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*Abstracts of 2nd International Congress on "Education, Motor Behaviour, Sport and Health"*





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“Education, Motor Behaviour, Sport and Health”**

**15-18 December 2021**

**Sfax, Tunisia**



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## JOURNAL INFORMATION

### ▶ AIMS AND SCOPE

The International Journal of Sport Studies for Health (IJSSH) publishes empirical and theoretical contributions in the science of physical activity, human movement, exercise, and sport. The journal's Editors and Editorial Board encourage researchers and scholars worldwide to submit their work for publication since the journal emphasizes its international perspective. Innovative applications, cultural and cross-cultural research and position statements of international organizations are especially welcomed. The major purposes of IJSSH are to promote understanding sport and health research and enhancing theoretical and practical knowledge in these fields and promote high-quality scientific and applied works in sport and exercise sciences in the fields of health.

### ▶ CONTENT COVERAGE

The journal publishes original research and reviews in all aspects of basic, biomedical and clinical sports medicine, such as injury management, physiotherapy and rehabilitation, exercise physiology, sports psychology, public health, Sports nutrition, and sports sciences.

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# **INTRODUCTION**

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## ***In the name of God***

The second International Congress on “Education, Motor Behaviour, Sport and Health” was organised in the High Institute of Sport and Physical Education of Sfax, University of Sfax, Tunisia, between 15th and 18th of december 2021 with the aims were to:

- (1) promote the educational systems and to discuss the learning programs
- (2) discuss scientific data about the promotion and developement of motor behavior for children and adolescents
- (3) discuss scientific data about the optimisation of training strategies and athletic outcomes in many sports And (4) promote health in different pathologies by practicing physical activities

It was a great opportunity for many scientists, students, coaches and athletes to present and discuss recent data about the main topics Some abstracts of the presented data are published in this special issue.

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### ■ Effect of Hypoxia on VO<sub>2</sub> Kinetics, Aerobic and Anaerobic Contributions, and the Perception of Effort in Exercise

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#### Abstract

**Introduction:** Hypoxia – a reduced partial pressure of oxygen in the inspired air (FIO<sub>2</sub>) – is an environmental stressor that can affect performance or, alternatively, can be used as an adjunct to testing and training of athletes. The purpose of this study was to investigate the effect of hypoxia on VO<sub>2</sub> kinetics, aerobic and anaerobic contributions, and the perception of effort during moderate and heavy intensity exercise.

**Method:** Six women (mean ± SD: 23 ± 1 y; 166 ± 7 cm; 67 ± 8 kg; VO<sub>2</sub>max, 49 ± 7 mL.kg<sup>-1</sup>.min<sup>-1</sup>) and three men (23 ± 0 y; 178 ± 3 cm; 80 ± 7 kg; 54 ± 8 mL.k<sup>-1</sup>.min<sup>-1</sup>) completed three cycle ergometer tests, one while breathing normoxic air (FIO<sub>2</sub> = ~ 21%) and two under hypoxic conditions (FIO<sub>2</sub> = ~ 15% and FIO<sub>2</sub> = ~ 12%). Cardiorespiratory (e.g., HR and VE), metabolic (e.g., VO<sub>2</sub> and the kinetics of the VO<sub>2</sub> response), and perceptual (e.g., RPE) responses were measured throughout 4 min of moderate intensity exercise, 6 min of heavy intensity exercise, and 7 min of recovery.

**Results:** In moderate intensity exercise, even with an FIO<sub>2</sub> of 11.6 ± 1.4%, the end-exercise VO<sub>2</sub> was unaffected, although the aerobic response was slowed slightly and RPE was elevated. In heavy exercise, even with an FIO<sub>2</sub> of only 12.1 ± 0.8% and a hemoglobin oxygen saturation of only 74 ± 6%, the end-exercise VO<sub>2</sub> was only marginally reduced (from 30 ± 5 mL.kg<sup>-1</sup>.min<sup>-1</sup> to 28 ± 5 mL.kg<sup>-1</sup>.min<sup>-1</sup>), this because of a significant reduction in the amplitude of the primary phase of the VO<sub>2</sub> response and despite an increase in the amplitude of the slow component. The RPE increased from 14 ± 1 in normoxia to 16 ± 1 in hypoxia. As a consequence of the effects on aerobic responses, the anaerobic contribution was larger in hypoxia, with the oxygen deficit increasing from 26 ± 4 mL.kg<sup>-1</sup> in normoxia to 54 ± 6 mL.kg<sup>-1</sup> in hypoxia; this increase could be attributed to a threefold rise in the glycolytic (lactic) contribution with no change in the phosphocreatine (alactic) contribution.

**Discussion:** In moderate intensity exercise, reductions in FIO<sub>2</sub>, and the associated reductions in hemoglobin oxygen saturation, were quite well compensated by exaggerated cardiorespiratory responses (HR and VE), so that

end-exercise VO<sub>2</sub> was unaffected. In contrast, in heavy intensity exercise, these compensatory responses were not adequate to prevent changes in the aerobic response profile, which led to an increased reliance on anaerobic pathways, specifically, on glycolysis. RPE was higher in hypoxia and reflected the cardiorespiratory responses and not the metabolic (VO<sub>2</sub>) responses.

**Conclusion:** The participants were resilient to the challenge of hypoxia. However, performance of heavy intensity exercise will suffer under conditions of hypoxia as a consequence of altered VO<sub>2</sub> kinetics which causes more rapid depletion of anaerobic reserves and engenders a higher perception of effort

**Keywords:** High Altitude, Cycling, Heavy Intensity, Moderate Intensity, RPE

### ■ Effects of Walking Football Practice During Ramadan Fasting on Heart Rate Variability and Physical Fitness in Healthy Middle-Aged Adults

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#### Abstract

**Introduction:** Walking football (WF) has been recently recognized as an enjoyable activity targeting older adults. The practice of exercise training in a fasted state can decrease body weight, fat free mass, and fat mass. It was demonstrated that HRV did not change after low-to-moderate aerobic exercise in either fed or fasted state in healthy individuals. Thus, the current study aimed to investigate the effects of WF training during Ramadan fasting on HRV, body composition, and physical performance in healthy middle-aged adults. We hypothesized that WF would improve HRV and fitness parameters in this age category.

**Method:** Thirty-one healthy sedentary men were ran-

domized to WF (n=18) and control (CON) (n=13) groups. The WF group performed a training program three times a week during the RF month while the CON participated only in RF. The assessments of HRV [mean heart rate (HR) and mean respiratory rate (RR)], body composition [body mass, BMI, fat mass (%), and lean mass (%)], handgrip, and lumbar strength, and 6-minute walk test (6MWT) were measured one week before Ramadan (BR), during Ramadan (DR), and one week after Ramadan (AR).

**Results:** The objective of this study was to investigate the effects of WF training and RF on HRV indices, body composition, and physical performance in middle aged adults. The current study found a significant effect of WF practice while fasting on mean RR and HR associated with an improvement in body composition and 6MWT performance.

**Discussion:** Our results corroborate in part with existing studies on the impact of Ramadan on HRV in healthy subjects. A study conducted on 80 women reported no significant difference in HRV parameters between the first and last week of Ramadan. There was also a minimal change in performance measures in WF after Ramadan, except for a substantial improvement in agility in WF group. This finding was in line with the study of Kordi et al., who argued that the higher agility fitness level at pre-Ramadan may be due to a reduction in body mass

**Conclusion:** These findings suggested that middle-aged adults achieved significant improvements in HRV and physical fitness parameters after four weeks of WF during RF. Exercise training while fasting played a substantial role in the improvement of physical fitness and cardiovascular autonomic balance, indicating that WF practice in a fasted state may contribute to exercise-induced cardio-protection.

*Keywords:* Autonomic Heart Function, Walking Soccer, Ramadan, Health, Fitness

### ■ The Effect of Yoga and Meditation on the Vigilance and Stress Level among the Civil Protection Workers in Gafsa as an Analyzed Sample

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#### Abstract

**Introduction:** Various studies have shown that mindfulness-based techniques and Yoga practice could be an effective method to improve alertness and decrease the effects of sleep disturbances such as stress, depression or

anxiety. The extended hours of the civil protection work that includes staying awake into the nightshift, opposes the natural circadian rhythms, which is predominantly possible to cause severe consequences on the worker's health, such as decreased vigilance and the occurrence of stress. Therefore, this study aims to examine the influence of Yoga and meditation practice on vigilance and stress Level among the civil protection intervention team.

**Method:** The study's sample was consisted of 10 subjects voluntarily participated, and was divided in two groups. The experimental group practices Yoga and Meditation sessions for four weeks. Meanwhile, the control group doesn't receive any Yoga nor Meditation sessions to study the results of the PSS and PVT tests which were taken before and after the intervention period in order to study the difference between the results of the same and the two groups.

**Results:** In one hand, the results of the PSS statistical analysis (t-test) shows that there is a significant effect of yoga and meditation practice on vigilance with a significant correlation at the 0.05 level (2-tailed) [ $P(T \leq t) = 0.031/t = 3.276$ ]. In the other hand, the SPSS results of the PSS test show that, [ $P(T \leq t) = 0.001/t = 8.485$ ] which mean the correlation is significant at the 0.05 level.

**Discussion:** After four weeks of intervention, in one hand, there was a significant decrease in the stress level among the experimental group ( $P = 0.001$ ), wherein the change was significantly more compared to the results of the control group which shows no significant difference ( $P = 0.178$ ). In the other hand, the results of PVT task show that there was a significant reduction in the scores of the reaction time among the experimental group ( $P = 0.031$ ). Meanwhile, the control group didn't show any significant correlation ( $P = 0.426$ ). Therefore, we can emphasize that our findings demonstrates a significant improvement in cognitive performance of vigilance, attention, executive functions, and on the psychological performance of stress. Thus so on, our study is in agreement with various studies implied on the practice of yoga and meditation which have proved its efficacy in the management of stress, anxiety, and depression, etc. also, the enhancement of cognitive functions. For instance, according to Prakash et al. in 2010, "Long-Term Yoga Meditation Improves Attention Span, Processing Speed, Attention Alternation Ability, and Performance in Interference Tests", in another study addressing the effects of yoga on anxiety and stress, 25 out of 35 trials noted a significant decrease in stress and anxiety symptoms when a yoga regimen was implemented

**Conclusion:** We were able to conclude that both vigilance and stress levels were significantly affected in a positive manner by the practice of yoga and meditation. In one hand, the PVT results showed that cognitive performance (reaction time) of the subjects was improved after the intervention period, indicating the improvement of vigilance. In the other hand, the level of stress was also

positively improved. More specifically, the experimental group registered lower scores in the PSS test from 7 to 13 which falls into the category of low-stress indication, comparing to the before PSS test scores.

*Keywords:* Vigilance, Stress, Yoga, Meditation, Civil Protection

### ■ Rating of Perceived Exertion at the Ventilatory Threshold: No Effect of Exercise Mode

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#### Abstract

**Introduction:** Ratings of perceived exertion (RPE) provide a psychological complement to physiological responses that are monitored during exercise. The purpose of this study was to compare RPE at the ventilatory threshold during incremental and prolonged running, cycling, and upper body exercise. The working hypothesis was that the RPE at the ventilatory threshold would be the same across the three exercise modes, which would reinforce the assertion that the ventilatory threshold serves as an “anchor” for the perception of effort.

**Method:** The participants were five women (mean  $\pm$  SD: 22  $\pm$  2 y; 167  $\pm$  6 cm; 62  $\pm$  9 kg) and five men (23  $\pm$  2 y; 179  $\pm$  7 cm; 84  $\pm$  8 kg). They completed incremental tests using running, cycling, and upper body exercise, to determine the ventilatory threshold and RPE associated with that threshold, for each exercise mode. Then they performed 20-min constant power tests at the ventilatory threshold for each mode. Cardiorespiratory-metabolic responses were measured using a MedGraphics metabolic system and Polar heart rate monitor. RPE was elicited using the Borg 6 to 20 scales (Borg, 1970).

**Results:** The ventilatory threshold was identified at 9.4  $\pm$  0.7 km.h<sup>-1</sup> in running, 135  $\pm$  24 W in cycling, and 46  $\pm$  5 W in upper body exercise. Associated metabolic demands were 61  $\pm$  4% of the mode-specific VO<sub>2</sub>max in running, 58  $\pm$  4% in cycling, 59  $\pm$  3% in upper body exercise; the values did not differ across the three exercise modes. The RPE at the ventilatory threshold also did not differ across the exercise modes: 11.9  $\pm$  1.4, 12.1  $\pm$  1.6, and 12.0  $\pm$  1.7, respectively. Similarly, during 20 minutes of exercise at each threshold, RPE did not differ across the three exercise modes: 12.1  $\pm$  1.6, 12.2  $\pm$  1.6, and 12.2  $\pm$  1.6, respectively.

**Discussion:** Although there was some inter-individual variability in perceptions (coefficient of variation was 15%

or less for every mode and every time point), the ventilatory threshold was perceived as “light” (~ 12 on the Borg scale), regardless of exercise mode. Responses that are unique to the ventilatory threshold – lactate production above resting levels, buffering and utilization of buffer stores, excess ventilation (at least relative to the VO<sub>2</sub>), shifting of the drive for ventilation from bringing in oxygen to removing CO<sub>2</sub> – may serve as an anchor for the perception of effort.

**Conclusion:** Exercise that is described as “light” likely falls near the upper boundary of the moderate exercise intensity domain. The consistency of perceptual responses at the ventilatory threshold supports the use of RPE for prescription of moderate intensity exercise. In addition, the results support the contention that RPE may serve as an “anchor” in the perception of effort.

*Keywords:* Anaerobic Threshold, Lactate Threshold, RPE, Upper Body Exercise

### ■ The Impact of Melatonin Ingestion Before Intradialytic Exercise on Monocytes Subtypes and Inflammation in Haemodialysis Patients: A Pilot Study

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#### Abstract

**Introduction:** Haemodialysis (HD) patients have monocytes (MO) reactivation that lead to an overproduction of pro-inflammatory cytokines. In line, HD patients with high CD14<sup>++</sup>CD16<sup>+</sup> monocyte counts are at increased risk for future cardio-vascular events. Several studies have shown a direct association between renal dysfunction and decreased melatonin (MEL) production. However, little is known about the acute effects of MEL intake on MO cells and inflammation during HD. The present study aimed to investigate the effects of MEL intake on MO subtypes and inflammation during intradialytic exercise in HD patients.

**Method:** Thirteen HD patients volunteered to participate in the current randomized-crossover study. Immunological responses were monitored in four HD sessions at different conditions: [exercise (EX) + MEL], [EX +

placebo (PLA)], [control (CON) + MEL] and [CON + PLA]. During all sessions, peripheral blood samples were collected to assess C-reactive protein (CRP) and MO subtypes [CD14++CD16- (classical), CD14++CD16+ (intermediate), CD14+CD16++ (non-classical)] before HD (T0), immediately after the end of intradialytic exercise (T1) and 1h after intradialytic exercise (T2) or at corresponding times in the control condition. Three mg of MEL or PLA was ingested 1h before starting exercise or the equivalent time in control group. During the exercise session, patients performed a 30-min bout of aerobic intradialytic exercise in the second hour of HD. The control condition consisted in a conventional resting HD session.

**Results:** The present findings indicate a significant fall of intermediate MO in [EX + MEL] and [EX + PLA] conditions at T1 compared to T0 ( $P = 0.02$ ,  $d = 1.20$  and  $P = 0.002$ ,  $d = 1.14$ , respectively), and at T2 compared to T0 ( $P = 0.006$ ,  $d = 0.48$ ;  $P = 0.015$ ,  $d = 0.81$ , respectively). Additionally, in [CON + MEL] condition, the proportion of intermediate MO showed a significant decrease at T2 compared to T0 ( $P = 0.02$ ,  $d = 1.57$ ). However, in [CON + PLA] condition no statistically significant differences were found. Regarding classical MO, non-classical MO and CRP, ANOVA showed no significant effect.

**Discussion:** HD patients present elevated counts of CD14++ CD16+ MO compared to controls with undamaged kidney function. In the present study, we showed that MEL intake during HD decreased the proportion of intermediate MO. This finding could be explained that MO has both membrane and nuclear MEL receptors. Moreover, it has been reported that MEL inhibits the production of tumor necrosis factor alpha in lipopolysaccharide stimulated human MO. Furthermore, intradialytic exercise alone or associated with acute MEL intake decreased the proportion of intermediate MO. In this sense, the decrease of CD14++ CD16+ MO counts after exercise could be explained by the fact that pro-inflammatory MO are preferentially marginalized or removed from the bloodstream after exercise and during the recovery phase of exercise, maybe to peripheral tissue compartments, areas of inflammation or to the spleen.

**Conclusion:** The present study indicates that self-paced intradialytic exercise did not aggravate the immune dysfunction or the pro-inflammatory environment associated with HD. Fortunately, no adverse events related to intradialytic exercise and MEL ingestion were detected in the present study. MEL intake alone or associated with intradialytic exercise may be an appropriate anti-inflammatory therapy for HD patients.

**Keywords:** Melatonin, Intradialytic Exercise, Immune Cells, Inflammation, Renal Failure

### ■ Ratings of Perceived Exertion During Exercise at the Ventilatory Threshold,

### at the Maximal Lactate Steady State, and at Critical Power

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#### Abstract

**Introduction:** Ratings of perceived exertion (RPE) provide a psychological complement to physiological responses that are monitored during exercise. The purpose of this descriptive study was to compare RPE during at the ventilatory threshold, at the maximal lactate steady state, and at critical power. We and others have suggested that the ventilatory threshold serves as an “anchor” for the perception of effort, it being the highest intensity perceived as “light”. The intent of this study was to determine if there was evidence that MLSS or CP might also serve as an “anchor” for the perception of effort.

**Method:** The participants were five women (mean  $\pm$  SD:  $21 \pm 2$  y;  $168 \pm 5$  cm;  $64 \pm 7$  kg) and five men ( $22 \pm 2$  y;  $181 \pm 8$  cm;  $85 \pm 9$  kg). They completed incremental tests to identify the ventilatory threshold, 30-min tests to determine MLSS, and other tests (exhaustion after 3 min to 12 min) to determine CP. Then, they performed 30 min of exercise at each threshold intensity. RPE was elicited using the Borg 6 to 20 scales (Borg, 1970).

**Results:** The work rates associated with the ventilatory threshold, MLSS, and CP were calculated to be  $101 \pm 21$  W,  $143 \pm 22$  W,  $167 \pm 23$  W, respectively. During exercise at the ventilatory threshold, there was no increase in blood lactate concentration and RPE was “light” throughout (at 30 min,  $12.1 \pm 12.1$ ). At MLSS, blood lactate concentration decreased from  $3.5 \pm 0.8$  mM to  $3.2 \pm 0.7$  mM and RPE increased from  $13.0 \pm 1.6$  to  $15.0 \pm 1.9$ . At CP,  $\dot{V}O_2$  reached  $95 \pm 3\%$   $\dot{V}O_{2max}$ ; blood lactate concentration increased from  $6.8 \pm 1.3$  mM to  $9.9 \pm 1.6$  mM and RPE increased from  $16.9 \pm 0.6$  to  $19.0 \pm 0.5$ .

**Discussion:** Consistent with other studies, exercise at the ventilatory threshold was perceived as “light” ( $\sim 12$ , coefficient of variation = 17%). At MLSS, RPE increased over time and was perceived as “hard” ( $\sim 15$ , coefficient of variation = 13%) after 30 min. Similarly, during exercise at CP, RPE increased over time so that the exercise was perceived as “very hard” ( $\sim 19$ , coefficient of variation = 3%) after 30 min.

**Conclusion:** RPEs at the ventilatory threshold clustered around “light”, consistent with the contention that the ventilatory threshold is an “anchor” for the perception of effort. However, RPEs were more tightly clustered around “somewhat hard” and “hard” during exercise at MLSS and

even more tightly clustered around “very hard” and “very very hard” during exercise at CP. While this suggests that MLSS and CP may (also) serve as anchors in the perception of effort, we caution that, at these higher intensities, RPE values are constrained by the upper limit of the Borg scale.

*Keywords:* Anaerobic Threshold, Lactate Threshold, MLSS, RPE

### ■ Aerobic training And RANKL Gene DNA-Methylation

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#### Abstract

**Introduction:** Osteoporosis is a skeletal disease that weakens bones and represents a leading cause of disability in aging population with morbidity consequences<sup>1</sup>. It is widely accepted that physical exercise reduces the risk of osteoporosis, possibly through epigenetic modifications such as changes in the DNA methylation profile. The osteoclast genesis RANKL gene has never been investigated. The aim of the present study was to assess the effect of aerobic training on RANKL DNA methylation among Tunisian-North African adults.

**Methods:** A total of 52 healthy sedentary adults (26 trained vs 26 not trained) were recruited for the study. All participants donated blood samples for QMSP analysis. The training session consists of four times per week for a continuing period of 12 weeks. It included jogging/walking at least 30 min on 60% of the target heart rate (THR), according to Karvonen’s Form, followed by strengthening, sheathing, and stretching activities. The level of DNA methylation within RANKL promoter region, SBP, DBP, HR, VO<sub>2</sub>peak, SpO<sub>2</sub> measurements and anthropometric parameters were determined before (T<sub>0</sub>) and after (T<sub>1</sub>) the training with the same conditions.

**Results:** The RANKL promoter region appeared highly methylated in trained ( $P = 41 \times 10^{-5}$ ), not trained group ( $P = 0.002$ ) and particularly in women ( $P = 0.0001$ ) after the training period. Furthermore, the relative increase of the level of DNA methylation in the trained group was considerably higher (550%) than in the control group (126%). Additionally, the cardiovascular parameters (SpO<sub>2</sub>, HR, and SBP) were significantly different in the training

group after training, except the DBP ( $P = 0.15$ ). The HR and SBP were significantly decreased after the training ( $P = 2.2 \times 10^{-16}$ ,  $P = 0.039$ , respectively) while the SpO<sub>2</sub> was significantly increased after the training ( $P = 0.012$ ). The BMI was significantly decreased after training among trained group compared to control ( $P = 0.005$ ). Paired t-test showed that distance ( $P = 6 \times 10^{-7}$ ) and VO<sub>2</sub> peak ( $P = 10^{-7}$ ) were significantly increased after the training period. Additionally, fat mass ( $P = 0.0007$ ) and the percentage of fat ( $P = 0.018$ ) were significantly decreased at the time T<sub>1</sub> for the trained group, suggesting that lean mass ( $P = 0.018$ ) and resistance ( $P = 0.00003$ ) were significantly increased after training period.

**Discussion:** The present study revealed a beneficial effect of physical activity on RANKL gene. We found that aerobic training increased the DNA methylation level within RANKL promoter region among Tunisian healthy adults. Previous researches confirmed the beneficial effect of aerobic training on DNA methylation. Ferrari et al. have indicated that a period of 12 weeks of continuous aerobic exercise protects adults from cardiovascular diseases possibly through altered methylation. While previous results suggested that a year of aerobic exercise did not alter gene specific methylation among healthy, inactive and postmenopausal women. The limited sample size could account for the discrepancies in results between the different groups.

**Conclusion:** Walking or jogging training increases DNA methylation within the RANKL promoter region which could reduce osteoporosis risk and other diseases related to RANKL methylation among Tunisian adults particularly women.

*Keywords:* RANKL, Osteoporosis, DNA Methylation, Aerobic Training

### ■ Pacing Stability in ‘New York City Marathon’

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#### Abstract

**Introduction:** Marathon performance is predicted by variables such as training, morphology, physiological, psychological aspects, and pacing strategy. Previous results indicated differences according to sex, competitive level, and age, but no studies investigated pacing track-

ing in marathon events. Thus, this study aimed to investigate the pacing tracking of runners by miles, from different competitive levels, alongside the 'New York City Marathon', from 2011 to 2019.

**Method:** Data comprised participants in the New York Marathon, between 2011 and 2019. Age, time event conclusion, and running pace for each mileage were obtained from the official website. Based on age groups classification, athletes were categorized in 1st to 3rd; 4th to 10th and >10th position. The pacing tracking across the marathon was tested through autocorrelations, and cut-off points suggested by Malina were considered ( $r < 0.3$  = low correlation;  $0.3 \leq r \leq 0.60$  = moderate correlation;  $r > 0.60$  = moderate-to-high correlation). Effect size was presented by  $r^2$ . Between-ranking groups pace differences, in the first and last mileage, were tested through multivariate analysis. Statistical analysis was computed in SPSS 26.0, with a significance level of 0.01.

**Results:** A total of 363,853 runners finished officially between 2011 and 2019. The average marathon race time was 4: 18: 30  $\pm$  0: 52: 19 (hh: mm: ss) (1st - 3rd 2: 39: 16  $\pm$  0: 23: 28; 4th - 10th 2: 54: 08  $\pm$  0: 30: 37; >10th 4: 19: 01  $\pm$  0: 51: 59). Tracking analysis results indicated that for the highest positioned athletes, running pace in the first mileage explained 14% of the running pace variance in the last mileage. For athletes in the 4th to 10th position and >10th, 11 and 6% of the running pace in the last mileage can be explained by the pace in the first mileage, respectively. The first and second groups presented a moderate correlation among performance across the running. Athletes classified as >10th showed a low correlation among the performance across the running. Multivariate analysis showed significant differences between groups (Pillai's Trace = 0.007;  $F = 163.565$ ;  $\eta^2 = 0.004$ ;  $P < 0.001$ ). In the first mileage, significant differences were observed between the 1st - 3rd and >10th (mean difference: -344.43 s;  $P < 0.001$ ), while non-significant differences were observed for 4th-10th group. In the last mileage, significant differences were observed (1st - 3rd vs 4th - 10th - mean difference: -45.60 s;  $P = 0.009$ ; 1st - 3rd vs >10th - mean difference: -213.84 s;  $P < 0.001$ ; 4th - 10th vs >10th - mean difference: -168.24 s;  $P < 0.001$ ).

**Discussion:** In general, (1) the highest positioned athletes showed the highest performance stability alongside the marathon; and (2) they also presented the highest performance in the first and last mileages, compared to 3rd - 10th and >10th groups. These results are in accordance with previous studies, where athletes with the best performance showed to be more stable.

**Conclusion:** The highest positioned athletes were to those with the best performance since the beginning, and also those more stable alongside the running. Athletes classified in the group >10th presented the lowest performance stability, from the first to the last mileage. Coaches and runners can use this information to better delineate their pacing strategy in future events, especially in the start line.

*Keywords:* Running, Performance, Marathon, Pacing, Tracking

## ■ Patellar Tendinopathy in Athletes and Postural Balance

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### Abstract

**Introduction:** Patellar tendinopathy (PT) is a frequent knee pathology in athletes that induces pain, quadriceps strength decrease and proprioceptive alterations. These three factors impair postural balance, and could increase subsequent injury risk. To the best of our knowledge, little evidence is available regarding PT effects on postural balance. Hence, we aimed to assess postural balance in athletes with PT.

**Methods:** A total of 29 athletes suffering from PT (experimental group) and 29 healthy athletes (control group) were recruited from local volleyball, basketball and handball teams. Participants completed the Victorian Institute of Sports Assessment for the Patellar Tendon (VISA-P), a valid questionnaire for assessing the severity of PT pain and dysfunction. Static postural balance was assessed using a stabilometric platform in a unideal posture and dynamic postural balance was evaluated via the Y balance test (YBT).

**Results:** Athletes with PT had a significantly ( $P < 0.001$ ) lower VISA-P score than healthy athletes (65.39% lower). Static postural balance asymmetry values were significantly ( $P < 0.001$ ) lower in the control group compared to the PT group in the eyes opened (61.35% lower) and eyes closed conditions (43.94% lower). Dynamic postural balance asymmetry values were also significantly ( $P < 0.001$ ) lower in controls compared to the PT group in the anterior (33.6% lower), posteromedial (19.65 lower) and posterolateral (35.3% lower) directions.

**Discussion:** Many potential mechanisms may contribute to the asymmetrical postural balance found in athletes with PT. Knee pain may explain our findings. The VISA-P scores result demonstrated that athletes with PT recruited in our study had significantly higher pain and dysfunction compared to controls. Pain disrupts postural balance control because it could place a specific demand due to its immediate relevance to survival which may alter proprioception.

**Conclusion:** The present study reported that athletes with PT had postural balance alterations compared to their healthy peers. Many athletes with PT continue to

participate in sport despite pain with an asymmetrical postural balance, which may put them at increased risk of subsequent sport-related injury. Therefore, coaches and physiotherapists should consider this risk by refining training and implementing specific rehabilitation strategies (i.e. implementing balance training).

*Keywords:* Postural Control, Patellar Tendinopathy, Athletes, Sport-Related Injury

### ■ Investigating the Differences of Asymmetrical Bimanual Coordination on Male and Female Athletes in Ballplayers and Non-ballplayers

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#### Abstract

**Introduction:** Two-handed coordination is an important and challenging issue in motor learning that is essential in performing daily tasks and recreational activities. An important feature of performing two-handed coordination skills is that both hands tend to do the same thing at the same time. Sometimes two hands do not necessarily do the same thing, and each limb performs different movements so that the patterns of these movements are different in space and time. This type of two-handed movement is called asymmetric two-handed coordination or independent two-handed tasks in which each hand acts separately, but ultimately both hands pursue a specific goal. The role of gender and level of experience and practice in two-handed coordination skills has not yet been fully investigated. Therefore, the aim of this study was to investigate the differences between asymmetric two-handed coordination in male and female athletes in ball and non-ball disciplines.

**Method:** The present study is of an applied type with a causal-comparative nature. The number of random samples of the present study was 30 male and female student students of the Faculty of Physical Education, University of Tehran with a mean and standard deviation of  $26 \pm 4.5$  years, which were divided into two groups: ball (14 players) and non-ball (16 players). It should be noted that ball disciplines included football, futsal, basketball, handball, volleyball, table tennis and non-ball disciplines included wrestling, karate, taekwondo, swimming and track and field, and most of the subjects had professional sports background. The Vienna instrument was used to measure asymmetric two-handed coordination.

**Results:** The results indicated that there was a significant

difference in asymmetric two-handed coordination skills between ball and non-ball athletes and also in girls and boys ( $P \leq 0.05$ ).

**Discussion:** One of the results of the present study was that girls have a significant advantage over boys in performing the task of asymmetric two-handed coordination. It seems that one of the reasons that girls performed better than boys in this study was that the task used in this study was a delicate task and required the use of fine finger muscles with high accuracy. Also, the results of some MRI studies have shown that the area of the corpus callosum is larger in girls than in boys, which makes the exchange of information between the two hemispheres easier, and as a result, girls can perform better in two-handed coordination tasks. Better performance of performance in ball players than non-ball players in asymmetric two-handed coordination was another result of this study, which can be the result of years of experience and training with both hands in the ball sports group. Previous research has shown that continuous use of the hands in exercise gradually increases the neuromuscular coordination between the hands and also increases the size of the brain areas related to the two-handed coordination tasks. Since in the present study, homework requires high eye and hand coordination, therefore, one of the other possible reasons for superiority of two-handed coordination in the ball group can be attributed to the stronger coordination between the eyes and the hand.

**Conclusion:** It can be concluded that fundamental shortcoming of two-handed coordination skills in sports success, it is expected that sports coaches, especially at a younger age, pay more attention to this basic issue.

*Keywords:* Asymmetrical, Bimanual Coordination, Ballplayers

### ■ E-learning (Online) Physical Activity and Consulting at COVID-19 Lockdown on Weight Loss Program in Women with Obesity

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#### Abstract

**Introduction:** Overweight and obesity are associated with increased morbidity and mortality from various chronic conditions. Weight loss is typically a slow process and requires patience and perseverance. Working out at home with online program in COVID-19 pandemic lockdown can more effective than it has ever been, and help maintaining weight loss programs, the aim of the



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## ABSTRACTS

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present study was to compare the results of a weight loss program in obese women with obesity who attended the program before and during the COVID-19 pandemic. Furthermore, we checked whether there were any differences in endocrine parameters.

**Method:** 102 subjects (age: 30 - 50 y; BMI: 27 - 40 kg/m<sup>2</sup>) who referred to the Health Counseling Center to participate in weight loss programs. After two weeks of participating in weight loss exercise programs that included three days of aerobic exercise per week for 60 minutes per session, lock-down conditions were created. During the quarantine period, 62 of them ran sports programs online via WhatsApp and YouTube, and 58 of them ran their workouts in person at the club. One hundred and twenty obese women were prospectively included to the weight loss program. Sixty two women attended the an-8 week program before COVID-19 pandemic and did their exercise online during the pandemic while those women (n = 58) began the program before the lockdown and keep on doing exercise during the COVID-19 pandemic. Patients were assigned to a meal plan with a specific calorie goal based on their starting weight and were offered a brief phone consultation with a registered dietitian. Due to lockdown, the program was prolonged for 6 weeks and taken online via WhatsApp and YouTube.

**Results:** The results showed that there was no significant difference between the two groups in terms of reducing body fat percentage (P = 0.085). Those who performed online program experienced 3.09% weight loss, whereas the other group had 5.01% weight loss.

**Discussion:** Given the limitations that exist in the implementation of sports exercises during the covid-19 pandemic, it seems that using strategies that can create the field of sports activities at home and indoors is very helpful, therefore creating motivation and social support in the pandemic period is necessary.

**Conclusion:** The overall result was that online sports training could be as effective as face-to-face training in sports clubs during the COVID-19 lock-down, so it is recommended that the strategies be applied to develop online sports programs on social media.

**Keywords:** E-learning, COVID-19 Lockdown, Weight Loss

### ■ Interval Training & Heart Health of Male Rats with Induced Hypertrophy

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#### Abstract

**Introduction:** Chronic inflammation is closely related to fibrosis and pathological cardiac hypertrophy. The regulatory mechanisms of myocardial inflammation begin with pattern diagnostic receptors (PPRs). Among these receptors, toll-like receptors (TLRs) activate the primary inflammatory responses of heart muscle cells. Due to the fact that exercise plays an important role in reducing inflammation and combating cardiovascular disease and it has been shown that the tLR4 and NF-κB messaging pathway play an important role in the process of inflammation and cardiac fibrosis, the aim of this study was to identify the effects of eight weeks of high-intensity interval training before isoproterenol induction on the expression of tLR4 and NF-κB genes in the left ventricular tissue of male rats with induced hypertrophy

**Method:** In the experimental method, 18 male Wistar rats were divided into two groups of control and interval training. After eight weeks of training, Pathologic hypertrophy was induced with the injection of 3 mg/kg-1 of isoproterenol for 7 days; 24 hours after the last injection session, rats were anesthetized by intraperitoneal injection of 50 mg ketamine and 10 mg xylazine. The rats were then dissected and cardiac tissue was extracted and transferred to -70°C. Also, in the present study, Real Time PCR was used to evaluate the expression of tLR4 and NF-κB genes. Data analysis was performed by SPSS software version 24 using independent t-test at a significance level of P < 0.5.

**Results:** The results of the present study showed that heart tissue weight indices, heart weight to body weight ratio (H/B) and left ventricular weight to heart weight ratio (V/H) were significant (P = 0.001) in the exercise group compared to the group. In the training group compared to the control group, the relative expression of tLR4 and NF-κB genes was significantly reduced (P = 0.001) in the control group compared to the control group

**Conclusion:** HIIT training may play an important role in preventing pathological cardiac hypertrophy by reducing the expression of tLR4 and NF-κB genes

**Keywords:** Virtual Reality Exercises, Performance, Motor-Perceptual Development, Taekwondo

### ■ The Effect of Acute Weight Loss with Caffeine Consumption on Psychomotor Performance, and Balance of Student-Thletes

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#### Abstract

**Introduction:** Today, obesity is one of the most important health problems in the world. Studies have shown that over the past two decades, the prevalence of overweightness and obesity has increased in many countries around the world leading to economic consequences and rising health care costs. Obesity in students is associated with not only physical and psychological problems but also a decrease in educational performance. Exercise is one way for weight loss. Physical activity, without a reduction in calorie intake, usually has no relevant effect on weight. Although it is possible to lose weight through physical activity alone, the amount of physical activity required for substantial weight loss is well beyond what is feasible for most people in today's world. High volumes of exercise are associated with weight loss and the prevention of weight gain. In fact, studies utilizing supervised exercise, to confirm the completion of the recommended dose of exercise, have found that engaging in > 250 min of exercise per week elicits clinically significant weight loss (> 5%). There is also evidence that coffee consumers have a lower body mass index (BMI) compared with individuals who do not consume coffee. Additionally, there is a negative association between coffee consumption and body weight gain in the long term. High caffeine intake has also been associated with weight loss. The aim of the present study was to assess the effect of the effect of acute weight loss with caffeine consumption on psychomotor performance, strength and balance of student-athletes

**Methods:** The subjects were athlete students of Qazvin province with an age range of 18 to 25 and Body mass index 25 to 30. A total of 20 students with specific and mentioned conditions were selected voluntarily. The selected subjects were randomly divided into two groups, acute weight loss with caffeine group (n = 10) and aerobic exercise without caffeine group (n = 10). A pretest-post-test research design with control group was employed. Psychomotor performance, anaerobic power and balance of student-athletes were assessed by various tests such as questionnaire, Vienna, Wingate and stability test. One-way ANCOVA and paired t-test were used for statistical analysis.

**Results:** The results indicated that acute weight loss with caffeine (P = 0.028) and aerobic exercise without caffeine (P = 0.025) had a significant effect on the motor performance of athlete students. Also, acute weight loss with caffeine (P = 0.015) and aerobic exercise without caffeine (P = 0.005) had a significant effect on the balance of athletic students. However, there was no significant effect on anaerobic power of both groups.

**Discussion:** The present study revealed a beneficial effect of caffeine consumption and aerobic exercise on psychomotor performance. According to the literature, caffeine has several important metabolic effects that might explain our results. We found that Caffeine consumption releases dopamine in the brain, which causes neurons trigger and has a positive effect on psychomotor performance. Acute weight loss reduces the anaerobic

power of athletes. It has been shown that Caffeine improves exercise performance and is considered an ergogenic substance. However, Harty et al. Have shown that acute caffeine consumption may have no effect on the strength and anaerobic power. In summary, consumption of caffeine improves psychomotor performance and balance.

**Conclusion:** In general, the results of this study indicated that acute weight loss with caffeine consumption improve psychomotor performance and balance of athlete students.

*Keywords:* Caffeine, Psychomotor Performance, Balance

### ■ The Effect of Virtual Reality Exercises on Motor-Perceptual Development Performance of Taekwondo Girls

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#### Abstract

**Introduction:** Taekwondo is one of the most popular traditional martial arts that originated in Korea and has become a modern international sport that has evolved in many parts of the world. In addition, Taekwondo has been one of the official Olympic Games since the 2000 Sydney Games. The sport has quickly gained popularity among the people. The usual Taekwondo training session is held in a large hall or open space with a high ceiling height with a protected tatami floor in the presence of an instructor. Differences in findings between studies have shown that there may be several factors that can influence the results, and more research is needed to better understand these factors, especially those prominent in virtual reality technology. Since virtual reality exercises involve the motor-perceptual system, this article seeks to answer the main question: What effect do virtual reality exercises have on the performance of motor-perceptual skills of taekwondo girls?

**Method:** The study is applied in terms of purpose of research method with a pre-test-post-test design with a control group. Taekwondo girls with an age range of 12 to 14 years and a yellow, green, blue and red belt category. Inclusion criteria include: player's weight were between 30 to 52 kg, physical health certification by filling PARQ form. 24 taekwondo girls were selected in Tehran. Subjects were randomly divided into 2 groups (N = 12): experimental group (virtual reality exercises) and control group (people who did only specialized taekwondo exercises). Perceptual -motor performance was measured by Bruninke-Osersky test. They did 12 training sessions for 4 weeks (3 training sessions per week for 4 consecu-

tive weeks) (considering a pre-test session and a post-test session). Virtual reality exercises to evaluate perceptual - motor performance in a taekwondo practitioner with the approach of accuracy, speed, concentration and coordination of nerves and muscles were evaluated under the supervision of 3 taekwondo instructors and its validity was confirmed. The reliability of this training protocol was confirmed by Cronbach's alpha test of 86%.

**Results:** The results showed that the observed differences between the mean scores of balance, flexibility and perception components in terms of group membership (experimental and control groups) in the post-test stage were significant. The mean of the experimental group compared to the control group in the components of balance, flexibility and perception has significantly increased, which indicates the effectiveness of virtual reality exercises on the perceptual - motor performance of taekwondo girls. Multivariate analysis of variance (MANOVA) was used to evaluate the effectiveness of virtual reality exercises  $F(5, 18) = 0.371$ ;  $P = 0.002$ , showed that there is a significant difference between the linear combination of perceptual-motor performance between the experimental and control groups.

**Discussion:** The rise of new technology in the virtual reality training program has encouraged many researchers to develop new systems, especially in education. The use of virtual reality (VR) as a tool is based on the assumption that virtual environments can arouse anxiety and provide an opportunity. The results showed that virtual reality exercises have a significant effect on the perceptual motor performance of taekwondo girls. These results are in line with the some studies.

**Conclusion:** The results showed that virtual reality exercises improve the performance of motor perceptual skills. In virtual environment, the individual is no longer merely an external and inactive viewer of computer images, but acts as an active participant in the 3D cyberspace of Rayaneh and is able to manipulate cyberspace with his actions and forget the external situation and focus on the activity of interest. In virtual environments, all the characteristics of the activity such as duration, intensity and type of feedback can be changed based on the goal and abilities of the person, and also people can view the results of their movement and correct it if necessary.

**Keywords:** Virtual Reality Exercises, Performance, Motor-Perceptual Development, Taekwondo

### ■ The Effect of High-Intensity Interval Training and Iranian Propolis Extract on Serum Levels of ALT and AST Enzymes in Patients with Nonalcoholic Fatty Liver

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#### Abstract

**Introduction:** In recent years, nonalcoholic fatty liver disease is known as the most common form of chronic liver disease, which can eventually lead to death. The aim of this research was to investigate the effect of High-intensity interval training (HIIT) and Iranian propolis extract on serum levels of ALT and AST enzymes in patients with non-alcoholic fatty liver.

**Method:** Eighteen females and 14 males with non-alcoholic fatty liver (mean age  $45.1 \pm 3.6$  years; BMI  $30.04 \pm 3.6$  kg/m<sup>2</sup>) were randomly assigned to one of the four groups of HIIT (n = 8), propolis supplement (n = 8), propolis + HIIT (n = 8) and control groups (n = 8). The subjects participated in 8 weeks of HIIT (one bout of 1-min intervals at 80 - 85% of the maximal heart rate [HRmax], interspersed by 2 min at 50 - 55% of the maximal heart rate. The Propolis supplement was taken 3 times a day in the form of 50 mg tablet after the main meals. Body composition, Serum AST and ALT levels were measured before the intervention and 48 hours after the last training session and supplementation. Data were analyzed using paired t-test and analysis of covariance at the significant level of  $P \leq 0.05$ .

**Results:** HIIT significantly reduced the levels of ALT and AST enzymes. Also, there was a significant decrease in enzymes levels in the propolis + HIIT groups. In the control and propolis groups, no significant within-group differences were observed in the amounts of any of the enzymes; but there was a significant difference between the propolis + HIIT group with the control group and the HIIT group with the control group.

**Discussion:** Studies have shown a decrease in liver enzymes following a variety of exercise sessions. HIIT also reduces liver enzymes by increasing basal metabolic rate and increasing lipid oxidation. It was also observed that propolis has antioxidant and anti-inflammatory effects and has led to a decrease in serum levels of ALT and ALP.

**Conclusion:** It seems that HIIT and propolis consumption can be used to reduce liver enzymes in patients with non-alcoholic fatty liver disease, which can be effective in treating patients with fatty liver disease. However, further research is required to reach more certainty in this issue.

**Keywords:** HIIT; Propolis; Aspartate Aminotransferase; Alanine Aminotransferase; Non-alcoholic Fatty Liver

### ■ Evaluation of Spiritual Intelligence among Female College Athletes and Non-athletes

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### Abstract

**Introduction:** In recent years, the concept of intelligence is not only considered as a cognitive ability, but has expanded to other areas such as emotional intelligence, existential intelligence, and a new concept that has recently entered this field, called the concept of spiritual intelligence. Intelligence is a concept that has long been interested in research and investigation into its dimensions, manifestations of features. The Western analytical concept of intelligence is more cognitive and involves the processing of information, while the combined Eastern approach to intelligence incorporates various components of human performance and experience, including cognition of intuition and emotion, in an integrated relationship. In general, intelligence makes a person adapt to the environment and provides her/him with ways to deal with problems and issues. Also, the ability to recognize the problem, provide suggested solutions for different areas of life and discover effective methods of problem solving is a characteristic of intelligent people. One of the most important and interesting topics in the field of sports psychology is spiritual intelligence, which to date has not been a very coherent and systematic research to identify and explain its features and components, compared to other types of intelligence. The aim of this study was to compare the spiritual intelligence of elite athletes, athletes and non-athletes.

**Method:** The statistical population in this study is all students of Qazvin province who were studying in 2015 - 2016. The sampling method used is a simple random method, the total statistical population was 450 people and was divided into 3 groups: elite students (150), regular athlete students (150) and non-athlete students (150). The research instruments included the King Spiritual Intelligence Questionnaire (2008) and 83 questions of Amram and Dryer Questionnaire (2008). The basis for selecting students was their membership in various sports teams, and the method of distributing of Questionnaire was through the site, social media such as Telegram, WhatsApp, and so on. The correlation between the first factor of this questionnaire and the comprehensive spiritual intelligence questionnaire of 83 questions of Amram and Dryer (2008) was 0.76 at the level of 0.01. The results were performed using SPSS 21 software and descriptive statistical methods such as: frequency, mean, standard deviation and inferential statistical methods of one-way analysis of variance.

**Results:** In this study, there is a significant difference between the spiritual intelligence of students of elite athletes, regular athletes and non-athletes ( $P = 0.010$ ,  $X^2 = 9.19$ ). On the other hand, this discrepancy between perception and relationship with the origin of spiritual intelligence in students of elite athletes, regular athletes and non-athletes is also significant ( $P = 0.028$ ,  $X^2 = 7.12$ ). Therefore, in order to determine the source of differences between the groups, two-way comparisons with adjusted alpha level were used.

**Discussion:** Azimi et al. (2014) showed that spirituality and empathy were higher in athletes with disabilities compared to non-athletes with disabilities, which is in accordance with the results of the present study. The results of this study regarding the superiority of spiritual intelligence in elite student-athletes are in accordance with the results of Dodo et al. (2015) who showed; the performance of religious rituals among the elite football players has resulted in high psychological preparations such as reducing fear and anxiety, reducing injury and further winning. Therefore, it can be justified that spirituality has had a significant impact on the success of student-athletes, which has made the difference between elite student-athlete and student-athlete students. On the other hand, the results of the present study are in line with the research of Behroozi et al. (2013) which showed; there is a significant relationship between spiritual intelligence and resilience. The findings of this study also showed that people who are at a high level in terms of spiritual intelligence in more difficult situations, show more resilience.

**Conclusion:** It can be said that the discovery of the existence of spiritual experiences of individuals, creates a basis for believing the existence of spiritual intelligence. Finally, it should be noted that the introduction of spiritual intelligence in the field of sports provides new opportunities for researchers to be sensitive about the role of spirituality and the behavior of athletes to conduct new studies and answer some questions. The unavailability of standardized tools to measure spiritual intelligence and the use of self-report tools was one of the limitations of this study. On the other hand, the cross-sectional nature of this research and the use of correlation design to show the relationship between variables is another weakness. Therefore, for more certainty in decision making, longitudinal studies can be the source of the effect.

**Keywords:** Spiritual Intelligence, Elite, Non-athlete

### ■ High Intensity Interval Training and Quercetin Supplement Improve Selected Neurophysiological Factors in the Hippocampus of Rats with Colon Cancer

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## Abstract

**Introduction:** Colon cancer is one of the most common malignant tumors. Various studies suggest that gut health has a significant effect on nerve damage despite anatomical distance between the intestine and the brain. The research evidences have clearly indicated that exercise has a unique effect on memory enhancement and affects memory function, including increased cerebral blood flow and protein production in the brain. Additionally, it is well known that lifestyle factors such as diet play a role in mental and cognitive health. This study aimed to shed light on the effects of colon cancer on the brain hippocampus and whether intermittent exercise and quercetin supplementation can help improve the function of brain-derived neurotrophic factor (BDNF) and cyclic AMP response element-binding protein (CREB) in the brain hippocampus of rats with colon cancer.

**Method:** A study of 50 male laboratory rats with colon cancer in five groups of rats including: (1) healthy control; (2) colon cancer control; (3) quercetin supplement cancer group; (4) intermittent exercise cancer group; and (5) quercetin supplement and exercise cancer group. BDNF and CREB were evaluated following the intervene variables. Necessary examination on BDNF and CREB in the hippocampus of male rats with colon cancer was performed in vitro and by laboratory specialists according to its standard procedure by ELISA method. The statistical analysis was performed using the SPSS v21.0 software (SPSS Inc., Chicago, IL). The data were analysed using Analysis of variance. Post-hoc tests of Bonferroni were used for comparing the means. Significant difference was set at  $P \leq 0.05$ .

**Results:** Eight weeks of intermittent training in the brain hippocampus of mice with colon cancer had no significant effect on the mean score of BDNF and CREB ( $P \geq 0.05$ ). Eight weeks of quercetin use in the hippocampus of mice with colon cancer affected the mean BDNF score ( $P \leq 0.05$ ), but had no significant effect on the mean CREB score ( $P \geq 0.05$ ). Eight weeks of intermittent exercise and quercetin consumption also had an effect on the mean BDNF score ( $P \leq 0.05$ ), however, had no significant effect on the mean CREB score ( $P \geq 0.05$ ).

**Discussion:** As it was shown in result section, those interventions including intermittent training and quercetin had significantly improved the levels of BDNF and CREB in the brain hippocampus of rats with colon cancer.

**Conclusion:** It can be concluded that applying intermittent training and quercetin would be effective in the levels of BDNF and CREB in the brain hippocampus of rats with colon cancer. So, it's highly recommended for prevention and treatment of the ill.

**Keywords:** Intermittent Exercise, Colon Cancer, Quercetin, BDNF, CREB

## ■ Effects of Virtual Training on Plasma Cortisol of Housewives

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## Abstract

**Introduction:** COVID-19 has become a widespread crisis with high mortality rates worldwide. In addition to the acute pathological effects, it has placed a high psychological burden and nervous stress on people. On the other hand, regular exercise is mentioned as a way to prevent and help treat stress. The pandemic has closed most gyms, and many housewives who exercised regularly three days a week to improve their general health have become inactive and lack exercise. Therefore, the present study investigated the effect of virtual exercise training at home on cortisol levels as one of stress hormones in housewives (30 women voluntarily,  $\pm 43$  years) who previously used to exercise regularly in Al-Zahra Saadatabad gym but has been inactive for about a year.

**Method:** The subjects were divided into two groups of 15 people (control and exercise). The exercise group participated in virtual exercises at home for 12 weeks. Blood samples were collected before and 48 hours after the last training session and sent to the laboratory to assess cortisol levels. Virtual exercises training at home, with an intensity of 60 to 85% of the maximum heart rate, were offered to the subjects through the WhatsApp social channel, three days a week. Complete explanations and how to perform the movements correctly were provided to the subjects in a visual form, and in case of any ambiguities, questions and answers were done virtually. Independent t-test were used to evaluate the data.

**Results:** 12 virtual exercise training at home induced Cortisol levels decreased significantly ( $P < 0.01$ ).

**Discussion:** Corona pandemics have been associated with the closure of indoor sports facilities across the country. Forced closure of gyms has disabled many sportswomen who are interested in sports and active before the time of exposure to the corona virus. Regarding the effect detraining on stress, the present study investigated the effect of exercise at home on cortisol levels following detraining resulting from the corona pandemic. Plasma cortisol is increase as result of stress situation like corona pandemic. In line with the present study, Dute Monteiro et al. (2021) showed that different types of ex-

ercise for 12 weeks significantly reduced cortisol in inactive middle-aged women. Exercise training can modulate cortisol levels by Adrenocorticotropic hormone (ACTH) pathway. ACTH stimulates the secretion of cortisol from the zona fasciculata of the adrenal cortex.

**Conclusion:** It can be stated that 12 weeks of virtual exercises at home in corona home conditions can reduce the stress caused by lack of exercise and corona pandemic in housewives.

**Keywords:** Virtual Exercises at Home, Corona Pandemic, Stress Hormones

### ■ Physical and Psychophysiological Responses to 10 km Cycling Time-Trial following Video Games in Team Sport

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#### Abstract

**Introduction:** Video games have been shown to not only induce stress, which influences cardiovascular, respiratory and metabolic systems, but also reduce or manage stress. Video games increase positive emotions. Therefore, it could improve physical performance. Thus, the objective of this study was to determine the impact of prior video games on endurance performance as well as the cardiorespiratory and metabolic responses and the perception of effort in team sports players. We hypothesized that prior video games could improve endurance performance without affecting metabolic and cardiorespiratory parameters.

**Method:** Seventeen team sports players ( $20.2 \pm 1.1$  years,  $74.6 \pm 6.7$  kg,  $179.5 \pm 5.1$  cm) completed a 10 km cycling time trial (TT10km) (Souissi et al. 2021) following 2 experimental conditions: (1) a 40 minute rest period consisting in reading books or magazines (CONT); (2) a 40 minute video game period (VG). Time to completion time was measured to assess the physical performance. Feedback was limited to distance updates every km only, at which point participants were asked to rate their perceived exertion (RPE). Cardiorespiratory [heart rate (HR), minute ventilation (VE) and oxygen consumption (VO<sub>2</sub>), carbon dioxide production (VCO<sub>2</sub>) and respiratory exchange ratio (RER)] were averaged for each covered km during TT10 km. Blood lactate concentration (La) and blood glucose concentration (Glu) were assessed at rest, at 5 km and im-

mediately after the TT10 km.

**Results:** The results of this study showed (1) a better endurance performance observed after the video games session compared to the control condition ( $807.41 \pm 74.30$  vs.  $833.05 \pm 68.21$  s,  $t = 4.71$ ,  $P < 0.0005$ ,  $d = 1.14$ ); (2) a significant effect of VG on HR ( $F = 6.32$ ;  $P = 0.02$ ;  $\eta^2 = 28$ ); (3) no significant effect of video games on VE ( $F = 0.01$ ;  $P = 0.89$ ;  $\eta^2 = 0.001$ ), VO<sub>2</sub> ( $F = 1.19$ ;  $P = 0.29$ ;  $\eta^2 = 0.02$ ), VCO<sub>2</sub> ( $F = 0.34$ ;  $P = 0.54$ ;  $\eta^2 = 0.02$ ), RER ( $F = 6.32$ ;  $P = 0.02$ ;  $\eta^2 = 28$ ) and metabolic parameters [(Glu) ( $F = 0.46$ ;  $P = 0.50$ ;  $\eta^2 = 0.02$ ) and (La) ( $F = 0.59$ ;  $P = 0.45$ ;  $\eta^2 = 0.03$ ); (3) a significant increase in HR through TT10 km ( $F = 71.88$ ;  $P < 0.0005$ ;  $\eta^2 = 0.81$ ), VE ( $F = 187.92$ ;  $P < 0.0005$ ;  $\eta^2 = 0.92$ ), VO<sub>2</sub> ( $F = 128.17$ ;  $P < 0.0005$ ;  $\eta^2 = 0.88$ ), VCO<sub>2</sub> ( $F = 57.04$ ;  $P < 0.0005$ ;  $\eta^2 = 0.80$ ), (Glu) ( $F = 102.02$ ;  $P < 0.0005$ ;  $\eta^2 = 0.86$ ) and (La) ( $F = 160.84$ ;  $P < 0.0005$ ;  $\eta^2 = 0.90$ ). Higher RPE values after VG compared to CONT ( $F = 11.06$ ;  $P = 0.004$ ;  $\eta^2 = 0.40$ ),

**Discussion:** The results of the present study suggested that VG improve self-paced performance and the perceptual responses. However, pacing strategy and physiological responses were unaffected lower RPE values could explain the positive effect of VG on endurance performance

Lower intensity video games does not induce mental fatigue which is in contrast with other studies (Fortes et al., 2019). From a psychological point of view, 30 min of VG successfully increase motivation resulting in a better endurance performance. Therefore, the present findings show that VG does not impair physiological responses including HR, VE, VCO<sub>2</sub> and RER. The better physical performance after VG task could be explained by a lower perceived exertion during the 10 km cycling time trial.

**Conclusion:** The present study demonstrate that lower intensity video game improve self-paced performance in team sport players by reducing perceived exertion during the exercise task.

**Keywords:** Video Games, RPE, Performance, Team-Sport Players

### ■ Does Mental Fatigue Impair Endurance Performance in Well-Trained Runners

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#### Abstract

**Introduction:** Mental fatigue (MF) is a psychobiologi-

cal state caused by prolonged periods of demanding cognitive activity. Mental fatigue impairs cognitive performance, but there is no clear consensus in the literature on the effects of mental exertion on physical performance. Indeed, many factors could explain these differences. Regarding fitness level, professional athletes are more tolerant to the mentally fatiguing task compared to the recreational athletes or healthy participants. Therefore, the present study aimed to investigate the effects of mental fatigue on self-paced running performance and the psychophysiological responses during 12-minute running exercise.

**Method:** Twenty runners ( $20.8 \pm 1.1$  years,  $70.6 \pm 4.9$  kg,  $175.1 \pm 3.9$  cm) performed, in a randomized order, two 12 min running self-paced field exercises after a control (CONT, reading books or magazines) and a mentally fatiguing task (MF, 30 of an incongruent Stroop task). Physical performance (Speed, covered distance) as well as the psychophysiological responses [rating of perceived exertion (RPE), heart rate (HR), minute ventilation (VE), oxygen uptake ( $VO_2$ ) and carbon dioxide production ( $VCO_2$ )] were assessed during exercise session. Blood lactate concentration (La) was assessed 2 min after exercise. Rating of mental fatigue, motivation, simple reaction time (SRT) and mood were assessed before and after each condition.

**Results:** Participants showed a higher rating of mental fatigue following MF ( $P < 0.001$ ). Motivation decreased after MF compared to CONT ( $P < 0.001$ ). A higher RPE was reported during the 12 min running time-trial following the MF ( $P < 0.001$ ). Covered distance was lower in MF compared to CONT condition ( $\Delta = 5\%$ ,  $P < 0.05$ ). However, pacing strategy, cardiorespiratory parameters and lactate concentration were not different during the 12 min running time-trial exercise ( $P > 0.05$ ).

**Discussion:** The results of the present study suggested that mental fatigue impairs running performance and the perceptual responses. However, pacing strategy and physiological responses were unaffected despite the increases of the cognitive demanding task. Previous studies investigating the effect of mental fatigue on time-trial exercise showed that time to complete the time-trial was longer following mental fatigue in response to 20 min (Martin et al., 2016), 30 min or 20 km cycling time trial from a psychological point of view, 45 min of incongruent Stroop task successfully induced mental fatigue. Physiological and metabolic parameters failed to explain the negative effect of mental fatigue on 12 min running time-trial. Therefore, the present findings show that mental fatigue does not impair physiological responses including HR, VE,  $VO_2$ ,  $VCO_2$  and RER. Our findings are in agreement with previous studies observed during self-paced or time to exhaustion exercise. The impaired physical performance after the mentally fatiguing task could be explained by a higher perceived exertion.

**Conclusion:** The present study demonstrate that a prolonged mental exertion impairs self-paced performance in runners. Despite the increase of fatigue after the men-

tally fatiguing task, pacing strategy, cardiorespiratory and metabolic responses were not affected.

**Keywords:** Mental fatigue, RPE, performance, runners

### ■ Effects of Eight Weeks of Mat Pilates Training on Flexibility, Selected Hematological Parameters and Plasma Volume Variations in Healthy Active Women

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#### Abstract

**Introduction:** Pilates training (PT) is intended to improve general body flexibility and health by emphasizing core strength, posture, and coordination of breathing with movement. Otherwise, PT has been used to reduce pain and disability and to improve sports performance. Further more, Pilates has been used to enhance the aerobic and anaerobic power of multiple sclerosis patients, as well as their endurance and decrease their fatigue frequency. Otherwise, hematological parameters (such as hemoglobin and hematocrit) and plasma volume variation (PVV) may be considered as a valuable marker in the evaluation of aerobic capacity development. The present study aimed to evaluate the effects of eight weeks of mat Pilates training (PT) on flexibility and selected hematological parameters, i.e. white blood cell (WBC), neutrophil, monocyte, lymphocyte, hematocrit, hemoglobin as well as plasma volume variations (PVV) in healthy, active women.

**Method:** Twenty-eight women physical education students with regular menstrual cycle [Ghazel et al. (2020)] volunteered to participate in the present investigation. They were assigned to two groups: a PT group (PG,  $n = 14$ ) that followed an 8-week PT program and a control group (CG,  $n = 14$ ). All participants performed leg raise and Groin flexibility test before and after PT. Blood samples were collected at rest at two separate occasions before and after PT.

**Results:** The results showed that eight weeks of PT program induce a significant increase in flexibility performances. Higher values were observed in PG compared to CG for adductor flexibility (52%,  $P < 0.001$ ), right ham-

string (11%,  $P < 0.01$ ), and left hamstring (11%,  $P < 0.01$ ). Furthermore, the PG had higher values of PVV and lower values of WBC (19.4%), neutrophil (32%), hematocrit (4.3%) and hemoglobin (4.6%) compared to CG ( $P < 0.05$ ).

**Discussion:** The results of this study suggest that eight weeks of mat PT reinforce the immune system and enhances the fluid regulatory. The current finding could enable physicians, coaches, and practitioners to take action by using PT program in order to enhance aerobic and flexibility performances. Interestingly, PT could potentially help to counteract the negative effects of isolation and confinement stress on immune competency. Taking into consideration the COVID-19 pandemic, application of such training program could be helpful in boosting the immune system and stay active.

**Conclusion:** The results of the present study suggested that PT could be an effective strategy for increasing flexibility and plasma volume variations and boosting immune system in healthy, active women.

*Keywords:* Flexibility, Immune Status, Endurance, Pilates

### ■ Effect of Gender Differences on Bipedal Postural Balance and Fall Risk in Adults with Multiple Sclerosis after Performing a Fatiguing Task

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#### Abstract

**Introduction:** Multiple sclerosis (MS) is characterized by affecting men and women differently, it is more frequent in women but its progression is faster and more severe in men. Results of previous studies regarding gender difference in fatigue perception in MS persons are contradictory. Fatigue has been shown to negatively affect postural balance and increased fall risk in MS persons. However, no study has taken into account gender differences in the response of these physical parameters to a fatiguing task in MS persons. This study aimed to investigate the combined effect of gender and fatigue on bipedal postural balance and fall risk in MS adults.

**Methods:** Eleven women (30.29 ± 7.99 years) and seven

men (30.91 ± 8.19 years) with relapsing-remitting MS were evaluated before and after executing a fatiguing protocol (3 x 5-sit to stand test (5-STST), six-minute walk test (6MWT) followed by 3 x 5-STST). Assessments included a posturographic test to evaluate bipedal postural balance in eyes opened (EO) and eyes closed (EC) conditions. The four square step test and the visual analogue scale of fatigue were used also to assess fall risk and fatigue, respectively. Heart rate (HR) and rate of perceived exertion (RPE) were recorded before, during and after the fatiguing task.

**Results:** Compared to women, men showed an impairment of posturographic parameters [mean center of pressure (CoP) velocity (CoPvm) in EO and EC:  $P < 0.05$ ,  $d = 2.5$ ,  $d = 0.29$  respectively; CoP sway area (CoPar) in EO and EC:  $P < 0.01$ ,  $d = 0.66$ ,  $d = 0.48$  respectively], and an increased fall risk ( $P < 0.05$ ;  $d = 0.75$ ). No gender differences were observed in performance of the fatiguing task (walked distance during the 6MWT and duration of 5-STST), in fatigue perception and exercise intensity (HR and RPE).

**Discussion:** Impairments of postural balance found only in men could be explained by the more increased level of inflammatory mediators in men compared to women with MS suffering from fatigue. The more important fall risk in fatigued men in this study could be attributable to gender differences in levels of oxidative stress biomarkers, which were higher in male than female rats with MS.

**Conclusion:** Fatiguing protocol impaired postural control and increased fall risk only in men. Therapist can consider these inconclusive gender differences in postural balance training programs for MS persons.

*Keywords:* Neurodegenerative Disease, Postural Stability, Fall Risk, Exercise-Induced Fatigue, Sex Differences

### ■ Effects of Hatha Yoga on Cognitive Functions in the Elderly

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#### Abstract

**Introduction:** Population ageing is a dominant demographic phenomenon and one of the chief societal problems of this century. Mind-body medicine (MBM) is applied as an alternative to mitigate the effects of ageing. As one of the various MBM, Hatha yoga has rapidly become a popular exercise owing to the numerous ben-



efits that it may bring its practitioners, but, most studies have overlooked the positive effects of yogic practices on cognitive functions in the elderly, especially with regard to sustained attention and cognitive speed and even existing research has shown mixed results. Therefore, the current study aimed at evaluating the effects of a Hatha yoga-based intervention on selective attention, sustained attention, episodic memory, and processing speed in the elderly.

**Method:** Thirty males aged between 65 and 75 years participated in this study. They belonged to 2 groups. The first group included 15 Hatha yoga practitioners for at least 2 years. The control group involved 15 male older adults who shared the same characteristics (age, years of formal education, and level of physical activity) as the Hatha yoga group but were naive to yoga, meditation, or any mind-body intervention. Neuropsychological tests were applied to measure executive functions (assessed by selective attention), sustained attention, episodic memory, and processing speed. The tests used were: The French adaptation of the Stroop Victoria test, the Zazzo's cancellation task, the five word test and a battery of computerized tests to evaluate reaction time (RT).

**Results:** Long-term Hatha yoga intervention showed promising results related to the executive function and RT, but no significant difference was found between the two groups as far as episodic memory and sustained attention although a trend of improvement was observed in favor of Hatha yoga practitioners.

**Discussion:** The present study's results showed a significant difference in the interfering errors corrected between the two groups. The present results corroborate with previous findings which found that participants in the mind-body exercise showed better Stroop test results in comparison with the control group. Nevertheless, Oken et al (2006) revealed that a 6-month Iyengar yoga intervention did not produce any significant improvement in inhibitory control assessed using the Stroop task. Similarly, no notable Kapalabhati breathing (breathing is a very important part of Hatha yoga) effect was detected by Pradhan (2013) in female adults' selective attention. According to the present study, no significant difference between the Hatha yoga group and the group control was observed in episodic memory outcome measures. This finding is contrary to previous studies of Eyre et al (2016) who reported that both Kundalini yoga and memory enhancement training improved verbal memory performance at 12- and 24-weeks follow-up. Also Cinalli et al (2008) found that yoga practice has a beneficial effect on cognitive functions such as delayed recall verbal episodic memory assessed by Hopkins verbal learning test. This study confirms that Hatha yoga intervention positively affected processing speed assessed by the reaction time tests. These results are relatively in agreement with those found by Hari Prasad (2013) who indicated that yoga group showed a more significant improvement in processing speed than the group following a 6-month yoga

intervention in which they used the trail making test-A. Lutz et al (2009) and Slagter et al (2009) also confirmed that a long-term meditation exercise could boost processing speed. Nevertheless, Oken et al (2006) revealed that the yoga intervention and the aerobic exercise participants did not show any improvement in RT compared to the control group, indicating that a short-term randomized exercise intervention does not affect cognitive functions in the elderly.

**Conclusion:** In conclusion, long-term Hatha yoga intervention practitioners have better cognitive abilities compared to the control group in certain aspects of cognitive functions. Because of its ability to prevent age-related cognitive decline, other physiological and psychological Hatha yoga variables need to be examined in order to highlight the correlation between yoga intervention and cognitive performance.

**Keywords:** Yoga; Older Adults; Executive Functions; Selective Attention; Sustained Attention; Episodic Memory; Processing Speed

### ■ The Acute Effect of Cardiopulmonary Rehabilitation Combined with Melatonin Supplementation in Patients with Myocardial Infarction Treated by Primary Angioplasty

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#### Abstract

**Introduction:** Patients with myocardial infarction (MI) treated by primary angioplasty have a low melatonin secretion which is the cause of sleep disorders. In addition, myocardial reperfusion induces an excessive formation of reactive oxygen species responsible for severe oxidative stress involved in numerous cellular alterations. In addition, these patients present pain and early fatigue during exercise. These disturbances lead to a decrease in the functional capacity of MI patients. Cardiopulmonary rehabilitation during hospitalization occupies a key position in the management of these patients, it has a class I indication. Moreover, exogenous melatonin improves the quality of sleep. It has an antioxidant role and has a strong protective effect against oxidative damage. It also has a cardioprotective role through its anti-inflammatory and platelet aggregation inhibiting action. The aim of the present study was to investigate the effect of early cardiopulmonary rehabilitation combined with melatonin supplementation during hospitalization in patients with MI.

**Method:** This was a randomized controlled trial. 15 patients were randomly divided into 3 groups: (1) MELEX: cardiopulmonary rehabilitation + melatonin; (2) EX, cardiopulmonary rehabilitation + placebo; and (3) CON, placebo. The outcomes are: (1) functional capacity measured by 6-minute walk test; (2) sleep quality evaluated by Spiegel score; (3) perception of effort measured by Rated Perceived Exertion scale; and (4) pain evaluated by visual analogue scale. Patients were assessed on 1 day after primary angioplasty then they were reassessed on hospital discharge day.

**Results:** Our results showed a significant difference between 3 groups in the improvement of functional capacity, sleep quality and perception of effort. These parameters were better in the MELEX group than in the other groups. However, there was no significant difference between the groups in pain assessment.

**Discussion:** In the present study, the results showed an improvement in functional capacity. This result, despite the short duration of the intervention, is correlated to the improvement in sleep quality. This is explained by the fact that physical exercise allows to decrease anxiety and core temperature. Also, it allows to resynchronize the biological clock. Moreover, melatonin supplementation improved sleep quality thanks to its sedative effect. The improvement of the perception of effort which is more observed in the MELEX group is explained by the effect of exercise which increases the secretion of serotonin, nor-adrenalin and dopamine but also by the good quality of sleep which decreases the feeling of fatigue. In the present study we have noticed a decrease of pain thanks to physical exercise which improves the secretion of endorphins and thanks to the supplementation of melatonin which acts as a curative or preventive tool of the acute pain by the anodic stimulation of the primary motor.

**Conclusion:** This work allowed us to recommend the beginning of the cardiopulmonary rehabilitation as soon as possible after primary angioplasty following MI and to add a daily dose of 4 mg of melatonin in order to improve the quality of sleep which has a direct effect on the perception of effort and on pain hence on the functional capacity during hospitalization which ensures a favorable prognosis.

**Keywords:** Acute Effect, Cardiopulmonary Rehabilitation, Melatonin, Myocardial Infarction

### ■ Salivary Testosterone and Cortisol Responses to Maximal Exercises in Tunisian Soccer Players

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### Abstract

**Introduction:** Professional soccer players are required to produce great capacity to make intense and repeated efforts supported by capabilities such as muscle strength, anaerobic power, speed, agility, or maximal aerobic power. Previous studies have demonstrated positive correlations between blood and salivary C and T. T and C responses to resistance exercise are affected by several variables such as intensity, volume, duration, rest periods, and muscle mass involvement (Fry et al., 1994). Events occurring outside of the optimal time frame may potentially have an adverse effect on performance. Therefore, the purpose of the study was to establish a relationship between the diurnal variations of salivary T and C with the circadian rhythm of strength and power performance and to examine whether perceived exertion would be affected by time of day in soccer players.

**Method:** Sixteen soccer players participated as volunteers in this study. A randomized cross-over design was used and players were allocated to a 1RM back squat protocol at 09:00 and 17:00 h, and a maximal 5 m sprint protocol at 09:00 and 17:00 h separated by at least 48 h. Variations in salivary T and C were measured after two modes of maximal exercise at two times of day in order to appraise diurnal fluctuations. The saliva sampling for the measurement of T and C concentrations was collected at three times; before exercise (P0), at 5 min (P5) and 60 min post exercise (P60).

**Results:** There was an improvement in sprint performance at 17:00 h compared to 09:00 h, while results did not reach a significant difference which leads to accept the null hypothesis. Furthermore, the performance of the 1RM squat was higher at 17:00 h compared to 09:00 h, but results did not reach statistical significance. There was a significant time of day effect for T and C with higher values present in the morning, but no exercise protocol effect. Elevated salivary concentrations of T and C were observed in the 09:00 h trials during both exercise modes. The mean salivary C concentrations at P60 was lower compared to pre and 5 min post values. Turkey's post hoc analysis exposed that this was only significant for 09:00 h tests.

**Discussion:** In this study, two sampling times were investigated. The findings indicated a variation of the daily mean 1RM; this is consistent with previous research. Hammouda et al., (2011) expressed enhanced sprint performance at 17:00 h when related to 07:00 h. Salivary hormone analysis revealed diurnal variation in T and C. The results agreed with De Luccia (2016) in suggesting that acute changes in serum hormone levels did not necessarily indicate changes in performance capabilities as no correlation was observed between hormone concentrations and performance parameters. Progress in our understanding of T and C that influence anabolic and catabolic processes are important for soccer players and the general athletic population. From a practical aspect,

practitioners seeking (or aiming to avoid) hypertrophy can perform these activities at any time of day without concern for diurnal variation.

**Conclusion:** The good understanding of the right diurnal variation in physical performance requires that future researches may contain more measurement time points to give a more exact illustration of the diurnal change of physical performance and fluctuation of hormones. Moreover, future works should also reflect that people present individually timed biological rhythms and sleep/wake rhythms, adding to the difficulty in precisely defining perfect times for training development and enhanced performance. In this study professional soccer players exposed a time-of-day impact for maximal exercise performance, or the ensuing salivary T and C responses. Moreover, results suggest that strength and power testing or training should be scheduled later during the day.

**Keywords:** Maximal Exercises, Anabolic Response, Catabolic Response, Time of Day

### ■ Influence of Repeated Sprint Training and High-Intensity Techniques Training on Physiological Responses, Time-Structure and, Technical-Tactical Aspects during Simulated Taekwondo Combat

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### Abstract

**Introduction:** During taekwondo match, athletes performed a mixture of offensives and defensives techniques executed at high intensity and intercepted with periods of low intensities. Taking into account the specific characteristics of combat sports, the application of the high-intensity interval training (HIIT) model in the field of

athletic performance has been widely recommended. It has been proposed that using specific training has been proposed to bring more variety during training, by combining physical and technical-tactical aspects. Despite the fact that the taekwondo training should be as close as possible to the reality of the competition, there is a lack of studies that addressed training protocols to improve performance determinants. Therefore, the objective of this study was to compare the physiological responses, time-motion and technical-tactical aspects after four weeks of repeated high-intensity technique training (RTT) or repeated sprint training (RST) program.

**Method:** Twenty-four taekwondo athletes (age:  $16 \pm 1$  years) were randomly assigned to either RST ( $10 \times 35$  m sprint, 10 s rest) or RTT ( $10 \times 6$  s \* Bandal-tchagui, 10 s rest),  $2 \times$  /week for 4 weeks. Athletes performed simulated taekwondo combats before and after training programs and physiological [i.e., delta blood lactate  $\Delta$  (La), peak heart rate (HR<sub>peak</sub>) and perceived exertion (RPE)], time-motion (time for preparatory and fighting activities) and technical-tactical (single attacks, combined attacks, counterattacks and defense) aspects were analyzed.

**Results:** For delta blood lactate, values were lower after compared to before training ( $P < 0.001$ ). Regarding HR peak, values were lower after compared to before training ( $P = 0.030$ ). For RPE, values were lower after compared to before training ( $P < 0.001$ ) and that RTT elicited lower values compared to RST after training ( $P = 0.002$ ). For fighting activity, a training group and time interaction effect was found ( $F_{1, 132} = 134.916$ ,  $P < 0.001$ ), with RTT and RST elicited higher values after compared to before training (all  $P < 0.001$ , respectively). Moreover, RST elicited lower values compared to RTT after training ( $P < 0.001$ ). For preparatory activity, RTT and RST elicited higher values after compared to before training (all  $P < 0.001$ , respectively) and higher values elicited by RTT compared to RST after training ( $P < 0.001$ ). For non-preparatory activity, RTT and RST elicited higher values before compared to after training (all  $P < 0.001$ ) and higher values elicited by RST compared to RTT after training ( $P < 0.001$ ). For single attacks, RTT resulted in higher values than RST after training ( $P < 0.001$ ). Moreover, regarding combined attacks, RTT resulted in higher values than RST after training ( $P < 0.001$ ). For counterattacks RTT elicited higher values compared to RST ( $P = 0.002$ ). For defense, RST resulted in higher values compared to RTT ( $P = 0.002$ ).

**Discussion:** The present study showed that delta blood lactate and HR peak were lower after the two training programs and did not differ according to the training modalities. Following 4 weeks of low-volume high-intensity training, Ouergui et.al found that delta lactate was lower for RTT group compared to RST and control groups. In the present study, the decrease in HR peak from before to after training programs can reflect the development of the cardiovascular fitness. Moreover, the findings about the time-motion aspects from the present study can indicate that adding taekwondo-specific techniques to regular

training regime induce specific improvements toward taekwondo activity. Likewise, single attacks, combined attacks and counterattacks seem to be more frequent after the RTT program. Similar results were found by Kamanulid et al. (2018, where punching force and frequency were enhanced during a simulated boxing fight following 4 weeks of all-out punching training.

**Conclusion:** The present study reported the effectiveness of a low-volume high-intensity training based on specific taekwondo techniques repetition added to regular training regimen to induce specific improvements in the technical tactical skills. Furthermore, since RTT program increase the periods of high-intensity activity, this type of training can allow athlete to cope with the combat demands.

*Keywords:* Martial Arts, Time-Motion Analysis, HIIT

### ■ Effect of 12-Week Zumba Training on Postural Balance in Middle-Aged Women

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#### Abstract

**Introduction:** Postural sways are not only a problem for older adults but also for middle-aged ones. There is a need to identify strategies that focus on middle-aged adults to have a global impact on postural sway, which is potentially important to delay this problem later in life. Strategies to promote physical activity and training at this stage of life can potentially prevent the risk of falls and promote quality of life. Zumba has become one of the most popular high-impact physical activities, especially for women. Scientific data in healthy women showed that Zumba has various positive effects on body composition, aerobic fitness, physical fitness and psychological well-being. Despite the good feasibility, in terms of adherence, and the reduction of sports barriers related to Zumba training, to the best of our knowledge, no data about this training modality effects on postural balance in middle-aged women was available. Therefore, the objective was to examine the effect of 12 weeks of a Zumba training program on postural balance in middle-aged women.

**Method:** 38 healthy inactive middle-aged women aged between 50 and 60 were randomly allocated to a control group and a Zumba group. Our protocol involved two test sessions at the pre and post-intervention where each

woman's postural balance was evaluated using a force platform. Postural balance measurements were recorded in the bipedal stance in four conditions: (1) firm surface/eyes open (EO); (2) firm surface/eyes closed (EC); (3) foam surface/EO; and (4) foam surface/EC.

**Results:** The Zumba group significantly improved in postural balance performance following 12-week Zumba training in post-intervention compared to pre-intervention session in both eyes' conditions (EO and EC) only on firm surface while on foam surface did not. However, the control group showed no significant difference between pre and post-intervention session in all postural conditions.

**Discussion:** Our major results showed that Zumba training improved posture balance in our middle-aged women. In accordance, previous studies reported that this training modality improved static and dynamic balance performances in young women and even in patients with Parkinson's disease. Postural balance gains indicated by the CoPvm values decrease may be explained by the muscle strength and endurance improvements, and flexibility demonstrated after this training modality. These improvements could be due to the nature of the exercises involved in our Zumba training program. These exercises are based on turning, twisting, stepping and jumping elements that may lead to a higher muscle activity.

**Conclusion:** 12-week Zumba training improved postural balance in middle-aged women. It could therefore be recommended as an effective way to promote health in middle-aged women.

*Keywords:* Women; Middle-Ages Zumba Training, Postural Balance

### ■ Neuromuscular-Training Improves Postural Balance in Athletes with Intellectual Disability

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#### Abstract

**Introduction:** Previous studies strongly recommended neuromuscular training to enhance balance and prevent the risk of sports injuries in athletes with typical development (NMT) (Benis et al., 2016). While athletes with ID are more susceptible to sports injuries, we aim to determine the effect of participation in NMT program on postural balance and risk of injuries in athletes with ID.

**Method:** Two groups of athletes with ID participated

in this study. The first group comprised 13 athletes. The control group comprised 14 participants. The first group followed a NMT program combined to their conventional training. Whereas, the control group simply continued with their conventional workout routine. The CoP sways were assessed before and after the NMT.

**Results:** The results showed a significant decrease ( $P < 0.001$ ) in CoP values in the bipedal and unideal postural balance after the training period, in both vision conditions, OE and CE, only in the NMT group.

**Discussion:** Our primary result showed that the CoPvm decreased after the NMT when maintaining bipedal posture in both vision conditions. Part of the NMT program consisted of balance exercises. The positive effect of balance exercises on static postural balance has been demonstrated in typical development athletes in various sports and in non-athletes as well as in sedentary people with ID. Balance exercises may lead to task-specific neural adaptations at the spinal and supraspinal levels that may reinforce agonist-antagonist muscle co-contraction that may contribute to increased joint stiffness, stabilized joints against perturbations, and therefore improved postural balance. On the other hand, including strength exercises in our NMT program seems to lead to specific adaptations in the nervous system, which may contribute to rapid recruitment and more synchronized discharge of different motor units, and an enhancement of neuronal firing rates and intramuscular and intramuscular coordination. All these factors lead to improve postural balance.

**Conclusion:** In conclusion, 12 weeks of NMT are effective to improve the postural balance in athletes with ID. In light of these results, it is recommended to incorporate the NMT in the conventional training program in athletes with ID to improve their balance and probably decrease sports injury risks known in these athletes.

**Keywords:** Intellectual Disability, Athletes, Postural Balance, Neuromuscular-Training

### ■ Combined Effect of Physical Activity and Time-Restricted Feeding on Physical Condition in Overweight Children

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#### Abstract

**Introduction:** Obesity has become a real public health problem, causing high mortality and morbidity in children and adolescents (OMS.2017). The worsening of sed-

entary status and inactivity of children and young people are causing a larger increase in this pandemic, affecting their quality of life and their psychological and physiological condition. The objective of this study was to investigate in overweight children the effects of one month of fasting TRF (14h of fasting at night/10 h of diurnal feeding) with an adapted diet and sprint interval training on body composition, biochemistry parameters, quality of life and physical performance.

**Method:** 24 obese children participated voluntarily (8 - 12 years) in this study. They were recruited according to criteria such as a BMI > 97th percentile and an age is between 8 - 12years. Topics were divided into 3 groups: (1) G1: TRF + CN (14: 10); (2) G2: (training + TRF + CN); and (3) G3: control. The MC and BMI measurements were performed before and after the intervention. Circumference of waist, hips and limbs and percentage of fat were measured before and after intervention. Blood samples were used to analyse lipid balance and fasting blood glucose. A 6-minute walk test was used to measure physical performance parameters, and the Hibou questionnaire score was used to estimate sleep quality.

**Results:** In this study, we found a significant decrease in MC and BMI at  $P < 0.01$  in G1 and G2, a significant decrease in all  $P < 0.01$  turns in G1 and G2, a very significant decrease in fat percentage in G2 at ( $P < 0.01$ ), and a significant decrease in G1 at ( $P < 0.005$ ). In addition, an improvement in the Hibou questionnaire score at ( $P < 0.01$ ) in G1 and G2, a decrease in fasting blood glucose levels in both G1 and G2 groups at ( $P < 0.01$ ). Our results showed an increase in walking distance during the 6-min walk test in both groups G1 and G2 at ( $P < 0.01$ ) without significant changes in heart rate and Borg scale of this test. The lipid balance showed no significant decrease in all three groups. Finally, no significant results were found for all parameters in the G3.

**Discussion:** The results of this study showed an improvement in body mass, BMI, waist circumference, hip circumference, arm circumference, thigh circumference, fasting blood glucose, Hibou questionnaire score, walking distance of 6 minutes, and percentage of fat from skin folds in both groups (TRF-EX, TRF-CN), on the other hand, no improvement noted in the control group compared to the pre-intervention. The heart rate and Borg scale measured during the 6-minute walk test, and triglyceride and total cholesterol levels showed no decrease for all three groups compared to the pre-intervention. Numerous studies in the literature show that fasting moments can lead to biological adaptations similar to caloric restriction such as increased autophagy and mitochondrial respiratory efficacy, which can lead to positive biological effects: These include improved and increased blood circulation, a defence against cardiovascular disease, modulation of reactive oxygen and inflammatory cytokines, as well as anti-mutagenic, antibacterial and anti-carcinogenic effects. In addition, the TRF is a diet that improves the functioning of circadian rhythm by

improving the time feeds mainly in the diurnal phase by improving the function of BMALT-CLOCK loop responsible for the hormonal variability and the cycle of day and night as. The improvement of these two loops improves the quality of sleep. Then it was verified that the high intensity training allows decrease in the visceral tissue and the complications related to this tissue by excessive increase of the oxidation of fat post exercise. Improved sleep quality by improving the secretion quality of sleep-related hormones. Based on our results and the results of other studies, the training of SIT associated with TRF and CN is highly recommended for fat mass loss, body composition and weight for the obese child.

**Conclusion:** The purpose of this study was to investigate in overweight or obese children the effects of one month of fasting TRF (14h of fasting night/10 of feeding day) with or without self-regulated AP on body mass, BMI, body composition, fasting blood glucose, physical performance and quality of life in children overweight or obese. This study showed that the TRF fasting training program and nutritional advice with or without SIT training in overweight children improved anthropometric parameters, some biochemical parameters, physical performance and quality of life.

*Keywords:* Physical Activity, TRF, Physical Condition, Overweight, Children

### ■ Total Sleep Deprivation: Impact on Decision-Making, Physical Performances and Subjective Experiences in Kung-Fu Athletes

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**Introduction:** Reaching the peak potential and achieving top performance depend upon several factors such as cognitive and physical conditioning. In addition to these common factors, sleep plays a crucial role to attain optimal performance and recovery outcomes. In this framework, nocturnal sleep deprivations is commonly found in elite athletes before and/or during important competitions, due to a state of stress, anxiety, activities for a period which exceeds 24 h (e.g., ultra-triathlon), or jetlag situation.

**Method:** A total of 24 kung-fu athletes ( $18 \pm 3$  years) voluntarily participated in the study. They completed, in a randomized order, two tests' sessions: without sleep deprivation (WSD) and with a total sleep deprivation (TSD).

**Results:** Data analyses showed that subjective experi-

ences were negatively affected by TSD; e.g., fatigue ( $P = 0.001$ ,  $d = 2.382$ ), and concentration ( $P = 0.01$ ,  $d = 0.622$ ). Moreover, the exposure to a TSD affects negatively the most of physical performances. Furthermore, results demonstrated a significant decrease of decision accuracy ( $P = 0.001$ ,  $d = 0.616$ ) with an increase of decision time ( $P = 0.001$ ,  $d = 0.587$ ), after one night of sleep deprivation.

**Discussion:** The main goal of the current study was to evaluate the effects of one night of sleep deprivation on physical performances, decision-making skills, and subjective experiences in kung-fu athletes. Firstly, it was hypothesized that TSD would be associated with a decline in the mood and feelings states. Our findings supported this assumption, indicating that acute nocturnal sleep deprivation was associated with a decrease of attention and concentration, as well as an increase of fatigue, tension, anger, and vigor in of Kung-Fu athletes. Secondly, it was hypothesized that the exposure to TSD would negatively affect decision-making skills in kung-fu athletes. This assumption was supported indicating that the exposure to total sleep deprivation affects negatively the decision making skills (a decrease of decision accuracy with an increase of decision time). Thirdly, it was hypothesized that the exposure to TSD would negatively affect physical performances in kung-fu athletes. Our findings supported this assumption, indicating that nocturnal sleep deprivation was associated with a decrease of performances regarding the toss of medicine ball, the horizontal jump, the vertical jump and the lumbar with flexed legs.

**Conclusion:** The current study confirmed that total sleep deprivation was associated with reductions in decision making and physical performances. The alteration of these cognitive and/or physical skills could be attributed to a reduced attention and concentration, as well as increased feelings of fatigue, which in turn were likely influenced by sleep disruptions. Yet, further studies are recommended to replicate the experimental design with other athletes.

*Keywords:* Total Sleep Deprivation, Decision-Making, Physical Performances Subjective Experiences

### ■ Relationships Between Well-being Indices, Mood State, and Physiological Responses During Taekwondo Sparring Sessions

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**Introduction:** It is well known that in addition to physiological aspects, negative or positive psychological states can affect athletes' performance during exercise and training. Concerning the relationship between exercise intensity and psychological states, Szabo (2003) showed that there was no significant correlation between exercise intensity and mood state in students during a 20-min of acute aerobic exercise. Moreover, it has been reported that fatigue and poor recovery recorded before training sessions reduced physical intensity, affected technical aspects. Taekwondo sparring sessions are among most appropriate exercises used by coaches to develop both physiological fitness and technical-tactical abilities of athletes. However, to the authors' current knowledge, there are no studies that investigated the relationships between physiological and psychological aspects in taekwondo sparring sessions. Thus, the objective of the present study was to investigate the relationships between physiological responses, and psychological aspects in taekwondo sparring sessions.

**Method:** Twenty-four adolescent (age  $17 \pm 1$  y, 12 males and 12 females) taekwondo athletes participated in the study. Each athlete was assigned to 1 (1 vs. 1, no sparring partner change) or 2 (1 vs. 2, within-round sparring partner change every min) opponents in different sparring area sizes (i.e.,  $4 \times 4$  m,  $6 \times 6$  m, and  $8 \times 8$  m). Blood lactate concentration (La) was measured before and after bouts. Heart rate (HR) was measured throughout contests, mean HR (HRmean) was determined, and rating of perceived exertion (CR-10) was assessed after each bout. Well-being indices [sleep, stress, fatigue, delayed onset muscle soreness (DOMS), and Hooper index (HI)] were assessed before each session, mood states were assessed before and after bouts.

**Results:** Results showed that HI was positively correlated with HRmean ( $P = 0.048$ ) and CR-10 ( $P = 0.012$ ), stress was positively correlated with CR-10 ( $P = 0.028$ ), DOMS was positively correlated with CR-10 ( $P = 0.015$ ), and vigor was positively correlated with fatigue (well-being,  $P = 0.044$ ). Moreover, during 1vs.1 condition, HRmean was negatively correlated with vigor post ( $r = -0.24$ ,  $P < 0.05$ , small). During 1vs.2 condition, CR-10 was positively correlated with DOMS ( $r = 0.26$ ,  $P < 0.05$ , small) and HI ( $r = 0.24$ ,  $P < 0.05$ , small); (La) post was negatively correlated with confusion pre ( $r = -0.24$ ,  $P < 0.05$ , small); HRmean was negatively correlated with tension post ( $r = -0.26$ ,  $P < 0.05$ , small), depression pre ( $r = -0.25$ ,  $P < 0.05$ , small) and post ( $r = -0.27$ ,  $P < 0.05$ , small); TMD pre ( $r = -0.26$ ,  $P < 0.05$ ,

small) and post ( $r = -0.26$ ,  $P < 0.05$ , small); positively correlated with vigor pre ( $r = 0.24$ ,  $P < 0.05$ , small) and post ( $r = 0.27$ ,  $P < 0.05$ , small); stress was negatively correlated with anger pre and post ( $r = -0.28$ ,  $P < 0.05$ , small;  $r = -0.28$ ,  $P < 0.05$ , small, respectively).

**Discussion:** Well-being indices were positively associated with CR-10 and HRmean and this highlights that exercise intensity is sensitive to effects of well-being indices. Thus, CR-10 and HR values recorded during exercise sessions can detect individual signs of psycho-physiological responses, which are related with athletes' pre-fatigue state. This result is not in line with the study of Selmi et al. (2018), which reported that perceived exertion during small-sided games is not influenced by well-being indices variability recorded before training session. Overall, it seems that the psychometric status, measured before the training session, substantially influences objective or subjective training intensity variables during specific taekwondo exercises. Regarding the effect of different area sizes, high DOMS and HI scores recorded with  $4 \times 4$  m determined an increase in lactate post. With  $6 \times 6$  m condition, a positive correlation was found between well-being indices (DOMS and HI) and HRmean. Similarly, with 1 vs. 2 condition, DOMS and HI resulted correlated with HRmean and CR-10. These findings confirm that well-being indices measured before training sessions are correlated with internal intensity and heart rate responses.

**Conclusion:** These results suggest that psychometric state should be monitored using mood state, and well-being indices to assess adherence and engagement and to ensure athletes optimal performance during taekwondo training.

**Keywords:** Training, Combats, Lactate, Psychological Aspects

## ■ Diurnal Variation in Dynamic Balance, Short-term Performance, and Psychological Variables in Athletic Women

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### Abstract

**Introduction:** The diurnal variation in short-term performance has been well documented in recent years,

but almost exclusively in the male population. Although women's participation in sport has increased dramatically over the years, research into how a woman's body responds to exercise is still lower than that of men. Thus, the aim of the present study was to investigate the effect of time of day on short-term performance, dynamic balance, attention, and psychological variables (i.e., mood) in young women.

**Method:** Ten female students in physical education (age  $21 \pm 3$  years; height:  $162 \pm 5$  cm, body-mass:  $56 \pm 5.5$  kg) completed the questionnaires of sleep quality, fatigue, stress and muscle soreness (Hooper) and the French version of POMS (POMS-f). After that, they passed a 30-s Wingate test in the morning (7:00 a.m.) and afternoon (4:00 p.m.). The digit cancellation test, squat jump (SJ) and counter-movement jump (CMJ) tests and the lower quarter Y balance test were performed at the start and at the end of each session.

**Results:** No morning-afternoon differences for fatigue index ( $P < 0.01$ ), negative moods ( $P < 0.01$ ) as well as fatigue, sleep, and Muscle soreness ( $P < 0.01$ ) were reported. The vigour ( $P < 0.01$ ) estimated by the POMS-f questionnaire and the stress estimated by the Hooper questionnaire were highest in the afternoon. The peak and average power ( $P < 0.01$ ) during the Wingate test, the composite score for Y balance ( $P < 0.01$ ) as well as performance in the CMJ ( $P < 0.1$ ) and SJ ( $P < 0.1$ ) were higher in the afternoon compared to the morning.

**Discussion:** As one would expect, the current data show that the performances obtained during the CMJ and SJ test and peak and average power during the Wingate test as well as the composite score during the Y balance test fluctuate during the day with the best performances in the afternoon. These data are consistent with some previous studies (Chtourou and Souissi, 2012; Chtourou et al., 2018); but not all of it. One possible explanation for the inconsistency between this study and previous ones is the typical time-of-day of training. Souissi et al. (2002) have shown that training regularly at a specific time of day can increase performance at that specific time of day. Given that women recruited for the present study regularly trained in the afternoon we could speculate that this training adaptation could be due to the acclimatization of their body to exercise at this time of day. Another possible explanation for the inconsistency is that vigor scores observed by the POMS-f questionnaire were better in the afternoon than in the morning. Moreover, the morning-afternoon differences for negative mood, fatigue, sleep, and muscle soreness estimated by the Hooper questionnaire could partially explain our results.

**Conclusion:** The present study demonstrates that time-of-day has significant effects on short-term performance, attention, and psychological variables in women. Weekly training sessions and trainings TOD: The number of weekly training sessions was lower (during  $3.7 \pm 2.4$  vs. pre  $5.6 \pm 2.3$ ). The reduced number of the weekly training session contributed to the higher insomnia ( $P = 0.013$ ).

Elite athletes preferred to train later during the day (during 14:38  $\pm$  4:32 vs. pre 13:59  $\pm$  4:32) during- compared to pre-lockdown. The later preferred TOD to train was associated with a lower sleep quality and higher insomnia (both;  $P = 0.005$ ).

**Recommendations:** These lockdown-induced behavioral changes were behind the reduced sleep quality and increased insomnia, causing a circadian disruption in elite athletes. Adherence to sleep hygiene could protect against this circadian disruption to limit detraining and facilitate a safe return to competition. Avoiding long and late naps is recommended whilst opting for a moderate dose of caffeine before a short (30 min) post-lunch nap. Quitting alcohol and cigarette consumption and avoiding caffeine consumption later during the day are recommended. Maintaining regular schedules of meals, bed and wake-up times are encouraged. Avoid heavy meals near bedtime and opt for a light tryptophan-rich snack one hour pre-bedtime. Outdoor training sessions, early during the day, are highly recommended to help align the body to the circadian clock.

**Keywords:** Diurnal Variation; Dynamic Balance; Short-term Performance.

### ■ How the COVID-19 Lockdown Modified Elite Athletes' Sleep and Circadian Rhythms: Practical Recommendations

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#### Abstract

**Introduction:** The coronavirus (COVID-19) enforced dramatic changes to day-to-day life that affected nearly everyone on this planet. For athletes, this implied that competitions were delayed or cancelled, which reduced the number of training sessions per week. Fewer weekly training sessions were associated with reduced sleep



quality in athletes. Besides the disrupted training behavior, eating and sleeping behaviors in athletes were also affected by the COVID-19 breakdown, resulting in a circadian deregulation in elite athletes. However, practical recommendations based on the lockdown-induced behavioral changes are lacking.

**Methods:** An international, web-based, cross sectional, questionnaire was developed to investigate training behavior, sleep quality (PSQI), insomnia severity (ISI) and bespoke questions about napping, health- and nutrition-related questions for distinctive periods: pre- and during-lockdown. The English survey was translated into 9 languages (Arabic, French, Italian, Japanese, Malay, Persian, Portuguese, Spanish and Turkish).

**Results:** Participants: 1454 elite athletes presented 40 countries from the five continents answered the survey: Asia (61%; n = 884); Europe (17%; n = 243); North and South America (13%; n = 190); Africa (9%; n = 133); and Australia (0.2%; n = 4). 58% (n = 828) of the athletes were male and 42% (n = 613) were female.

PSQI and ISI: PSQI ( $4.1 \pm 2.4$  to  $5.8 \pm 3.1$ ) and ISI ( $5.1 \pm 4.7$  to  $7.7 \pm 6.4$ ) scores were higher during- compared to pre-lockdown ( $P < 0.05$ ).

**Sleeping Behavior:** Lower sleep quality and higher insomnia were associated to the longer sleep onset latency and the delayed bedtime (all  $P < 0.001$ ). Napping frequency and duration increased compared to pre lockdown with a concomitant later preferred TOD to nap (all  $P < 0.001$ ), which was associated with higher insomnia and lower sleep quality during the lockdown (all  $P < 0.001$ ).

**Nutrition behavior:** The increase in caffeine and alcohol consumption while locked-down reduced sleep quality ( $P = 0.038$ ,  $P < 0.001$ ) and insomnia ( $P = 0.002$ ,  $P = 0.007$ ). Besides, eating after midnight increased during lockdown and was associated with lower sleep quality and higher insomnia (all  $P < 0.001$ ).

**Weekly Training Sessions and Trainings TOD:** The number of weekly training sessions was lower (during  $3.7 \pm 2.4$  vs. pre  $5.6 \pm 2.3$ ). The reduced number of the weekly training session contributed in the higher insomnia ( $P = 0.013$ ). Elite athletes preferred to train later during the day (during 14:  $38 \pm 4$ :  $32$  vs. pre 13:  $59 \pm 4$ :  $32$ ) during- compared to pre-lockdown. The later preferred TOD to train was associated with a lower sleep quality and higher insomnia (both;  $P = 0.005$ ).

**Recommendations:** These lockdown-induced behavioral changes were behind the reduced sleep quality and increased insomnia, causing a circadian disruption in elite athletes. Adherence to sleep hygiene could protect against this circadian disruption to limit detraining and facilitate a safe return to competition. Avoiding long and late naps is recommended whilst opting for a moderate dose of caffeine before a short (30 min) post-lunch nap. Quitting alcohol and cigarette consumption and avoiding caffeine consumption later during the day are recommended. Maintaining regular schedules of meals, bed and wake-up times are encouraged. Avoid heavy meals

near bedtime and opt for a light tryptophan-rich snack one hour pre-bedtime. Outdoor training sessions, early during the day, are highly recommended to help align the body to the circadian clock.

**Keywords:** COVID-19, Lockdown, Elite Athletes, Sleep and Circadian Rhythms

### ■The Effect of Martial Arts Exercises on the Self-Descriptive Components of Martial Arts girls and Boys

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**Introduction:** Martial arts originated from East Asian culture are more focused on the relationship between body and mind, which ultimately aims to increase mental power. Since body image is one of the influential traits in the personality dimensions of individuals, in this study we sought to investigate the effect of martial arts on the self-descriptive components of the body in martial arts girls and boys. Since it is a multidimensional structural description and includes many factors such as education, family, emotional and social characteristics, as well as physical characteristics, it seems that the performance of sports and environmental interactions can affect it. Therefore, the main purpose of this study was to compare the effect of martial arts exercises on the self-descriptive components of martial arts girls and boys.

**Methods:** The research method was descriptive in which initially 200 questionnaires were distributed online to male and female athletes. Independent-test was used to analyze the data.

**Results:** It was suggested that there was a significant difference of martial arts training on the self-descriptive components of girls and boys in martial arts with a greater impact for boys.

**Conclusion:** Based on the research findings, it seems that martial arts exercises can have a positive effect on the self-descriptive components of martial arts athletes, especially for boy ones.

**Keywords:** Martial Arts, Body Image, Athletes, Self-Descriptive

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