associated with cardiorespiratory fitness, where individuals with lower scores have higher aerobic capacity (Gonzales et al., 2023). In addition, regular exercise has been shown to lower average RHR values by 5–10 bpm, reflecting increased physiological adaptation to physical activity (Reimers et al., 2018).

Table 4. Basal Pulse Norm
Based on Physical Fitness Level

Category	Denyut Nadi Basal	Scientific Sources
Athletes are very fit	< 50 bpm	Biswas, 2020
Good	50 – 59 bpm	Gonzales et al., 2023
Enough	60 – 69 bpm	Reimers et al., 2018
Less	70 – 79 bpm	Reimers et al., 2018
Bad	≥ 80 bpm	Biswas, 2020

Through this instrument, it is hoped that the data collected will be able to objectively describe the difference in the level *of physiological recovery* between runners who train in the morning and at night. To support the validity of the data, this instrument has gone through a validity and reliability test process, so that each question item is proven to be able to measure research variables accurately and consistently. Thus, the data collected can be scientifically accounted for.

The research procedure has the following steps, compiling a questionnaire using Google Forms, searching for 20 research subjects, grouping research subjects into two groups based on the time of running training carried out, processing and analyzing research data using SPSS version 31. The data obtained was then analyzed using *comparative* techniques and using *independent samples t tests* to determine the difference and compare the difference in results between group 1 and group 2.

FINDINGS AND DISCUSSION

Research Results

The *Pittsburgh Sleep Quality Index* (PSQI) instrument was used to assess subjective sleep quality in each group of runners. Higher PSQI values indicate poorer sleep quality. The results of the descriptive analysis of sleep quality are presented in Table 5.

Table 5. Descriptive Statistics of Sleep Quality Values

	Mean & SD	*Minimum*	*Maximum*
Group 1	10.2±5.7	0	17
Group 2	8.3±5.9	0	20

In table 5, it can be seen that the average value of sleep quality of the morning runner group was 10.2, while the night runner group was 8.3. The results showed that the two groups had relatively similar sleep quality. Although the night group showed a lower PSQI score, the difference was still in an insignificant range. The minimum and maximum values also show a wide variety of individuals, indicating that the quality of sleep of each subject is influenced by their habits and body conditions.

Table 6. Descriptive Statistics of Mood Values

	Mean & SD	*Minimum*	*Maximum*
Group 1	4.1±16.2	-6	46
Group 2	5±11.4	-12	22

Based on table 6, the average mood score in the morning runner group was 4.1, while the night runner group was 5. These results show that the moods of the two groups do not differ much, with a tendency to stable emotional states after exercise. A large standard deviation value indicates a difference in emotional responses between individuals to running activities carried out at different times.

Table 7. Descriptive Statistics of Basal Pulse Values

	Mean & SD	*Minimum*	*Maximum*
Group 1	56.6±10.2	45	78
Group 2	56±9.5	40	75

Table 7 shows that the average basal pulse rate value of the morning runner group was 56.6 bpm, while the night runner group was 56 bpm. This value shows that the basal pulse of the two groups is in the normal category and there is no noticeable difference. This condition illustrates that the training time, both morning and night, does not have a significant effect on the efficiency of the heart's work or the level of physiological recovery of the runner.

Table 8. Differential Tests Using *Independent Samples T-Test*

Itself.		***Independent samples t test***
		Groups 1&2
P	Sleep Quality	0.978
	Mood	0.784
	Denyut Nadi Basal	0.819

Using the independent sample t test method, the results of the different tests shown in table 8 showed that the significance value of P for sleep quality P = 0.978, mood P = 0.784, and basal pulse P = 0.819, P > 0.05. Based on these results, it can be concluded that there is no significant difference between morning and evening exercise for all physiological variables measured. These results indicate that exercise time does not have a significant effect on sleep quality, mood, or basal pulse.

Factors such as sleep habits, stress, and individual physiological adaptations may play a greater role in determining the condition of the body's recovery after exercise. Factors such as sleep habits, stress levels, and an individual's initial physiological adaptation status should be considered as more dominant variables in the context of post-exercise recovery. These results are consistent with the findings Andriana & Ashadi, (2019) and research Saidi et al., (2021) which states that consistency of exercise and a healthy lifestyle determine the effectiveness of physiological recovery more than the time of exercise implementation.

Discussion

Exercise activities have an important role to maintain physical fitness, psychological stability, and physiological function (Merlo & Vela, 2022). The right intensity and timing of exercise can improve endurance and balance cardiovascular function. However, the effectiveness of this exercise is influenced by the body's circadian rhythm, which is divided into ergotropic (morning) and trophotropic (night) phases (Facer-Childs & Brandstaetter, 2015). Based on previous research, high-intensity exercise at night can improve the sympathetic nervous system, disrupt sleep quality, and cause a rise in body temperature that slows recovery (Kim et al., 2023). Nonetheless, the selection of exercise time is often based on social factors and the individual's dense routine (Puciato, 2019).

The results showed that there was no significant difference between morning and evening exercise on physiological variables, such as basal pulse, sleep quality, and mood. This happens because the body of the study subjects has been able to adapt to the exercise time, as long as the activity is carried out consistently and accompanied by a healthy lifestyle that supports the physiological recovery process. These findings are in line with the results of the study (Teo et al., 2011) which suggests that physical activity at night does not have a general adverse effect on sleep. Similar results were also found by Ali & Putra (2022) , where the effectiveness of physiological recovery (cortisol hormone profile) is more determined by the intensity of exercise and strategy *recovery* compared to the implementation time in trained athletes.

To validate the finding that exercise time does not significantly affect physiological recovery, several similar studies support this conclusion, particularly on sleep and performance variables. For example, systematic studies and meta-analyses by Stutz et al., (2019) It concluded that physical activity at night (afternoon to night) did not generally negatively impact sleep quality in healthy participants. Instead, they found an increase in the duration of slow-wave sleep (*slow-wave sleep*) after exercising at night. This is reinforced by Thomas et al., (2020) that specifically examines endurance runners (*endurance runners*). The study showed that even high-intensity exercise that ended 3.5 hours before bed did not interfere with total sleep time (*Total Sleep Time*) as well as cardiac autonomic activity, which indicates that the athlete's body has a high adaptation to the stress of night training. These findings are consistent with the results of current research involving the running community, where chronic and regular exercise habits allow the body to balance post-workout sympathetic and parasympathetic responses, so that the effects of exercise time are minimal on recovery Thomas et al., (2020).

Nonetheless, there are other studies that provide conflicting findings, especially when it involves long-term adaptations and populations with specific metabolic conditions. Research by Moholdt et al., (2021) showed significant differences in glycemic control (*glycaemic control*) in men *overweight*/obesity who practice in the morning compared to the evening. Evening exercise has been shown to provide better improvements in glycemic profiles (e.g., lower serum glucose levels), suggesting that exercise timing can have a specific, non-neutral metabolic impact in this population. This difference in results can be explained by different circadian rhythm mechanisms in glucose regulation. In the morning, insulin sensitivity tends to be lower, while at night, muscles may be more receptive to glucose absorption in response to exercise, thus optimizing metabolic adaptation (Moholdt et al., 2021). Performance adaptations, such as endurance and strength, also indicate time specificity, where consistent training at a given time can optimize performance improvements at the same time (*circadian specificity*) (Bruggisser et al., 2023). A finding that is in line with research by Küüsmaa et al., 2023) which sees adaptation in increased strength and endurance.

Overall, the contradiction of these findings regarding the timing of these exercises highlights the central role of the context and population studied. The research that supports this research is Stutz et al., (2019) & Thomas et al., (2020) generally focuses on healthy, well-trained individuals (*endurance runners*), suggests that in athletes who are in excellent physiological condition and have reached a chronic level of adaptation, training time (morning vs. night) is no longer the primary determinant of physiological recovery. Instead, factors such as routine consistency, cooling strategy, and overall sleep quality became more dominant. Meanwhile, research that contradicts Bruggisser et al., (2023) & Moholdt et al., (2021) It shows that in metabolic adaptation or peak performance enhancement, circadian rhythm factors still play a role, especially in populations that are poorly trained or have metabolic risk. Therefore, it can be concluded that the effectiveness of exercise time is specific to the training objectives and fitness status of the subject; neutral for recovery in trained athletes, but essential for metabolic adaptation and performance optimization in the general population (Kim et al., 2023).

There are several limitations in the current research that need to be corrected in future studies. First, this study only included a population of chronic (routine) runners, so findings regarding adaptability and recovery may not be generalized to individuals who started acute exercise (*new-beginners*) or the general public who have different daily routines (e.g., individuals with office jobs). Second, the study has limitations in terms of the number of subjects and the control of the variables of exercise intensity, where variations in the intensity and duration that subjects perform independently can be a disruptive factor (*confounding factor*) on the results of physiological recovery. Third, although basal pulse, sleep quality, and mood are measured, future research is suggested to measure more objective and sensitive physiological stress markers such as plasma cortisol or full-spectrum changes in heart rate variability (HRV). As such, further research needs to focus on comparisons between acute versus chronic runners with a larger number of subjects, standardized treatments, and more in-depth measurements of hormonal biomarkers (such as Testosterone/Cortisol ratios) to confirm these circadian adaptation findings (Teo et al., 2011).

CONCLUSIONS

Based on the results of a study involving 20 members of the running community in the city of Surabaya, it can be concluded that there is no significant difference between exercises carried out in the morning and at night on aspects of sleep quality, mood, and basal pulse. The results of the statistical test showed a significance value above 0.05 for all variables, so that the training time did not directly affect the physiological recovery process of the runners. These findings illustrate that the body of runners who are used to training has a good ability to adapt to differences in training times. As long as exercise is carried out consistently and balanced with a healthy lifestyle, the physiological recovery process can take place optimally. Factors such as sleep habits, stress levels, and consistency of exercise routines actually have a greater influence on the quality of recovery than the difference in the time of exercise implementation. In other words, the training time can be adjusted to individual preferences as long as the body's recovery principles are maintained.

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