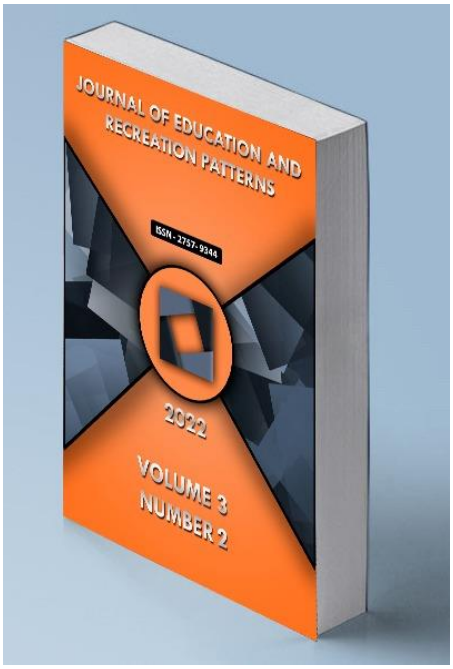

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ABSTRACT

Purporse: Different methodologies are applied to increase the performance of athletes in sports involving high-intensity activities. Some of these methodologies can be listed as massage applications used before sports activities and listening to music. Listening to music with pre-competition massage treatments can have an impact on performance, but the effect of massage and listening to music during and after Ramadan may arouse curiosity. The aim of this study is to determine the effect of massage and massage + music protocols applied during and after Ramadan on Running-Based Anaerobic Sprint Test Performance (RAST).

Methods: Twenty athletes (age, 21.30± 1.49 years; height, 175.10± 2.51 cm; 74.50± 2.79 kg; BMI 24.30±.75) who exercise regularly participated in the study. The study was carried out using four different protocols during the month of Ramadan (massage/massage+music) and after (massage/massage+music) after a 5-minute warm-up at 72-hour intervals. RAST was applied after massage applications and maximum, minimum, average power and FI values were evaluated after RAST.

Results: It showed that ARMM protocol values were more effective than RM, ARM and RMM protocols.

Conclusions: Massage+listening to music before performing RAST can be recommended to coaches and athletes.

Keywords: Fasting, Massage, Music, Running Based Anaerobic Sprint Test

INTRODUCTION

Muslims are required to abstain from eating, drinking, smoking, and even sexual activity from sunrise to sunset during the month of Ramadan, which is one of the five most essential rules (five conditions) of Islam and the holiest month of the year (Roky et al., 2004; Chaouachi et al., 2009; Waterhouse, 2010). Since Ramadan fasting involves abstinence from food and drink for approximately 13-18 hours every day for 29-30 days (Azizi, 2010; Mosaferchi et al., 2020), changes in nighttime sleep duration and sleep patterns (Taoudi et al., 1999; Margolis & Reed, 2004), general fatigue that may occur during daily physical activity (Ben Salama et al., 1993), abnormalities in the immune system, hypohydration, and decreased psychomotor performance can be observed (Chamari et al., 2019). Although some researchers reported that fasting causes a decrease in physical performance (Zerguini et al., 2007; Meckel, Ismaeel, & Eliakim, 2008; Wilson, Drust, & Reilly, 2009a; Chtourou et al., 2011a), fasting did not observe significant performance decreases (Gueye et al., 2003; Karli et al., 2007; Chaouachi et al., 2009; Ferguson et al., 2009). For example, Zerguini et al., (2007) stated that more than 70% of professional football players had a negative impact on their training and performance during fasting, while Kirkendall et al., (2008) stated that football players had little effect on their physical performance during fasting. Along with determining the aerobic and anaerobic capacities of the athletes by the trainers and sports scientists, one of the most important conditions is to maximize their current capacity. For example, after the resistance training program applied to the athletes, there was an increase in the sprint capacity and anaerobic power of the athletes (MacDougall et al., 1977; Slade et al., 2002; Chromiak et al., 2004; Pennington, 2021), in addition, after electromyostimulation (EMS) training as a different training model It has also been stated that there is an increase in anaerobic capacity (Miyamoto et al., 2016). In addition to the applied training programs, one of the most important applications used by the athletes in order to increase the current capacity is massage. Massage is widely used to contribute to the increase in performance before and after exercise (Ogai et al., 2008; Arroyo-Morales et al., 2011). Studies have shown that massage facilitates performance after anaerobic running and is effective in removing lactic acid after anaerobic exercise (Micklewright et al., 2005; Budak et al., 2020). In addition, depending on the content of the studies carried out, besides the development of the physical capacity of the athletes, it also contributes to the psychological optimum performance. For example, the use of music in the field of exercise, which has features such as increasing attention capacity, changing and raising mood, and increasing work efficiency, is increasing (Terry et al., 2006; Brooks & Brooks, 2010; Hutchinson et al., 2011; Rad & Hafezi, 2013). Methods such as warming up, stretching, music and visual feedback before competitions are essential to improve athletic performance. Many athletes like to listen to music and train at high intensity while warming up (Castañeda-Babarro et al., 2020). Music is an external resource that can be used to increase the ergogenic effect of a wide variety of exercise modes and intensities (Nakamura et al., 2010; Ballmann et al., 2018). Additionally, it has been shown that changes in mood, motivation, warm-up rate, and arousal of music can result in performance gains (Hayakawa et al., 2000; Ballmann et al., 2018). However, it is not known how preference affects the above-mentioned mechanisms, especially during anaerobic exercise. Predetermined music use was used to study the association between music and anaerobic exercise, with varying degrees of success(Pujol & Langenfeld, 1999; Simpson & Karageorghis, 2006).

Although both music and massage are frequently employed by athletes, they have differing benefits on performance. Regarding the performance parameters of the athletes during Ramadan, it is clearly evident that there are varied results. The effects of massage and massage accompanied by listening to music during and after Ramadan can be studied by trainers and sports scientists. As a result, the purpose of this study is to look at how applying massage and

massage combined with listening to music can affect RAST performance both during and after Ramadan.

METHOD

Participants

The power analysis program G*Power (version 3.1.9.3, Germany) was used to determine the study group. As a result of the power analysis (confidence interval=.95, alpha value=.05 and beta value=.80, and effect size value=.60) it was determined at least 12 athletes who regularly exercise should be included in the study(Faul et al., 2007). According to the World Health Organization (WHO) criteria, the 18-25 age group (age, 21.30± 1.49 years; height, 175.10± 2.51 cm; 74.50±2.79 kg; BMI 24.30±.75) who regularly exercise and in the study regularly participate 20 people participated (WHO, 2020). The inclusion criteria for study participants were as follows: (a) performing regular exercise (at least 150-300 minutes of moderate-intensity physical activity per week or at least 75-150 minutes of vigorous aerobic physical activity); (b) not having a history of disability that would affect the result of the study; (c) ensuring regular participation in the study; (d) obeying the investigators' commands throughout the course of the study; and (e) not having a known skin allergy. The exclusion criteria were as follows All of the people who volunteered to take part in the research were provided with the pertinent information regarding the requirements and potential dangers associated with the study, and they all signed a document indicating that they did so of their own free will. During the course of the study, participants were given the directive to continue their normal level of physical activity; however, they were advised to refrain from engaging in any severe activities for the preceding twenty-four hours. During the course of the research project, the people who agreed to take part were given the strict directive not to use any kind of medication, including anabolic steroids, other hormones, metabolic modulators, diuretics, non-steroidal anti-inflammatory medications (NSAIDs), etc. Before beginning the investigation, the appropriate consent was received from the Malatya Inonu University Non-Invasive Clinical Research Ethics Committee (Ethics Committee Protocol Number: 2022/3535).

Experimental Design of the Study

Participants in the study were all compiled into one group to begin with. In total, four distinct massage protocols were used for the measurements, and each procedure was separated by a rest period of 72 hours. These massage regimens were utilized before, during, and after the holy month of Ramadan (Bowers, Foss, & Fox, 2012). The findings of previous studies suggest that the benefits of Ramadan on sprint performance may last for at least two weeks after the end of Ramadan even if the holy month of fasting has ended (Girard & Farooq, 2012; Boukhris et al., 2022). Because of this situation, the study was carried out in the middle of Ramadan (on the last 15 days) and two weeks after Ramadan in order to ensure the sufficient effect of the month of Ramadan in the people who participated in the study. After the massage, the Running-Based Anaerobic Sprint Test (RAST) (6x35m) measurements of the participants were taken. All protocols were performed at the same time of the day (15:00-17.30) in order to avoid the effects of the circadian rhythm and to be the hours when the effect of Ramadan fasting increased (Souissi et al., 2004). Protocols created accordingly;

a) ***Time of massage during Ramadan (RM);*** RAST measurements after 5 minutes of jogging (40% HR) and 10 minutes of massage,

b) ***Massage+listening to music during Ramadan (RMM);*** RAST measurements after 5 minutes of jogging (40% HR) and 10 minutes of music+massage,

c) ***Massage time after Ramadan (ARM);*** RAST measurements after 5 minutes of jogging (40% HR) and 10 minutes of massage,

d) ***Massage+listening to music after Ramadan (ARMM);*** RAST measurements after 5 minutes of jogging (40% HR) and 10 minutes of music+massage.

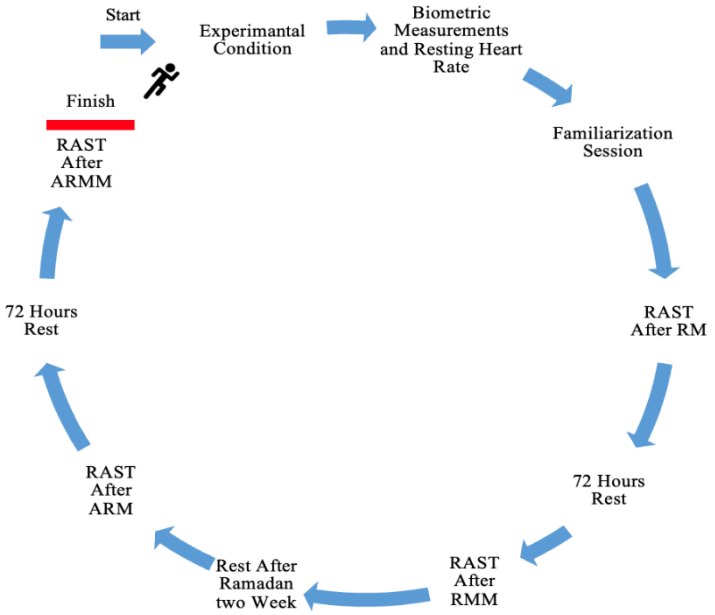

Figure 1. *Experimental Design*

Anthropometric Measurements

The volunteers' (SECA® Gmbh, Hamburg, Germany) ankles, calves, hips, scapulae, and head were measured while they stood barefoot and against a wall. Frankfurt's scale model had a head position indicator and a height gauge that activated with each exhale. Participants weighed themselves while wearing minimal clothing (Toledo 2096 PP, So Bernardo do Campo, Brazil). BMI was determined by dividing weight (in kilogrammes) by height (m^2) (Sales et al., 2018).

Running-Based Anaerobic Sprint Test (RAST)

Minimum, maximum, average power (W), and fatigue index (FI) are all components of the RAST test, which measures an athlete's anaerobic performance capacity. The test entails six maximal sprints of 35 metres separated by 10-second rest intervals (Zagatto, Beck, & Gobatto, 2009). As a result of the test, W and FI were calculated as previously suggested (Buchheit, 2005). Maximum, minimum, and average power levels as well as FI values were determined by the computations. All measures were taken within a gym to eliminate the possibility of ambient influences influencing research subjects' performance. During the trial, the temperature ranged from 18 degrees to 200 degrees Fahrenheit, and there was no breeze. Participants' RAST values were recorded using infrared photocell gates (Witty, Micro Gate System, Mahopac, NY, USA) spaced at 35-m intervals, with the test administered following a series of massage procedures. In order to reach the highest values during the test (Andrade et al., 2015; Sales et al., 2018), verbal motivational support was given to the participants during each run (35m).

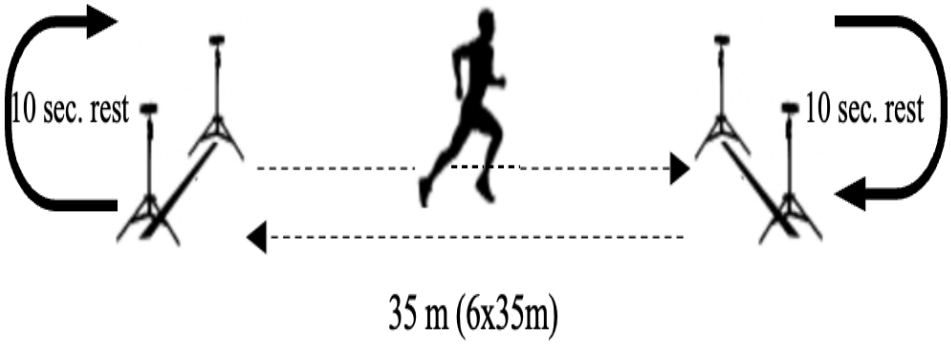

Figure 2. *Scheme of RAST procedures.*

Massage Protocols

Researchers used four distinct Swedish massage techniques on the study's athletes, and each was assessed independently. A minimum of 72 hours of rest was allowed between massage methods used before, during, and after Ramadan (Bowers et al., 2012). Before each massage, the massage bed was disinfected with a wipe and a new disposable cover was placed on top. The temperature in the massage room was just right ($22\text{-}26^0$). So that there wouldn't be any unintentional stimulation for the participants, no strong-smelling scents were employed in the room. About 15 millilitres of traditional baby oil were used to massage each athlete. All massage protocols were applied for 10 minutes after a 5-minute warm-up run. Due to the high intensity of RAST in the music+massage protocols, only up-tempo music (>120 - 140 bpm) was played. Music selection criteria were determined according to the five recommendations of Karageorghis et al., (2009) in their study (Karageorghis et al., 2009). While applying the massage, the massage was performed in the direction of the heart and muscle fibers by using eufluorage, friction, petrissage, and pressing applications (Weerapong, Hume, & Kolt, 2005; Açak & Öncü, 2006; Gürkan, 2018; Jelvéus A, 2011). In order to ensure consistency between massage applications applied to different people, massage applications were performed by three masseurs who received the same training and carried out similar studies together. In order to ensure consistency between the protocols, the same people were massaged by the same masseurs.

Statistical Analysis

Two-way repeated measures ANOVA test was used in the study, the first factor being Ramadan (During Ramadan and After Ramadan) and the second factor being massage (massage with and without music). The assumption of normal distribution was examined using the Shapiro-Wilk test. Mauchly's sphericity test was performed for the sphericity assumption. A Greenhouse-Geisser correction for sphericity was used where necessary. Two groups (massage with and without music) were considered as the between-subject factor (group), and two measurements (During Ramadan and After Ramadan) were considered as the inter-subject factor (time). These analyzes were made for Max Power (W), Minimum Power (W), Average Power (W), and Fatigue Index (%) measurements. The results are presented as mean ± standard deviation. $p < 0.05$ was considered significant. Analyzes were performed using Python 3.9 and IBM SPSS Statistics for Windows version 26.0 (New York; USA).

FINDINGS

Figure 3 shows the changes in the Max Power (W) parameter of the participants. According to the result of the study, a statistically significant difference was found between the Ramadan periods [During vs. After] in terms of Max Power (W) value (F= 24.14; p1< 0.001; np2= 0.73). In addition, the massage groups [with music vs. without music] were statistically significant in terms of the Max Power (W) value (F = 23.49; p2 < 0.001; np2 = 0.72). The interaction effect (Ramadan period*Massage) was statistically significant for Max Power (W) (F= 8.68; p= 0.016; np2= 0.49).

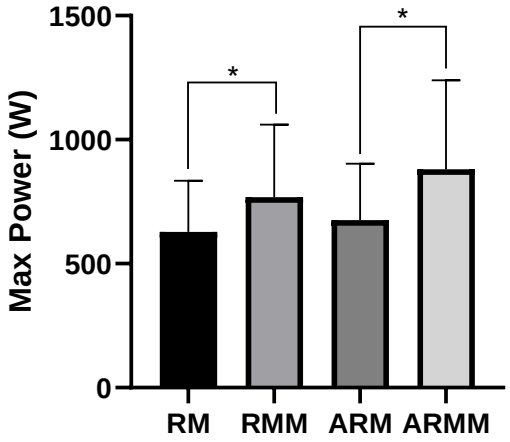

Figure 3. *Comparison of the measured values of Max Power (W); *statistically significant p-value < 0.05.*

The changes in the Minimum Power (W) parameter of the participants are presented in Figure 4. According to the result of the study, a statistically significant difference was found between the Ramadan periods [During vs. After] in terms of Minimum Power (W) value (F= 12.40; p1= 0.006; np2= 0.58). The massage groups [with music vs. without music] were statistically significant in terms of the Minimum Power (W) value (F= 12.10; p2= 0.007; np2= 0.57). The interaction effect (Ramadan period*Massage) was not statistically significant for Minimum Power (W) value (F= 0.024; p= 0.88; np2= 0.003).

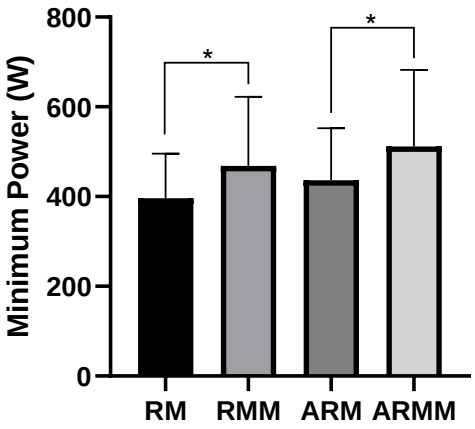

Figure 4. *Comparison of the measured values of the Minimum Power (W); *statistically significant p-value < 0.05.*

The changes in the Average Power (W) parameter of the participants are presented in Figure 5. According to the result of the study, there was a statistically significant difference between Ramadan periods [During vs. After] in terms of the Average Power (W) value (F= 22.87; p1= 0.001; np2= 0.71). The massage groups [with music vs. without music] were statistically significant in terms of the Average Power (W) value (F= 26.97; p2= 0.001; np2= 0.75). The interaction effect (Ramadan period*NAP) was statistically significant for Max Power (W) (F= 7.92; p= 0.02; np2=0.46).

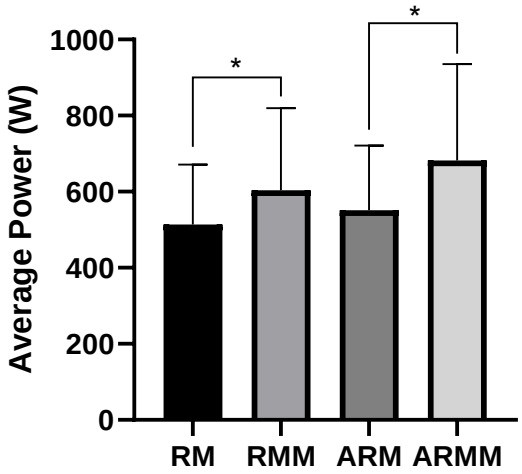

Figure 5. *Comparison of the measured values of the Average Power (W); *statistically significant p-value < 0.05.*

Figure 6 shows the changes in the Fatigue Index (%) parameter of the participants. According to the result of the study, there was a statistically significant difference between Ramadan periods [During vs. After] in terms of the Fatigue Index (%) value (F= 18.63; p1=0.002; np2=0.67). In addition, the massage groups [with music vs. without music] were statistically significant in terms of the Fatigue Index (%) value (F=16.91; p2=0.003; np2=0.65). The interaction effect (Ramadan period*Massage) for Fatigue Index (%) was statistically significant (F= 5.33; p= 0.04; np2=0.37).

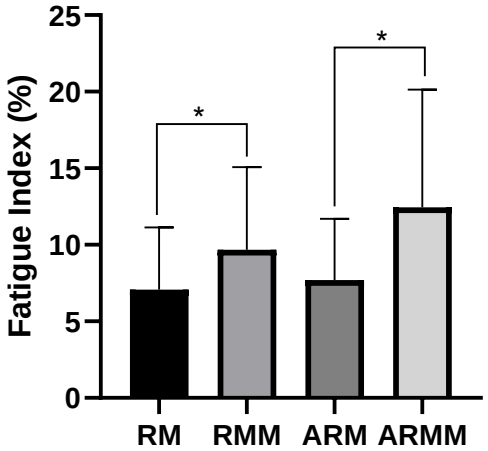

Figure 6. *Comparison of the measured values of the Fatigue Index (%); *statistically significant p-value < 0.05.*

DISCUSSION

It is stated that the sprint performance of the athlete in high-intensity activities is important. For this reason, sports scientists are trying to determine the most accurate programs to improve the performance of athletes. For this purpose, different programs are applied to the athletes. It is thought that massage and listening to music, which are among the protocols applied, affect performance indicators. However, the effect of listening to music combined with massage in addition to the applied massage protocols on performance development has not been determined yet. Accordingly, the aim of this study is to investigate the effects of massage and massage + listening to music applied during and after Ramadan on RAST performance. According to the results of the study, the participants' Maximum Power (W) during Ramadan was significantly lower than after Ramadan. In addition, the Maximum Power (W) value was higher in the group that received massage + music compared to the group that was only massaged, and this increase was statistically significant. The Ramadan * massage interaction was statistically significant for the Maximum Power (W) value. The interaction results showed that massaging with music after Ramadan will positively affect the Maximum Power (W) value. Participants' Minimum Power (W) was significantly lower during Ramadan than after Ramadan. It can also be said that massaging with music increases the Minimum Power (W) value. However, the Ramadan * massage interaction was not significant for Minimum Power (W). The Average Power (W) value during Ramadan was also significantly lower than after Ramadan. Also, massage+music increased the Average Power (W) of the participants. The Ramadan * massage interaction was significant for the Average Power (W) value. This interaction effect showed that massaging after Ramadan and with music would increase the Average Power (W) value. Participants' Fatigue Index (%) during Ramadan was also significantly lower than after Ramadan. In addition, the Fatigue Index (%) value was higher in the group that was massaged with music than in the group that was massaged without music. The Ramadan * massage interaction was statistically significant for the Fatigue Index (%). The results showed that massage with music after Ramadan will increase FI (%).

As far as we know, there is no other study that tests and compares the effect of massage protocols applied during and after Ramadan on the same group of athletes. Implementation of this procedure in the current study allows each massage protocol to produce different physiological and performance results. According to the findings of our study, it was determined that massage + listening to music after Ramadan had a positive effect on RAST performance. Although this study is the first to examine the acute effect of massage + listening to music applied to athletes during and after Ramadan, our findings are consistent with studies with similar characteristics examining the effects of massage on sprint performance. But there are studies that massage does not have a positive contribution speed and sprint performance to. For example, it has been determined that massage does not prevent speed performance but can be psychologically beneficial for athletes (Peña et al., 2014), aromatherapy massage applied to futsal athletes contributes to sprint performance (Bayer & Eken, 2022). Furthermore, sports massage application positively affects the power values of athletes(Peña et al., 2014; Bayer & Eken, 2021). However, in another study, massage has negative effects on speed and reaction time (Arabaci, 2008), massage applied to increase sprint performance does not significantly benefit sprint performance (Dafydd, 2012), and the effectiveness of pre-competition massage applications is controversial (Moran, Hauth, & Rabena, 2018). When the studies are examined, it can be stated that the source of the differences between the results obtained is different sample groups, the time when the measurements are made or the individual differences between the people who apply the massage.

There are no studies on the effect of listening to music before exercise during and after Ramadan on performance development, but the effect of listening to music before exercise is

consistent with our study results. In a study, it was stated that listening to music will increase performance speed, and listening to higher tempo music (example of Brohmer & Becker, 2006) will increase speed more (Jamshidzad et al., 2018). Koç et al., (2009) examined the effect of music on WAnT performance in 14 male and 6 female subjects under three conditions: slow music, fast music, and no music. They found higher power outputs in both fast and slow music conditions than in no-music conditions (Brohmer & Becker (2006) study, 17 subjects were tested for Wingate performance under conditions with and without music. Accordingly, it shows that music can physiologically improve anaerobic exercise performance. According to Eliakim et al. (2007), examined the effect of listening to music during warm-up on anaerobic performance in elite national level adolescent volleyball players. They noted that music affects warming and may have a temporary beneficial effect on anaerobic performance. Chen et al., (2022). studied an interactive music tempo control with closed-loop heart rate feedback to improve an athlete's physio-psychological states. According to the results of the study, listening to interactive music has a significant effect on heart rate and perceived effort (RPE) level in basketball players who listen to asynchronous music or not at all during the activity However, Atan (2013), examined the effect of music listening and rhythm on anaerobic exercise, and as a result, he stated that listening to music and rhythm did not increase anaerobic performance. Szabo et al. (1999), did not find a significant difference between slow and fast music in terms of exhaustion time for maximal cycling exercise. Rad & Hafezi (2013), stated that there is no ergogenic benefit of music at 100 m swimming speed. It can be said that the source of the differences between the study findings is the differences in the music tempo, the type of sample or the time intervals in which the study was conducted.

It was determined that RAST values during Ramadan were not effective compared to post-Ramadan values. Our results are similar to the results of the studies in Ramadan. For example, Zerguini et al. (2007), reported an overall decrease in soccer players during Ramadan after tests of speed, agility, dribbling and endurance. Meckel et al. (2008), reported that the performances of 3000 m running time, 6 × 40 m running time and vertical jump tests adversely affect young football players in Ramadan. Wilson et al. (2009b), showed that sprinting ability or agility in football players is affected by Ramadan fasting. Nizar Souissi et al. (2007), showed that the effect of time of day on anaerobic power variables tended to disappear during Ramadan during strength speed and Wingate tests. While it did not show any change in the morning performance of the people participating in the study during the Ramadan fast, it impaired the afternoon and evening anaerobic performance. Regarding the anaerobic performances, the performance of the football players during the repeated sprint ability (RSA) and Wingate tests during Ramadan showed a significant decrease (Chtourou et al., 2011b). Hamouda et al. (2012), stated that during the 5×6 s RSA test during Ramadan, athletes showed a significant decrease in Peak Power.

CONCLUSION

In conclusion, our research demonstrates that fasting during Ramadan has a negative impact on anaerobic performance, especially during periods of intense hunger. Nonetheless, the results demonstrate that massage combined with listening to music (120-140 rpm) has a beneficial effect on anaerobic performance both during and after Ramadan. After all these research results, the effect of massage + listening to music on exercise performance is an undeniable fact. In addition to the results of this study, the inclusion of different sample groups in the study or the examination of the effect of listening to massage + music at different times of the day in Ramadan may contribute to the relevant literature and the field of sports science.

Limitations and Recommendations

There are limitations to be considered when interpreting this study's results. Not one RAST test from before, during, or after the holy month of Ramadan was compared to any other. Furthermore, regulating nutritional (calorie) differences between Ramadan and the subsequent months was impossible.

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