Original Article

Dynamic levels of hormonal, oxidants, insomnia, and stress in badminton athletes who practice morning and evening

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ABSTRACT

Circadian rhythms are internal mechanisms that regulate various aspects of the human body's physiology and behaviour that are influenced by activity, physicality, and change time in 24 hours. This study aims to compare oxidant levels and hormonal levels based on differences in training times, namely morning and evening, in badminton athletes. This research involved 44 badminton athletes using a purposive sampling technique who were divided into a morning group (n = 22) and an evening group (n = 22). Melatonin levels were measured using the Elabscience Kit (No. E-EL-H2016) and malondialdehyde (MDA) levels using spectrophotometry. All research procedures have received ethical approval from the Hasanuddin University Medical Faculty Ethics Commission (Number: 377/UN4.6.4.5.31/PP36/2023). The results of this study indicate that the athlete's melatonin value in the morning was 76.71 ± (29.05-247.45) higher than in the evening 80.43 ± (50.83-155.24) Meanwhile, the athlete's MDA value in the evening was 2.08 ± (0.74–4.57) higher compared to the MDA in the morning of 1.09 ± (0.33–3.71). Meanwhile, based on the insomnia value for evening training, a higher value was obtained compared to morning training, namely 9.50 ± (3-11). However, there was no significant difference in stress levels. The results of the study showed that badminton athletes who trained at night tended to experience sleep disturbances (insomnia) and increased oxidant levels, while hormonal levels, especially melatonin, were higher in athletes who trained in the morning.
Keywords: Sport medicine, Melatonin, Oxidative stress, Morning exercise, Night exercise, Insomnia, Stress level.

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INTRODUCTION

Exercise has many health benefits, such as reducing the incidence and severity of metabolic diseases and increasing healthy life expectancy because it can provide many metabolic benefits through the liver, adipose tissue, and pancreas (Kim *et al.*, 2022; Mode *et al.*, 2023) However, excessive exercise activity can disrupt the production of free radicals and antioxidants, which is known as oxidative stress (Yunus, 2020). Someone who exercises in the right way, like by increasing the intensity of the exercise and choosing the right time to exercise, will get maximum benefits. In general, the best time to exercise is in the morning, and the best time to rest is in the afternoon. This is because some evidence shows that humans go through two different phases in their lives, namely the ergotropic phase when they carry out activities in the morning and the trophotropic phase when they rest at night (Andriana and Ashadi, 2019).

However, activities during the day can cause an increase in blood pressure and pulse rate. Furthermore, all body functions will slow down at night, resulting in drowsiness. However, if someone forces themselves to exercise at night, this schedule change can disrupt *the internal timekeeper,* whose function is to direct the body's abilities (Jensen *et al.*, 2016). A person who exercises before bedtime with maximum energy will experience an increase in physiological arousal characterized by symptoms of increased heart rate and increased breathing (Kline and Youngstedt, 2017; Andriana and Ashadi, 2019). Circadian rhythms are also disrupted when someone exercises at night. For example, melatonin levels are reduced when the circadian rhythm is disrupted, and its function as an antioxidant can increase reactive oxygen species (ROS) in cells (Mushab, Hairrudin, and Abrori, 2020).

There are also a lot more people doing badminton at night than in the morning. Several athletes' complaints that arise after exercising at night, such as muscle pain, easy injuries, and sleep disturbances, are of particular interest to us. Therefore, we want to look further at the influence of training time, which is associated with changes in oxidant levels and changes in levels of the hormone melatonin after exercise in badminton athletes both in the morning and at night. Researchers also compared the levels of insomnia and stress in badminton athletes.

METHODS

This research is an experimental study with a cross-sectional design to see the comparison of MDA, melatonin, insomnia, and stress levels that are associated with differences in morning and evening training times in junior badminton athletes aged 10–16 who regularly exercise at least 3 times a week. This research has received ethical approval from the ethics commission of the Faculty of Medicine, Hasanuddin University (Number: 377/UN4.6.4.5.31/PP36/2023) and was carried out in 2023. The process of taking athlete blood samples was carried out at the South Sulawesi Badminton Association. After ensuring that the athlete is in good condition, a 3 cc blood sample is taken from the median cubital vein.

15 minutes of morning and evening badminton practice. Then the blood sample is centrifuged to obtain serum, which will then be measured using the melatonin hormone levels *Elisa Kit* and a human Elisa reader tool. Oxidant levels are seen using the MDA biomarker by spectrophotometry. Whereas measuring stress level with the perceived stress scale (PSS)-10 and insomnia with a questionnaire insomnia rating scale Bivariate analysis to relate variables is an *unpaired T-test* if the data is normally distributed. Meanwhile, if the data is not normally distributed, the alternative, non-parametric *Mann-Whitney* test was used.

RESULTS

Table 1. Characteristics sample age.

		Morning Athlete		Night Athlete	
		Frequency	Percent (%)	Frequency	Percent (%)
Age	10	3	13.6	6	27.3
	11	4	18.2	1	4.5
	12	3	13.6	5	22.7
	13	6	27.3	6	27.3
	14	5	22.7	4	18.2
	15	-	-	6	27.3
	16	1	4.5	1	4.5
Total		**22**	**100**	**22**	**100**

Based on the Table 1 obtained, the characteristics of the subject studied were based on age. Group athlete morning on the range of 10–16 years, with donations by athletes 13 years old (27.3%). Likewise, in groups, evening athletes in the age range of 10–16 years Ages include group-age athletes in junior badminton.

Table 2. BMI characteristics sample.

		Morning Athlete		Night Athlete			
		Frequency	Percent (%)	Frequency	Percent(%)	Frequency	Percent (%)
BMI	16.0-18.0	13	58.6	-	-	-	-
	18.1-20.0	6	27	12	54.5		
	20.1-23.0	1	4.5	4	18.5	21	95.5
	23.1-26.0	2	9	6	27	1	4.5
Total		**22**	**100**	**22**	**100**	**22**	**100**

Based on the Table 2, the obtained description characteristics were subjected to study in accordance with the Body Mass Index. BMI in athletes Morning ranges from 16.0 to 26.0 kg/m^2, dominated by BMI, which ranges from 16.0 to 18.0 kg/m^2 (58.6%). Likewise, for group athletes, most nights ranged from 18.1-20.0 kg/m^2 (54.5%). Meanwhile, the non-athlete group evening with the most ranged from 20.1-23.0 kg/m^2 (95.5%). BMI group in each group, including the normal BMI category.

From Table 3, the mean ± SD value of melatonin levels for morning athletes is higher than that for evening athletes, namely 98.64 ± 61.30 and 80.43 ± 31.28. The results of the independent T-test are not significant; there is no difference with a value of p = .707 (p > .005).

From Table 4, the mean ± SD value of MDA levels for night athletes is higher than that for morning athletes, namely 1.45 ± 0.94 and 2.17 ± 0.95. The results of the independent t-test are significant; there are differences in MDA levels between athletes in the morning and athletes in the evening, with a value of p = .012 (p < .005).

Table 3. Melatonin levels in morning athletes and evening athletes.

Group	Mean ± SD	*p*-value
Morning athlete	98.64 ± 61.30	.707[a]
Night athlete	80.43 ± 31.28	

Note. [a]*Independent T-test.*

Table 4. MDA levels in morning athletes and evening athletes.

Group	**Mean ± SD**	***p*-value**
Morning athlete	1.45 ± 0 .94	.012[a]
Night athlete	2.17 ± 0 .95	

Note. [a]*Independent T-test.*

Table 5. Stress questionnaire values for morning athletes and evening athletes.

Group	**Mean ± SD**	***p*-value**
Morning athlete	12.09 ± 4.71	.124[a]
Night athlete	11.73 ± 1.12	

Note. [a]*Independent T-test.*

From Table 5, the mean ± SD value of the stress questionnaire indicates that stress for morning athletes is higher than that for night athletes, namely 12.09 ± 4.71 and 11.73 ± 1.12. The results of the *independent T-test* are not significant; there is no difference with a value of p = .124 (p > .005).

Table 6. Values insomnia questionnaire for morning athletes and evening athletes.

Group	**Mean ± SD**	***p*-value**
Morning athlete	7.77 ± 3.02	.001[a]
Night athlete	14.95 ± 2.62	

Note. [a]*Independent T-test.*

From Table 6, the mean ± SD value of the insomnia questionnaire for the night is higher compared to morning athletes, namely 14.95 ± 2.62 and 7.77 ± 3.02. The results of the independent t-test are significant; there is a difference with a value of p = .001 (p < .005).

DISCUSSION

Melatonin levels

Rhythm circadian is a daily change in behaviour and activities biologically caused by the capacity to experience something synchronized in organisms with a 24-hour cycle of light and darkness in the environment. This rhythm originates from the biological clock inside the body, which regulates lots of elements of physiology in humans, including the cycle of sleep, variety of blood pressure daily, and temperature of the body (Refinetti, 2012). The suprachiasmatic nucleus (SCN) hypothalamus, which receives signals of light and dark in a direct way through the track retinohypothalamus, houses a known internal rhythm generator as a "*biological clock*." Circadian clock processes centre send information from outside to the peripheral clock various tissues and cells, whose functions may be simultaneous or independent (Refinetti, 2012). The pineal gland in the SCN mediates the circadian melatonin cycle, which is partially regulated by the light-dark process (Nobari et al., 2023).

Melatonin (N-acetyl-5-methoxytryptamine) is an endogenous pineal gland neurohormone whose secretions are controlled by light and dark cycles. Melatonin plays an important role in overcoming radicals and reducing damage to the oxidative level (Emens and Burgess, 2015). Melatonin receptors can be found throughout the body (e.g., muscles, skeleton, mitochondria, pancreas, tissue adipose, retina, brain, platelets, and skin) (Tan *et al.*, 2013). Melatonin also plays a role in the management of insomnia, obesity, diabetes, and metabolic syndromes. A number of studies support the effect of melatonin on oxidative stress, inflammation, and cellular apoptosis in living humans with obesity and animal models of obesity. Research conducted on young footballers has shown that acute consumption of melatonin (6 mg) before intensity Keep going to continuously increase defence immunity and lipid metabolism and reverse damage resulting from oxidation after exercising with increased activity of total antioxidants that can cause enhancement of physique performance (Ben Dhia *et al.*, 2022) and also act as antioxidants with stimulated activity of antioxidant enzymes such as SOD (superoxide dismutase), CAT (catalase), and GPX (glutathione peroxidase).

This research reports that athletes' melatonin values at morning exercise are higher than at evening exercise. This thing, in line with Marrin et al., shows enhancement. Endogenous melatonin levels after sport are higher in the morning compared to the afternoon, which shows that the morning MLT administration day can increase the number of MLTs in the blood, so the increased effect will benefit him. Ghattassi et al. show melatonin consumption can influence cognitive performance Morning day (e.g., alertness and timing reactions) and some performance Specific period short from player football, however, performance measured in the afternoon still has not changed. In the morning, lipid peroxidation capacity total antioxidant, and activity enzyme certain higher than evening day. Other findings on *salivary* melatonin have been proven to increase during and after morning and evening exercise, with mornings producing more improvement (Marrin *et al.*, 2011). Physiological levels of melatonin have been found to contribute to the capacity of human serum antioxidants as a whole (Nobari et al., 2023).

Insomnia

Getting enough sleep is an important element for health and performance, especially among elite athletes. According to the National Sleep Foundation, there are consistent findings that exercise increases total sleep time and sleep quality. Sleep deprivation alters cognition, pain, mood, metabolism, inflammation, and immunity, which can ultimately have a negative impact on athletic performance (Kashefi, Mirzaei, and Shabani, 2014). Exercise is generally considered a non-pharmacological behaviour that can initiate sleep through hyperthermia. Enhancement of metabolism, which warms the pre-optic area and anterior hypothalamus, has proven to start sleep (Gong *et al.*, 2000). Exercise can induce both acute and delayed changes in melatonin secretion, although the changes induced by exercise vary according to when the exercise is performed. (Carlson *et al.*, 2019). Sleep deprivation of 6 to 7 hours (every 24 hours) can lead to many comorbidities, such as hypertension and diabetes, and a 12% higher risk of death. Adolescence is characterized by a high proportion of people frequently staying up late, pushing bedtime to one to three hours later than in pre-adolescence, with difficulty waking up early in the morning. This is due to one of them: biological reasons: Circadian biological rhythms are unbalanced, so that melatonin secretion is delayed in the morning while increasing in the afternoon (Chahine, Chahine, and Nader, 2022).

The negative impacts associated with exercising at night include sleep disturbances. Increased production of the hormone adrenaline, which has an impact on increasing heart rate and body temperature, can cause difficulty falling asleep immediately after physical activity at night. High-intensity exercise in the hours before bed increases physiological responses. Heart rate increases, lactic acid builds up, and breathing rate increases, all of which can disrupt normal sleep patterns. Badminton is one of the most popular sports with an anaerobic energy system. The ATP-PC and lactic acid energy systems are used in as much as 70% of badminton matches. The energy system poses a significant threat of creating a hypoxic environment. In fact, after playing badminton, a person's cells and muscles will be damaged, causing feelings of tiredness. Therefore, recovery is very important to prevent injury and other negative effects (Romadhan, Purnama, and Sabarini, 2023).

Other research has proven that sleep plays a major role in physiological recovery, especially with regard to cardiovascular and endocrine function. Conversely, short sleep duration is associated with increased cortisol levels and systemic inflammation. In general, regular physical exercise can improve sleep quality. These beneficial effects are lost with vigorous exercise, which is basically done at night, as a result of exposure to bright light. Accumulating evidence suggests that intense exercise in the evening during the phase of increased melatonin secretion can blunt melatonin levels, increase cortisol levels, and induce hyperthermia (Banzet *et al.,* 2012). As a result, youth athletes' rest and recovery are hampered. It has been observed that changes in sleep quality and quantity affect sports performance the following day (Cooper, 2005; López Flores *et al.,* 2018). For example, a reduction in total sleep time can cause fatigue, reduced aerobic capacity (Skein *et al.*, 2011), sub-maximal strength, and precision (Reyner and Horne, 2013). Thus, the importance of sleep for optimal athletic performance and recovery, cognitive/academic performance, and well-being, as well as reducing the risk of injury and disease in athletes (Bergeron *et al.*, 2015) (Cheikh *et al.*, 2020), Melatonin acts as an antioxidant capable of protecting against potential molecular damage (Brancaccio et al., 2007; Maldonado et al., 2012). Additionally, the ability of melatonin to influence immune function has been demonstrated (Brancaccio et al. 2010). Numerous studies show that melatonin manifests its anti-oxidative properties by increasing the activity of antioxidant enzymes, producing molecules that protect against oxidative stress, and decreasing the amount of reactive oxygen species. Exercise that has been performed at night or in the dark at night with either moderate or high intensity results in delayed melatonin secretion (Rastegar et al. 2018). The result of research by Cheick et al. (2020 on 14 volleyball players found that melatonin levels were higher in the morning day compared to the evening day after exercises. (Cheikh *et al.*, 2020).

The results of this research showed that evening athletes achieve higher insomnia scores than athletes who train in the morning. In line with other findings, physical activity improves sleep quality by increasing melatonin levels at night, especially in participants who exercise in the morning (Chahine, Chahine, and Nader, 2022). It has been reported that aerobic exercise in the morning or evening stimulates the earlier release of melatonin and shifts the circadian rhythm. This is associated with increased melatonin at night and decreased cortisol levels—the perfect physiological pattern for these two hormones (Youngstedt, Elliott, and Kripke, 2019). In fact, an important marker of hypothalamic-pituitary adrenocortical function is cortisol levels, with increases in cortisol levels peaking in the afternoon and a sharp decline in the evening (Morita, Sasai-Sakuma, and Inoue, 2017). The importance of melatonin, secreted by the pineal gland, has been emphasized in sleep disorders from the perspective of endocrine biochemical systems. This hormone associated with sleep is secreted more often at night and is closely related to the onset of sleep, deep sleep, and maintenance of good sleep quality (Vitale et al., 2017). In fact, morning exercise can improve sleep quality, leading to the maintenance of stable sleep throughout the night, thereby triggering improvements in overall sleep pattern architecture (Chahine, Chahine, and Nader, 2022).

An imbalance between oxidative stress and antioxidant defence is one of the mechanisms underlying cardiovascular complications (New et al., 2013). Oxidative stress is a condition where there is an imbalance between antioxidant defences and free radicals. Increased levels of free radicals will oxidize proteins, lipids, and nucleic acids. Lipid oxidation produces lipid peroxides, which can be measured at MDA levels. (Arslan et al., 2014). Decreased antioxidant capacity will cause oxidative stress, which predisposes to cardiovascular disease complications (Akhigbe and Ajayi, 2021).

Under oxidative stress, reactive oxygen species (ROS) trigger endothelial dysfunction through disrupting nitric oxide (NO) signalling, a vasoprotective agent. Superoxide reacts with NO to form peroxynitrite, a powerful vasoconstrictor. ROS are also associated with structural changes in blood vessels, such as wall thickening and lumen narrowing (Kawamura and Muraoka, 2018). The redox system experiences a circadian rhythm, where antioxidants are more efficient in the morning and lipid peroxidation levels are higher in the afternoon. Oxidative stress was higher in the afternoon, with peak MDA concentrations occurring at 18:00 (lower values at 06:00). Meanwhile, antioxidant status parameters (total antioxidant status (TAS), total bilirubin (TBIL), uric acid (UA), CAT, and GPx activity) are higher in the morning, with peak concentrations at 06:00 (Powers et al.,, 2020).

The results of this study are in line with the results of research by Hammouda et al. They concluded that antioxidant status was more efficient in morning exercise than in morning exercise in the afternoon in young soccer players. Circadian rhythms regulate all activities in the body, including the antioxidant system, where antioxidant system activity is higher in the morning. High GPx levels in the morning will increase even higher with regular moderate-intensity exercise. The mechanism of the greater increase in GPx-1 in the morning group may be related to higher levels of melatonin in the morning compared to the afternoon. Melatonin secretion is still ongoing at 08.00 and is no longer secreted at 16.00. Melatonin has been shown to increase more after exercise in the morning than in the afternoon. Afternoon exercise blunts or reduces melatonin secretion compared to morning exercise. Melatonin is an antioxidant hormone that can stimulate other antioxidant enzymes (SOD and GPx). Melatonin contributes to increasing the body's total antioxidant capacity. The antioxidant capacity of melatonin is 10 times more efficient than that of other antioxidants (Sato et al., 2020).

The results of this study showed that MDA levels were higher in athletes who trained at night compared to athletes who trained in the morning. This is in line with research by Jusup et al. (2022 showing that the decrease in MDA levels after regular exercise in the morning is significantly greater than in the afternoon. This decrease was associated with a greater increase in the antioxidant enzyme GPx-1 in the morning group compared to the morning group in the afternoon group. Previous research involving health respondents showed a significant increase in MDA levels after exercise in the afternoon (Jusup et al., 2022).

Stress level

Performance and well-being of athletes are influenced by internal and external demands. In some years, space-scope training, density competition, pressure social and media, as well as efforts to increase performance, have increased in various disciplines of sport. However, practice combined with too much recovery is not adequate, and a level of stress can give rise to the risk of overreaching or overtraining syndrome. These things be marked with change psychological negative period short and term long (e.g., atmosphere heart depressed, attitude apathetic in a way general, decline price self, instability emotions, anxiety, easy offended, annoyance sleep, decline weight, loss lust eat), change biological (increase rest). beat heart, increase vulnerability to injury, hormonal changes), and be accompanied by a decline in capacity performance (Heidari *et al.*, 2018). If it occurs in athletes who experience it, nonconformity between recovery and stress is not enough to tolerate the burden of high training.

According to Kellmann and Kallus, from a perspective-oriented system, stress reflects destabilization or deviation from internal norms (biological or psychological) (Kellmann and Kallus, 2016). Stress model transactional cognitive emphasizes the importance of the assessment process. Someone who strengthens or weakens the effect of a potential situation gives rise to stress. Rather, recovery describes multilevel processes (including factors psychological and social), where ability performance is built back. However, many athletes tend to ignore symptoms and not make enough recovery because they are possibly afraid to skip exercise and/or competition (Van Tonder *et al.*, 2016).

This study discovered that athletes' stress levels were higher in the morning than in the evening. That thing in line with the study by Gerber *et al. (*2013 that level of recovery is low and level of stress is high in a way significant predicts problem-marked mental health with symptoms of depression, fatigue, and insomnia (Gerber *et al.*, 2023) Strength predictions, circumstances, recovery, and stress are similar for symptoms of depression and fatigue. Although elite athletes report higher levels of recovery when compared to levels of stress. This has become a problem for elite athletes who have a low recovery rate or a high stress level.

Our findings are an encouraging study from previously found that recovery is not only the main performance athlete's main factor; matter this also contributes to minimizing the risk of negative mental health impacts like depression, fatigue, or insomnia (Heidari *et al.*, 2019). Because of variations in potency recovery, capacity to endure stress, genetics, background behind training, or health status moment here, athletes with standard performance may show different responses to the training stimulus provided. As a consequence, the burden exercise is certain possible in accordance with one athlete, but it results in excessive exercise in others (Emens and Burgess, 2015). This thing highlights the importance of monitoring (psychological), which describes a systematic process of collection and interpretation of information about recovery and condition stress in athletes. (Heidari *et al.*, 2019).

Although the importance of sleep for performance and health in athletes is already well known, the latest evidence shows that most big athletes often fail to fulfil recommendations for this sleep moment (Fullagar *et al.*, 2015). Under review, it was reported that 50–78% of elite athletes experience disturbance sleep and 22–26% have a timetable of very disturbed sleep (Kölling *et al.*, 2015). Likewise, latest Research finds that 88% of athletes do not get enough sleep—as much as 8 hours (Kölling *et al.*, 2015). Although there are a number of obstacles to optimal practice for athletes, such as situational place stay, travel, itinerary exercise, and hygiene, the schedule sleep an athlete often does not prioritize moment in timetable practice and practice developed, which can cause scheduling more beginning session exercise in the morning. Unfortunately, research has previously shown that this, in turn, can negatively impact the quantity and quality of sleep obtained by student-athletes in college at night before exercise in the morning, causing sleepiness and fatigue during the day (Filho *et al.*, 2015).

Apart from that, there are a number of outside factors that limit schedules and itineraries that also affect sleep status and recovery. Studies previously showed that circumstances and anxiety situations can negatively impact athletes sleep (Brink *et al.*, 2012), for example, before competition essentials and travel. Next, before the session morning exercise, there was pressure to fall asleep, but you didn’t get lots of sleep, so you can give rise to worry situational, potential bother sleep. In the environment of work, when workers are currently on duty, they report frequently higher levels of anxiety because they are afraid of excessive sleep or are not awakened due to alarm (Walsh *et al.*, 2021). Enhancement level of worry This often worsens quality sleep, which is associated with declining cognitive and performance. Unknown is the same phenomenon that can occur in athletes when face-to-face exercise occurs on a morning, and the fear of sleeping excessively or missing the alarm can increase level anxiety at night. Therefore, increased anxiety can influence quantity and quality of sleep, and so on, evaluate perceived recovery on the next day if sleep turns out to be disturbed (Heidari *et al.*, 2019).

In other studies, the level of anxiety increased at night before session exercise in the morning compared with non-exercise days. In turn, higher levels of anxiety may also have a negative impact on total sleep and the measurement of perceived recovery status by the next day. Interestingly, the effect This was only observed in males, but the magnitude of the effect was the same. What is the total time Sleep affects recovery status Possible comparable in both types of gender. Is it known in studies that reflection from the level of anxiety reported higher before days of exercise morning day because enhancement level worry possible has caused sleep to be more restless? Because the perceived recovery status is lower on days of session exercise and mornings, and the recovery status ratings are lower linked with reduced total time sleep, not enough sleep is possible, which bothers the athlete's ability to recover in a way adequate and feel ready to do practice. train tomorrow. There is also a possibility that there is more high anxiety at night before the morning session of exercise. The day also has a negative impact on recovery status, as shown by the negative relationship between recovery status and level of anxiety. Similar findings were noted before competition, where total time reduction sleep was linked with enhancement level fatigue and low level strength the next day. Simultaneously with the results of the study moment this and the findings before, apparently total time reduction sleep impact negative on various index recovery before session training and competition. Possible implications can be acute and chronic after total time reduction. Sleep with often-session exercise on the morning. Even athletes in studies This only reports perceived recovery status; research previously also observed declines in physical performance, ability, cognitive ability, and time reaction after disturbance sleep (Walsh *et al.*, 2021). In extreme cases, when sleep is limited to evenings before exercise sessions, athletes tend to report a more heartbreaking atmosphere, a higher level of fatigue, and a greater perception of effort during exercise compared to evenings, when athletes take notes and 8 hours of sleep is recommended (Ritland *et al.*, 2019). Over time, less sleep can cause persistent fatigue, which is a general symptom of recovery that is not adequate and is frequently reported by athletes who exercise excessively. In addition, athletes who sleep less than 8 hours per night found 1.7 times more likely to experience injury compared to a sleeping athlete for more than 8 hours (Milewski *et al.*, 2014). However, the total increase in sleep through intervention-repair targeted sleep has been directly linked with various aspects of enhancement performance among athletes (Kirschen, Jones, and Hale, 2020). This shows that a continuous focus on improving quality sleep has the possibility of reversing a negative trend in pattern-induced recovery and performance-disrupted sleep (Merfeld *et al.*, 2022).

Stress is a situation faced by an individual. Man will experience good stress that is sourced from inside and outside himself. Stress can cause conflict, pressure, frustration, and crises. However, excessive stress will make individuals distressed or experience suffering, a sense of disconnection, hope, even depression, or worry. On the contrary, if the stress is very light or they are not experiencing stress, they will easily feel bored and unmotivated. According to a number of studies, regular exercise can have lots of benefits for the body, like preventing obesity, diabetes, hyperlipidaemia, stroke, hypertension, and stress (Andalasari and Berbudi, 2018). Sport has become a need for the public in a wide sense. Proven with its growing centre health and sports as well as fulfilled spaces public on the day holidays by people who want to exercise. This demonstrates that sport is no longer just a necessity but has evolved into a way of life. In general, the public does sport to guard their fitness bodies as well as their health, so they can operate activities daily with fitness, but there are also a few of them who do it because of a hobby or chase performance in the event or sporting events (Andalasari and Berbudi, 2018).

Based on data from Riskesdas, a lot of Indonesia's population is suffering stress, especially the elderly. But there are some strategies for managing stress, among other things, through sports (Chandra and Lontoh, 2022). Sports, besides, can help Managing stress can also increase a person's mental health. Sport not only reduces stress and depression but is also beneficial to guard individual mental health. Someone who frequently exercises their own level of trust has more satisfaction and happiness (Astuti, Surmantika, and Rubai, 2021).

Based on the results of research on the groups, athletes in the morning and evening, respectively, have a low stress level. This thing is possible to relate to a number of studies previously that stated that sports are effective in reducing stress. Regular and planned exercise works for looking after movement function and dealing with stress. Regular exercise can lower the incidence and severity of stress-related mood disorders, including anxiety and depression. This thing relates to existing changes in chemistry in the brain after exercise, like an increase in neurotransmitters, especially serotonin and dopamine, as well as secretion endorphins (Wahyudi, Freeari, and Nazriati, 2015). Hormone endorphins produced during exercise will replace hormone stress, making emotions more stable. You can do sports to stimulate the release of serotonin and dopamine hormones, which give rise to feelings of happiness and lower stress. People who have the habit of exercising can lower their stress. When exercising, hormones cortisol and epinephrine, which are hormone stress, will decrease, so those who are routinely doing sports will be more exposed to stress, both physical and mental (Stevens, RE et al., 2013).

Our research results state, there is no difference between practicing morning and evening athletes. This is because in research on student-athletes, accumulation triggers stress from roles they as students and athletes often consider not strong. Remember that pattern? Think stress reflects somebody's view of the stress process. That alone, and not simply evaluation to trigger stress, there is a certain possibility that, although student-athletes and non-athletes have the same stress pattern, there is no difference in stress patterns. Optimization model stress is also aware that the internal and external worlds can influence system values, perceptions, or confidence about stress (Crum, 2020). We don't investigate impact variables external to pattern thinking stress or perception stress in this study; however, we recommend researchers integrate variables external in the study next to explore pattern thinking stress in athletes. For example, understanding role trigger stress organization, like culture team, procedure selection, or trainer's interpersonal skills (Arnold, Fletcher, and Daniels, 2013) in influence pattern think stress or evaluation to stress can be useful moment designing intervention pattern think stress (Avery *et al.*, 2022).

Apart from that, the athlete's stress value in the morning is higher than that of the afternoon athlete. This is possible because one of them requires more sleep for athletes who train in the morning. In another research study, Heishman *et al.* (2017) reported sleep alone at night before morning (time from 07:00) and sessions of afternoon practice (time from 13:45) on 10 college basketball players height (21 ± 1 year) for five weeks of training pre-season. Duration Sleep more short at night before session exercise morning compared to afternoon session (-42 minutes, $p < .029$) (Jensen *et al.*, 2016) Mah *et al.* also reported an impact of time from start of the morning to duration of sleep alone in 628 college athletes (20 ± 1 year), with 71% of the team showing duration less sleep on average of 7 hours and time reported wake-up before 07:30, which is no direct influence of time from start of training to duration of sleep (Mah *et al.*, 2018).

CONCLUSIONS AND RECOMMENDATIONS

Based on this research, it can be concluded that there is an increase in oxidant levels (MDA) and insomnia at night. Meanwhile, levels of the hormone melatonin were higher in athletes who exercised in the morning. A part of this is that stress levels did not differ significantly between athletes who trained in the morning or evening.

Research limitations

This research was only conducted on junior athletes and did not involve senior athletes. In this study, we only looked at oxidant levels after exercise but did not compare them with antioxidant levels.

Suggestion

Future research should look at oxidant levels, inflammation, and muscle damage in senior athletes as well. Future research should compare oxidant and antioxidant levels in athletes and non-athletes who train in the morning and evening.

AUTHOR CONTRIBUTIONS

AA, MAA, ARAA, MU, NR, AYD, AIZR, WU and FU conceived the study. AIZR, WU, FU collected samples and prepared the initial draft of this manuscript. AA, MAA, ARAA, MU, NR, AYD, MIB, RR, MER conducted further reviews and provided scientific input on this manuscript. All authors read and approved the final manuscript.

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DISCLOSURE STATEMENT

No potential conflict of interest were reported by the author.

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