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Impact of time-of-day on judo-specific performance

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ORIGINAL PAPER

Abstract

In judo tournaments, matches for each weight category are held on the same day and athletes competing at the finals have to compete at different times of the day. This study aimed to investigate the effect of time-of-day on judo specific performance and the changes in physiological load following judo specific performance. Fourteen male judo athletes (age 19.1±1.4 years) voluntarily participated in the study. At the 1st visit, anthropometrical measurements and familiarization procedures were conducted and the athletes' chronotype was determined. Athletes performed the Special Judo Fitness Test (SJFT) during 2nd and 3rd visits. Athletes randomly performed two consecutive SJFTs with 15 min intervals at 10:00h, which is the official start time of matches, and at 18:00h which is the time when the finals start. During SJFT applications, athletes heart rate (HR), blood lactate (bLA), body temperature and rate of perceived exertion (RPE) were monitored. The changes in total throw numbers ($F_{1, 13}$= 1.32, p=0.27) and SJFT index ($F_{1, 13}$= 0.30, p=0.59) were not different between morning and evening. There were similar changes in bLA ($F_{4, 52}$=0.66, p=0.63), RPE ($F_{1, 13}$=1.42, p=0.26) and body temperature ($F_{1.4, 18.0}$=1.18, p=0.31) which were measured before and after the tests. However, HR measured in the evening were higher compared to morning measurement at all measurement times ($F_{1, 13}$=10.28, p=0.01), but there was no difference in SJFT throws ($F_{3.8, 48.8}$=0.49, p=0.74). In conclusion, different times of the day did not affect judo specific performance as well as physiological variables in judo athletes.

Keywords: Martial arts; combat sports; judo; chronotype; special judo fitness test.

Impacto de la hora del día en el rendimiento específico de judo

Resumen

En los torneos de judo, los combates de cada categoría de peso se disputan en el mismo día, y los atletas que compiten en las rondas finales deben hacerlo en diferentes momentos de la jornada. Este estudio tuvo como objetivo investigar el efecto de la hora del día en el rendimiento específico del judo y los cambios en la carga fisiológica tras haber desarrollado un esfuerzo específico de judo. Catorce judokas masculinos (edad 19,1 ± 1,4 años) participaron voluntariamente en la inestigación. En la 1ª visita se realizaron medidas antropométricas, procedimientos de familiarización y se determinó el cronotipo de los atletas. Los judokas realizaron el Special Judo Fitness Test (SJFT) durante la segunda y tercera visita. Realizaron aleatoriamente dos SJFT consecutivos con intervalos de 15 min a las 10:00 h, hora oficial de inicio de los combates, y a las 18:00 h, hora de inicio de las finales. Durante las aplicaciones del SJFT, se monitoreó la frecuencia cardíaca (HR), el lactato en sangre (bLA), la temperatura corporal y el índice de esfuerzo percibido (RPE) de los atletas. Los cambios en el número total de proyecciones ($F_{1, 13}$ = 1,32, p

Impacto da hora do dia no desempenho específico do judo

Resumo

Nos torneios de judo, as lutas de cada categoria de peso são disputadas na mesma jornada, e os atletas que competem nas provas finais devem fazê-lo em horários diferentes do dia. Este estudo teve como objetivo investigar o efeito da hora do dia no desempenho específico do judo e nas mudanças na carga fisiológica após a realização do desempenho específico do judo. Quatorze judocas do sexo masculino (idade 19,1 ± 1,4 anos) participaram voluntariamente do estudo. Na primeira visita foram realizadas medidas antropométricas e procedimentos de familiarização, e determinado o cronótipo dos atletas. Os judocas realizaram o Special Judo Fitness Test (SJFT) durante a segunda e terceira visita. Eles realizaram aleatoriamente dois SJFTs consecutivos com intervalos de 15 minutos às 10h, horário oficial de início das lutas, e às 18h, horário de início das finais. Durante as aplicações do SJFT, foram monitorizados a frequência cardíaca (HR), o lactato sanguíneo (bLA), a temperatura corporal e a taxa de perceção de esforço (RPE) dos atletas. As mudanças no número total de projeções ($F_{1, 13}$ = 1,32, p = 0,27) e no

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= 0,27) y el índice SJFT ($F_{1, 13}$ = 0,30, p = 0,59) no fueron diferentes entre la mañana y la tarde. Hubo cambios similares en bLA ($F_{4, 52}$ = 0,66, p = 0,63), RPE ($F_{1, 13}$ = 1,42, p = 0,26) y temperatura corporal ($F_{1.4, 18.0}$ = 1,18, p = 0,31), medidos antes y después de las pruebas. Sin embargo, la HR medida por la noche fue más alta que la medida por la mañana en todos los momentos de medición ($F_{1, 13}$ = 10,28, p = 0,01), pero no hubo diferencia en las proyecciones del SJFT ($F_{3.8, 48.8}$ = 0,49, p = 0,74) . En conclusión, los diferentes momentos del día no afectaron al rendimiento específico del judo ni a las variables fisiológicas de los judokas.

Palabras clave: Artes marciales; deportes de combate; judo; cronotipo; special judo fitness test.

índice SJFT ($F_{1, 13}$ = 0,30, p = 0,59) não foram diferentes entre a manhã e a tarde. Houve mudanças semelhantes em bLA ($F_{4, 52}$ = 0,66, p = 0,63), RPE ($F_{1, 13}$ = 1,42, p = 0,26) e a temperatura corporal ($F_{1.4, 18.0}$ = 1,18, p = 0,31), medidos antes e após os testes. No entanto, a FC medida à noite foi maior do que a medida pela manhã em todos os momentos ($F_{1, 13}$ = 10,28, p = 0,01), mas não houve diferença nas projeções realizadas no SJFT ($F_{3.8, 48.8}$ = 0,49, p = 0,74). Em conclusão, os diferentes horários do dia não afetaram o desempenho específico do judo ou as variáveis fisiológicas dos judocas.

Palavras-chave: Artes marciais; desportos de combate; judo; cronótipo; special judo fitness test.

1. Introduction

Judo is an Olympic combat sport where both aerobic and anaerobic energy metabolisms are used, and which includes short-term high intensity activities (Franchini et al., 2003; Julio et al., 2017). Judo matches consist of 30 seconds high intensity efforts interspersed by 10 seconds intervals (Franchini et al., 2011b). Athletes should perform techniques that require short-term maximal actions to be successful during judo matches (Miarka et al., 2016). Therefore, anaerobic system is predominant in judo and anaerobic glycolysis system is of great importance for judo performance (Degoutte et al., 2003).

Different times of the day could affect exercise performance (Souissi et al., 2004; Teo et al., 2011; Ammar et al., 2017). There are findings stating that short-term maximal performance is better in the afternoon compared to morning especially due to factors such as sleep, warm-up, body temperature (Hill et al., 1992; Souissi et al. 2007, 2010, 2013a). Judo tournaments start in the morning for each weight category and end in the same day. Preliminary rounds are held in the morning and afternoon while the final block starts in the evening (Ceylan et al., 2020; IJF, 2022). Especially athletes who qualify for the finals can perform matches during different times of the day. There are conflicting findings related to the effect of different times of the day on judo performance. Chtourou et al. (2013) suggested that the performance presented on different days cannot provide an insight into the changes in judo performance and investigated short-term maximal performance pre and post matches held at different times on the same day in judo athletes. However, the time-of-day effect was not presented per se due to the study design. The researchers indicated higher anaerobic performance in the afternoon compared to morning, but these differences disappear after a judo match. Muscle fatigue can be caused by the matches comprising high-intensity interval activities on the same day. Therefore, it might not be possible to present the effect of the time-of-day on exercise performance. Moreover, as the exercise intensity during judo matches is not standard, comparison of the matches implemented at different times on different days would not be appropriate. In another study, Souissi et al. (2013a) reported better anaerobic power in judo athletes in the afternoon compared to morning on the same day. However, sleep deficiency suppressed this difference. It seems impossible to investigate solely the time-of-day effect on performance because of successive supramaximal tests and/or judo matches on the same day which also resulted in fatigue in athletes. Unlike abovementioned findings, the short-term repetitive maximal performance in elite judo athletes was not affected by different times of the day (Chtourou et al., 2018).

Therefore, there are conflicting findings related to the time-of-day effect on judo performance by a limited number of studies. Moreover, some of these studies could not reveal the effect of time-of-day on judo performance due to fatigue resulting from high-intensity exercise tests performed in the morning, afternoon, and evening within the same day. It is important to implement performance test on different days rather than on the same day to evaluate the effect of the time-of-day on judo performance and to eliminate possible effect of fatigue following the tests. Accordingly, the aim of this study was to investigate the changes in performance and physiological outputs between morning and evening in judo athletes in different days. The study hypothesized that athletes' performance and physiological responses would be affected by the different times of the day.

2. Material and methods

2.1. Participants

Fourteen male judo athletes whose characteristics can be found in Table 1 voluntarily participated in the study. The *tori* (executor) and *uke*s (those who perform the technique) were chosen from the same weight category for the Special Judo Fitness Test (SJFT) as judo performance is affected by body mass and anthropometric characteristics (Franchini et al., 2011b). The inclusion criteria for the study were as follows: a) participating in official tournaments (i.e. national championships, European Championships, Continental Cups) for the last 2 years, b) training at least 3 times per week and free from any injury for the last 3 months, c) holding at least brown belt, d) older than 18 years old and younger than 27 years old, e) having at least 6 years of judo experience.

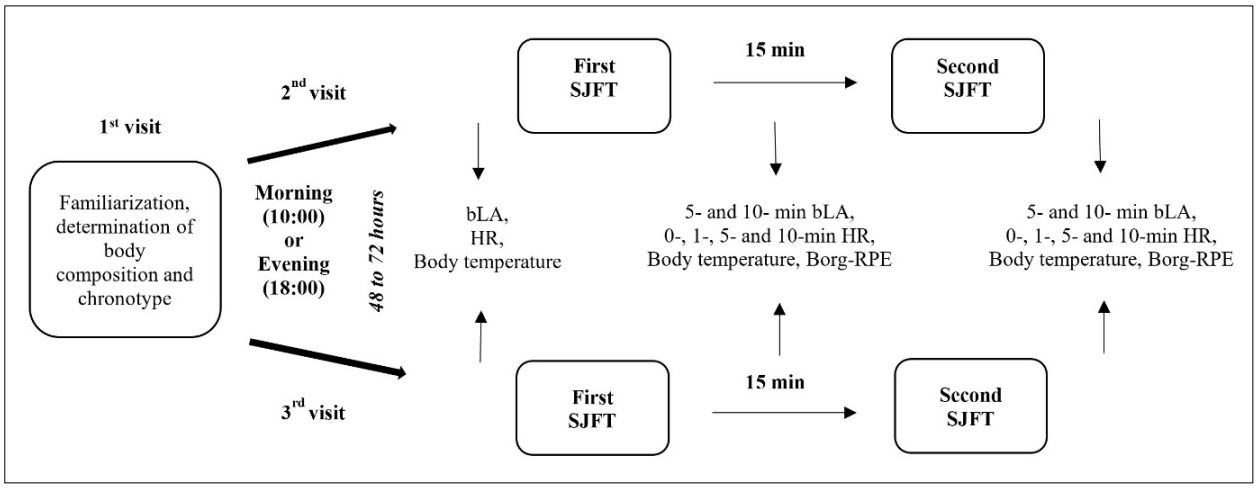
Table 1. Physical characteristics of the participants (n = 14).

Variables	***M* ± *SD***	**%95 CI**
Age (year)	19.1 ± 1.4	18.3 - 19.9
Body height (cm)	176.2 ± 9.3	170.8 - 181.6
Body mass (kg)	75.9 ± 11.9	69.0 - 82.8
Body mass index (kg·m^{-2})	24.4 ± 2.9	22.7 - 26.1
Fat percent (%)	13.0 ± 3.5	11.0 - 15.0
Judo experience (year)	9.6 ± 2.7	8.0 - 11.1

The study was carried out in accordance with the latest version of the Declaration of Helsinki. Ethical approval was obtained from local Non-invasive Clinical Ethical Board (2020/80). Athletes were informed about the nature of the study in detail and signed informed consent form was obtained from each participant.

2.2. General Design

The athletes visited judo hall 3 times for the study. During the first visit, athletes were informed about the tests that would be implemented and familiarization was carried out and also athletes' chronotype was determined, and anthropometrical measurements were obtained. During the 2nd and 3rd visits, which were carried out with at least 48h and at most 72h rest intervals, athletes executed two consecutive SJFT with 15 min intervals. SJFTs were implemented randomly for each athlete in the morning and evening at 10:00h and 18:00h, which is usually the time when the preliminary rounds and finals start during official judo competitions, respectively.



SJFT; special judo fitness test, bLA; blood lactate concentration, Borg-RPE; Borg's Rating of perceived exertion, HR; heart rate

Figure 1. Experimental design.

Body temperature, heart rate (HR) and blood lactate concentration (bLA) were measured before and after SJFT applications. Rate of perceived exertion (RPE) was measured immediately after

the tests. Athletes were instructed to sleep at least 8 hours before the measurements and refrain from any exhaustive exercise the day before the measurements. Moreover, athletes were also told to refrain from alcohol and caffeine intake 24h before the measurements and any heavy food intake 2h before the measurements.

2.3. Experimental Design

- *Body composition*: Body height was measured in a standing position barefoot to the nearest 0.1 cm using a stadiometer and body mass was measured with a digital scale to the nearest 0.1 kg (Seca 213, Germany). A researcher with extensive testing experience conducted biceps, triceps, subscapular and suprailiac skinfold measurements using a caliper (Holtain, UK) and athletes' body fat percentage calculated from body density with Siri's equation (Durnin & Womersley, 1974).
- *Chronotype*: 'Morningness–Eveningness Questionnaire (MEQ)' which was developed by Horne and Ostberg (1976) and adapted into Turkish by Pündük et al. (2005) was used to determine athletes' chronotypes.
- *Special Judo Fitness Test*: SJFT was used to simulate judo match performance. It presents the similar physiological responses following a judo match and has positive relationships with performance parameters in competition (e.g. effective combat time and the number of attacks) (Ceylan & Balci, 2018). Three athletes of similar body weight and height performed the SJFT according to the following protocol: two judokas (*uke*) were positioned at a distance of 6 m from each other, while the test executor (*tori*) was positioned 3 m from the judokas to be thrown. The procedure was divided into three periods − 15 s (A), 30 s (B) and 30 s (C) − with 10-s intervals between them. In each period, the executor threw the opponents using the ippon-seoi-nage technique as many times as possible. Performance was determined based on the total throws completed during each of the three periods (A + B + C). The heart rate (HR) was measured with an HR monitor (Seego, Realtrack Sytems, Spain) immediately after the test and then 1 min later to calculate the index using the following equation:

$$\text{Index (bpm.throws}^{-1}) = \frac{\text{final HR (bpm) + HR at 1 min after the test (bpm)}}{\text{Number of throws}}$$

  Reliability values (ICC) of the number of throws and index have been previously reported as 0.73 and 0.88, respectively (Franchini et al., 2010).
- *Heart rate and blood lactate measurements*: Resting bLA and HR of the athletes were measured following a 30 min rest in the supine position. Immediately, 5 and 10 minutes following each SJFT application bLA and HR was measured again. LA was measured with a lactate device (Edge Blood Lactate Monitoring System, ApexBio Inc., Taiwan) by the same experienced researcher. Before each measurement, the site was cleaned with alcohol and dried with cotton, obtaining a 0.3 µl blood sample from the fingertip of the middle finger. HR was monitored with an HR monitor (RS300X, Polar, Finland).
- *Body temperature*: Before and after each test, athletes' body temperature was measured with a digital thermometer on the athletes' forehead. Before each measurement, athletes' forehead was cleaned with a clean cloth.
- *Rating of Perceived Exertion*: Immediately after each SJFT, athletes rated the perceived exertion (RPE) using the Borg scale. The RPE scale allows athletes to present a subjective exertion rate for the exercise on a 15-point RPE scale, ranging from 6 (very light) to 20 (very hard) (Chen et al., 2002; Bromley et al., 2018).

2.4. Statistical Analysis

The data normality was checked with the Shapiro-Wilk test and descriptive methods using skewness and kurtosis coefficients (Ghasemi & Zahediasl, 2012). Descriptive statistics were used to present subjects' characteristics. 95% confidence intervals (CI) were also provided. Two-way repeated measures ANOVA (morning-evening measurements × repeated measures for each variable) was used to investigate the differences in total throw numbers, SJFT index, RPE (2×2), body

temperature (2×3), bLA (2×5), HR (2×9) measured before, during and/or after the SJFT applications. Sphericity was tested with Mauchly's sphericity test, and when sphericity was violated Greenhouse-Geisser correction was used. Eta squared (η2) was used to determine effect size (ES), using the 0.0099, 0.0588, and 0.1379 considered as small, medium, and large effect sizes (Cohen, 1988). Analysis was carried out using Statistical Package for Social Science (SPSS Inc. Chicago, USA) 16.0 software. Significance was set at $p<0.05$.

3. Results

72% of the athletes were classified as intermediate type, 21% of them were classified as morning type and 7% was evening type. However, none of the athletes was neither fully morning nor evening type.

The change in the total number of throws in the first and second SJFT applications was similar in morning and evening ($F_{1, 13} = 1.32$, $p = 0.27$). There was no significant main effect of different times of the day ($F_{1, 13} = 2.59$, $p = 0.13$) and two consecutive SJFT applications interspersed by 15 min ($F_{1, 13} = 0.10$, $p = 0.76$) on the number of throws (Figure 2A).

As seen in Figure 2B, the main effect of two consecutive SJFT applications was significant on SJFT index ($F_{1, 13} = 4.97$, $p = 0.04$, $\eta^2 = 0.10$, ES = Medium). Following the first applications, SJFT performance decreased. However, there was no main effect of different times of the day on SJFT index ($F_{1, 13} = 0.80$, $p = 0.78$), there was also non-significant interaction effect of SJFT applications and different times of the day on SJFT index ($F_{1, 13} = 0.30$, $p = 0.59$).

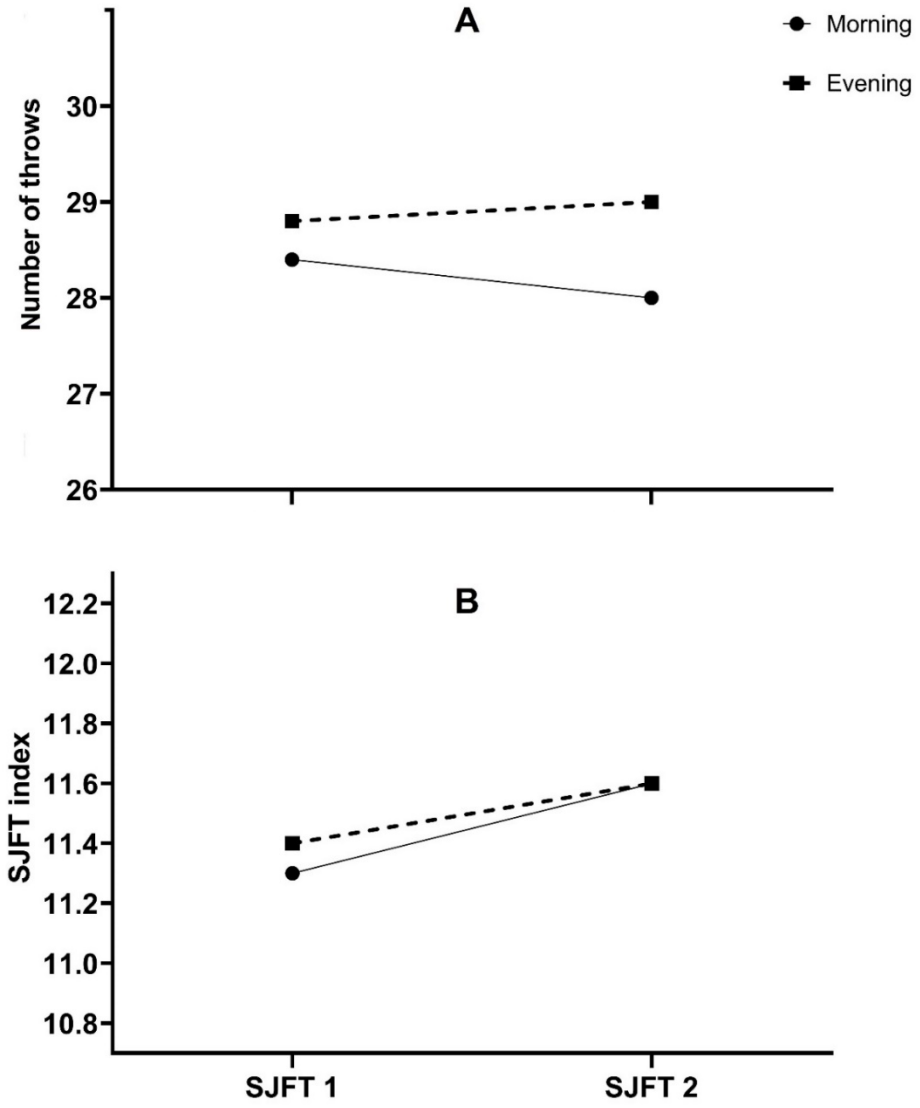


Figure 2. The total throw numbers and index for SJFT at the morning and evening.

The bLA increased significantly following second SJFT applications compared to first SJFT applications ($F_{2.3, 29.8} = 282.70$, $p < 0.001$, $\eta^2 = 0.94$, ES = Large). There was no main effect of different times of the day on bLA ($F_{1, 13} = 1.34$, $p = 0.27$). Moreover, the changes in bLA following SJFT applications during morning and evening were similar ($F_{4, 52} = 0.66$, $p = 0.63$).

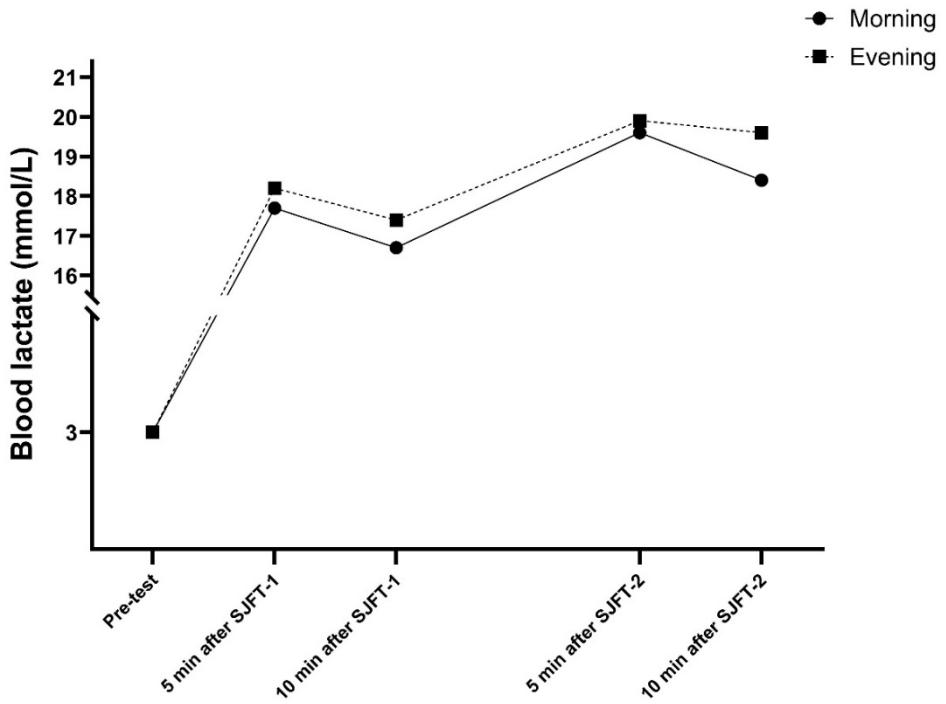


Figure 3. The changes in blood lactate during the experiments.

There was significant main effect of different times of the day on HR ($F_{1, 13} = 10.28$, $p = 0.01$, $\eta^2 = 0.002$, ES = Small). Mean HR values measured in the morning were found higher compared to those monitored in the evening. As expected, two consecutive SJFT applications significantly increased HR ($F_{2.6, 33.4} = 587.9$, $p < 0.001$, $\eta^2 = 0.97$, ES = Large). However, the changes in HR during morning and evening SJFT application were found similar ($F_{3.8, 48.8} = 0.49$, $p = 0.74$) (Figure 5).

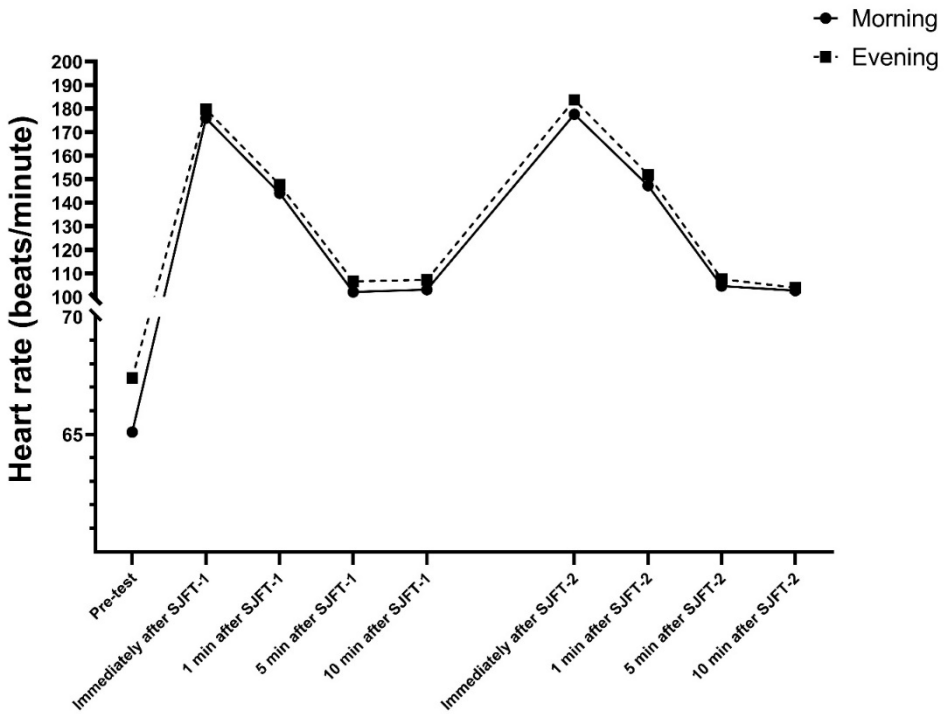


Figure 4. The changes in heart rate during the experiments.

The main effect of SJFT applications on body temperature was significant ($F_{2, 26}$ = 86.4, p < 0.001, η^2 = 0.77, ES = Large). The body temperature decreased following the SJFT applications. However, there was no main effect of different times of the day on body temperature ($F_{1, 13}$ = 1.71, p = 0.21). Moreover, the changes in body temperature before and after the SJFT applications were found similar in the morning and evening ($F_{1.4, 18.0}$ = 1.18, p = 0.31) (Table 2).

There was a significant main effect of SJFT applications interspersed by 15 min on RPE ($F_{1, 13}$ = 16.44, p < 0.001, η^2 = 0.25, ES = Large). Athletes presented higher RPE scores following second SJFT application. However, there was no main effect of different times of the day on RPE ($F_{1, 13}$ = 0.39, p = 0.54), the SJFT applications performed in the morning and evening resulted in the similar RPE responses ($F_{1, 13}$ = 1.42, p = 0.26) (Table 2).

Table 2. Change in body temperature and rate of perceived exertion (RPE) during the experiment

Variables		Morning		Evening	
		M±SD	%95 CI	M±SD	%95 CI
Body temperature (C°)	Pre-test	36.9±0.3	36.7-37.0	37.0±0.4	36.8-37.2
	After first SJFT	36.2±0.1	36.1-36.3	36.2±0.2	36.1-36.3
	After second SJFT	36.1±0.3	35.9-36.2	36.2±0.2	36.1-36.3
RPE	After first SJFT	14.0±2.3	12.7-15.3	13.2±2.1	12.0-14.4
	After second SJFT	15.1±2.8	13.5-16.8	15.3±2.1	14.1-16.5

4. Discussion

There are numerous studies reporting better anaerobic performance in the evening compared to morning. Anaerobic power is an important component of judo performance and SJFT provides both aerobic and anaerobic performances of judo athletes (Detanico & Santos, 2012; Ceylan & Balci, 2018) and thus SJFT was used to monitor the changes in performance of judo athletes during morning (10:00 h) and evening (18:00 h) applications. The main finding of the study was that judo specific performance did not differ at different times of the day. SJFT total number of throws and index scores were found similar in the morning and evening. Moreover, there were similar changes in athletes' bLa, RPE and body temperature responses measured before and after SJFT applications during morning and evening hours. Only HR values were higher in the morning compared to evening at all measurement times, but the HR changes during SJFT applications were found similar.

In the numerous studies applied to individuals from different physical fitness levels, findings indicate that anaerobic power is higher in the afternoon and evening (Kin İşler, 2005; Souissi et al., 2007; Hill & Chtourou, 2020; Mirizio et al., 2020; Ünver & Atan, 2021). However, in the current study, there was no difference in SJFT total number of throws between morning and evening. Also, there was no time-of-day effect on SJFT index, the changes in specific judo performance (index score), and two consecutive SJFT were similar between morning and evening. Similarly, Chtourou et al. (2018) reported that multiple jump and sprint performance were the similar in elite judo athletes in the morning (07:00 h) and in the evening (17:00 h). Contrary to the results of our study**,** Chtourou et al. (2013) emphasized that judo matches are completed on the same day, and it is not logical to evaluate the effect of the time-of-day on judo specific performance on different days. The authors implemented Wingate tests before and after the judo matches in the morning, afternoon and evening and stated that athletes presented better mean and peak power in the evening (16:00 h) compared to morning (09:00 h). Nevertheless, athletes' performance during a 5 min judo match is not standardized, and the authors also did not present any data related to the effort presented by the athletes. Six Wingate tests and three judo matches performed on the same day most probably could affect the performance of the athletes independent of the effect of time-of-day. In another study, mean and peak power of the judo athletes were found higher in the evening compared to morning, but caffeine intake was indicated to decrease this difference in the performance (Souissi et al., 2013b). All exercise applications were performed on the same day in the studies mentioned above. The possible fatigue following the high-intensity exercise tests can be the main factor affecting exercise performance. In study designs where the time-of-day effect on anaerobic power was investigated, exercise tests, which were implemented in morning, afternoon, and evening were performed on different days to eliminate the possible effect of fatigue (Kin İşler, 2005, 2006; Pense

et al., 2019; Ünver & Atan, 2021). Also, the training time-of-day and chronotype may also have an influence on these results. Most of the athletes participating in this study were intermediate type and had experience of training both in the morning and evening. In this context, the results of the current research show that judo performance was not affected by different times of the day.

Circadian rhythm led to differences in cardiovascular variables at different times of the day (Vandewalle et al., 2007). In the current study, the athletes' HR were found higher in the evening compared to morning, but the changes in HR during SJFT applications were similar. There are conflicting findings related to effect of time-of-day on HR (Kurt et al., 2010; Ünver & Atan, 2021). Kurt et al. (2010) indicated no difference in HR at rest and and during exercise in trained young individuals between morning and evening. Another study (Ünver & Atan, 2021) reported similar changes in HR following Wingate test at different times of the day (09.00 h – 14.00 h – 19.00 h).

In our study, the changes in bLA before and after SJFT executed in the morning and evening were found similar in line with the performance outputs. There are divergent results in the literature regarding the effect of time-of-day on the bLA response to exercise. Kin İşler (2006) indicated that different times of the day affected anaerobic performance but did not affect bLA at rest and following the exercise. However, Kurt et al. (2010) reported similar performance during short-term maximal running exercise in trained young individuals between morning and evening although the authors stated higher rest and post-exercise bLA following exercise in the evening compared to morning. In young soccer players, bLA was found higher in the evening compared to morning in line with changes in the performance (Hammouda et al., 2011). In another study applied to soccer players, although peak anaerobic power was found higher in the afternoon compared to morning and evening, the changes in bLA was found similar (Ünver & Atan, 2021). It was stated that the different times of the day did not affect bLA before exercise but peak bLA was higher in the evening compared to morning in line with the increase in the exercise performance following the exhaustive exercises (Souissi et al., 2020). The effect of the time-of-day on the changes in exercise performance and bLA was not compatible. This could have stemmed from the differences in the percentage of the predominant energy systems used during the exercises as well as the differences in the intervals for blood sample collections following the exercise. Also, the different results can be explained by the fact that the participants were at different levels of performance.

The changes in exercise performance at different times of the day have been associated with the increase in body temperature (Blake, 1967; Bernard et al., 1997; Souissi et al., 2007). Nonetheless, there are studies indicating no relationship between exercise performance and the changes in body temperature due to the different times of the day (Kin İşler, 2005, 2006; Waterhouse et al., 2005; Pense et al., 2019). The results of the present study show that there was no effect of different times of the day on the changes in both judo specific performance and body temperature. The athletes' body temperate decreased following the tests and this change was similar at all test times. It is thought that the decrease in skin temperature was due to sweating. Deschenes et al. (1998) indicated higher body temperature at rest and during the exercise in the evening compared to morning regardless of the maximal and submaximal exercise performance. The studies mentioned above show that although body temperature is higher in the evening than morning, this difference does not affect exercise performance. Moreover, the results of these studies should be handled with caution as different methods used to monitor body temperature could affect the results (Pense et al., 2019).

As expected, the RPE responses of the athletes following 2nd SJFT was higher than following the 1st test. However, this difference was similar in the morning and evening. Athletes' SJFT performances and physiological outputs did not differ at different times of the day. Similar findings were suggested by previous studies (Deschenes et al., 1998; Souissi et al., 2020). There are conflicting findings related to effect of time-of-day on RPE. There is no consistent relationship between performance differences or similarities and RPE (Trine & Morgan, 1995; Souissi et al., 2020). This may have resulted from the differences in research protocols.

This study had some limitations. There is relationship between chronotype, and exercise performance performed at different times of the day (Knajer et al., 2019). In the current study, most of the athletes were intermediate type while there was not fully morning or evening type. Therefore, the effect of chronotypes of the athletes on the study's findings was limited. Moreover, the accustomedness to the training hours could also affects exercise performance (Rae et al., 2015;

Knaier et al., 2019). Some of the athletes in the current study had trainings in both morning and evening while some had only in the evenings. This difference may affect the study findings. Besides, although all the athletes participated in trainings in the evening, the similarity in the performance in the morning and evening is an important finding.

6. Conclusions

Unlike the hypothesis of the current study, the findings revealed that the different times of the day does not affect judo specific performance as well as bLA, HR, RPE and body temperature before and during the tests and during recovery. Given the chronotypes of the participants, the participation in the trainings at times that are not in line with their chronotypes could decrease the effect of the different times of the day.

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