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Effect of repeated use of social media before training sessions on countermovement jumping and internal training load in high-level volleyball players

Efecto del uso repetido de redes sociales antes de las sesiones de entrenamiento sobre el salto con contramovimiento y la carga de entrenamiento interna en jugadores de voleibol de alto nivel

Efeito do uso repetido das redes sociais antes das sessões de treinamento no salto com contramovimento e carga interna de treinamento em jogadores de voleibol de alto nível

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ABSTRACT

To verify the effect of repeated use of social media on smartphones immediately before countermovement jump (CMJ) and internal training load (ITL) training sessions in young male high-level volleyball athletes. 18 young international-level athletes participated in a randomized crossover study for a total of two weeks. The athletes are from the Brazilian under-19 team and were randomized into two experimental conditions, social media (SMA) and control (CON). SMA used social media for 30 minutes before training sessions for a week, while CON watched emotionally neutral videos. During this period, the ITL was analyzed using the session rating of perceived exertion (s-RPE) method. The CMJ was analyzed before, between, and after the two-week training. In the second week, the athletes reversed the experimental conditions. The CMJ was decreased after the training week (p = 0.04), but with no difference between the experimental conditions (p = 0.51). The ITL was not different between the experimental conditions after the analyzed training week (p = 0.95). Repeated use of social media on smartphones immediately before training sessions for a week was not enough to harm the CMJ, nor did it increase the ITL in young international-level volleyball athletes.

Keywords: Cognitive fatigue, Volleyball, Sport training, Brain, Team sport.

RESUMEN

Verificar el efecto del uso repetido de redes sociales en teléfonos inteligentes inmediatamente antes de las sesiones de entrenamiento en salto con contra-movimiento (SCM) y carga de entrenamiento interna (CEI) en jóvenes atletas masculinos de voleibol de alto nivel. 18 atletas jóvenes de notoriedad mundial participaron en un estudio cruzado y aleatorizado durante un total de dos semanas. Los atletas son de la selección brasileña sub-19 y fueron distribuidos aleatoriamente en dos condiciones experimentales, redes sociales (TEL) y control (CON). La TEL utilizó las redes sociales durante 30 minutos antes del entrenamiento durante una semana, mientras que la CON vio vídeos emocionalmente neutros. Durante este período, el CEI se analizó mediante el método de percepción subjetiva del esfuerzo de la sesión. El SCM se analizó antes e después del entrenamiento de una semana. En la segunda semana, los atletas invirtieron las condiciones experimentales. El SCM disminuyó después de la semana de entrenamiento (p = 0,04), pero sin diferencias entre las condiciones experimentales (p = 0,51). El CEI no fue diferente entre las condiciones experimentales después de la semana de entrenamiento analizada (p = 0,95). El uso repetido de las redes sociales en los teléfonos inteligentes inmediatamente antes del entrenamiento durante una semana no fue suficiente para afectar la SCM, ni aumentó la CEI en jóvenes atletas de voleibol de nivel internacional.

Palabras clave: Fatiga cognitiva, Voleibol, Entrenamiento deportivo, Cerebro, Deporte de equipo.

RESUMO

Verificar o efeito do uso repetido de redes sociais em smartphones imediatamente antes de sessões de treinamento do salto com contramovimento (SCM) e carga interna de treinamento (CIT) em jovens atletas masculinos de voleibol de alto nível. 18 jovens atletas de nível internacional participaram de um estudo cruzado e randomizado durante um total de duas semanas. Os atletas são da seleção brasileira sub-19 e foram randomizados em duas condições experimentais, redes sociais (SMA) e controle (CON). O SMA usou as redes sociais por 30 minutos antes dos treinos durante uma semana, enquanto o CON assistia vídeos emocionalmente neutros. Nesse período, o CIT foi analisado através do método da percepção subjetiva do esforço da sessão (PSE-s). O SCM foi analisado antes, entre e após o treinamento de duas semanas. Na segunda semana, os atletas inverteram as condições experimentais. O SCM diminuiu após a semana de treinamento (p = 0,04), mas sem diferença entre as condições experimentais (p = 0,51). O CIT não foi diferente entre as condições experimentais após a semana de treinamento analisada (p = 0,95). O uso repetido de redes sociais em smartphones imediatamente antes dos treinos durante uma semana não foi suficiente para prejudicar o SCM, nem aumentou a CIT em jovens atletas de voleibol de nível internacional.

Palavras chave: Fadiga cognitiva, Voleibol, Treinamento esportivo, Cérebro, Esporte coletivo.

INTRODUCTION

Volleyball is one of the five most played sports globally (Moreno et al., 2016). The modality is played by two teams, each composed of six regular players, on a court divided into two sides (Palao et al., 2024). It is characterized by unpredictability and intermittence, leading the athletes to make decisions in high-intensity contexts (Fortes et al., 2020; Zarceño et al., 2017). The defensive (i.e., blocking and dig) and offensive (setting and attacking) actions require the development of physical abilities such as endurance, change-of-direction (COD), and vertical jump (VJ) (Freitas et al., 2014; Freitas-Junior et al., 2021).

The attacking, serving, and blocking actions depend on the VJ due to the technique involved in these actions. Indeed, VJ is a critical motor skill for the modality since many defensive and offensive techniques require the ability to jump as high as possible (Berriel et al., 2020a). Hence, periodically analyzing the VJ becomes necessary to understand the development of this ability in athletes. In this context, the countermovement jump (CMJ) is the

main test since it represents lower limbs' power (Claudino et al., 2017; Freitas-Junior, 2021). High-level athletes have better CMJ qualities than their lower-level peers (Sattler et al., 2015). Moreover, the CMJ can identify internal load accumulation or poor adaptations to training (Sattler et al., 2015).

The internal training load (ITL) is the individual response to the external stimulus applied during the training process (Freitas et al., 2014; Freitas-Junior et al., 2020). It is expected that internal and external load present a positive correlation. The lack of balance between external load and recovery might lead to a non-functional overreaching, injuries, and diseases (Sánchez-Beleña & Vaamonde, 2017). The ITL can be analyzed using biological markers such as serum creatine kinase (CK), salivary cortisol, heart rate variability, and psychophysiological markers such as the session rating of perceived exertion of the session (s-RPE) (Berriel et al., 2020b; Lima et al., 2020). The s-RPE is product of the rating perceived exertion (RPE) multiplying by the total time of the training session (Foster et al., 2001). Moreover, the s-RPE is closely related to the commitment of the CMJ (Claudino et al., 2017). Specifically in volleyball, the accumulation of ITL during a period of intensifying training loads compromised the development of CMJ in high-level adult athletes (Freitas et al., 2014). Then, the daily monitoring of ITL is crucial to monitor the volleyball athletes' performance.

The RPE can also be increased in the presence of mental fatigue (MF) (Smith et al., 2015; Smith et al., 2016). MF is a psychobiological state characterized by feelings of tiredness and lack of energy after long periods of cognitive activity, causing aversion to continue the activity performed (Marcora et al., 2009; Smith et al., 2016). Previous studies have indicated that MF compromises physical performance, such as a decrease in the distance covered in soccer athletes during the Yo-Yo Intermittent Recovery Test level 1 (Yo-Yo IR1) following an increase in RPE (Smith et al., 2016). Also, an increase in the time of the 100 and 200 m tests, freestyle, in high-level swimming athletes was found (Fortes et al., 2021c). Moreover, athletes from intermittent sports had higher RPE during an intermittent running protocol under MF (Smith et al., 2015). Therefore, the presence of MF might worse physical performance and increase RPE response, leading to repeatedly training under the MF status and improving the accumulation of ITL. However, it is worth noting that the aforementioned studies assessed a single session, and the literature lacks further evidence about the repeated effect of MF.

MF can be induced through everyday activities such as driving a car, playing video games, and using smartphones on social media (Fortes et al., 2021b; 2021c; Smith et al., 2018). Regarding social media on smartphones, athletes from various sports recognize that they use it, and that this fact can cause MF (Russel et al., 2019). According to Durand-Bush and DesClouds (2018), the prolonged use of social media requires high cognitive inhibition due to videos and photos that cause negative emotions and generate a drawback in brain functioning (disturbance in attention, concentration, memory, and executive functions). Commonly, amateur athletes use social media on smartphones (e.g., Instagram®, WhatsApp®, and Facebook®) before training sessions or official competitions (García-Naveira et al., 2023; Thompson et al., 2020), situation can cause greater s-RPE with consequent impairment of physical development. This fact was verified by Fortes et al. (2021a), who reported higher ITL after four weeks in young volleyball athletes who used social media on smartphones immediately before training sessions. However, no differences were found in the CMJ between athletes (Fortes et al., 2021a), It is worth noting that the study mentioned above was the only one that verified the repeated effect of MF through the use of social media on smartphones in volleyball athletes. Furthermore, this study was carried out with regional level athletes and parallel groups, which may interpret the findings as difficult due to individual variability.

From a practical point of view, checking whether the use of social media on smartphones before the start of training sessions causes harm to athletes' performance is important so that team technical committees can plan actions to manage the daily use of smartphones by athletes. Therefore, this study aimed to verify the effect of repeated use of social media on smartphones before each training session on ITL and CMJ in young volleyball athletes in a crossover design. High ITL responses were expected in the condition that athletes use social media on smartphones but no compromise on CMJ.

MATERIAL Y MÉTODOS

Research design

A crossover randomized and counterbalanced study was used, with an intra-subject design (Ato et al., 2013). All participants underwent a two-week experiment (i.e., baseline assessment, 1 week of volleyball training with our experimental manipulations [social media or control], and a post-experiment assessment). The dependent variables were vertical jump with countermovement and internal training load.

Participants

A-priori sample size calculation was performed using G*Power software version 3.1.9.2 (Universität Kiel, Kiel, Germany), for an analysis of variance (ANOVA) with repeated measures within–between groups interaction using the option "ANOVA: repeated measures, within-between factors interaction" for visuomotor skill in mentally fatigued athletes (Cutsem et al., 2019), including the following criteria: (a) power = 0.95; (b) medium ES (ηp^2 = .20 or f = 0.50); (c) α =.05; (d) the number of groups = 2; (e) number of measurements = 3; (f) correlation among repeated measures = 0.5; and (g) nonsphericity correction = 1. Results indicated that fourteen subjects would be necessary for the study. Using the non-probabilistic method for sample recruitment, eighteen high-level male young volleyball players (age, 17.33 ± 0.22 y; height, 198.19 ± 8.13 cm and body mass, 90.55 ± 9.20 kg) participated in this study. They were recruited from Brazilian National Squad Team competing at the world level, train between five and six times a week, for an average amount of 35 ± 1.36 h per week, and had been playing volleyball for an average of 6.2 ± 1.34 y. According to participants, their vision was considered normal or corrected-to-normal. Before the experiment, the subjects were informed of the study's purpose, methods, and risks. All participants volunteer to participate in the study, and all participants provided their written informed consent before participation. For all younger participants (i.e., age <18 years), we obtained written informed consent from their parents/legal guardians and the written informed assent of the young participants before their participation. The study was approved by Ethics Committee of the Federal University of Paraíba (approval number: 4.563.942) and followed the ethical principles in the Declaration of Helsinki.

Instruments

a) An electronic contact jump mat (Elite Jump®, São Paulo, Brazil) was used to analyze the CMJ height. Each participant performed three attempts with a 30-second interval between trials, and we retained the mean for analysis. During the CMJ there were no restrictions regarding the knee angle, and participants were instructed to keep their hands on their waist and their legs straight during the flight, as well as to land at the takeoff point. Previous studies indicated good reproducibility of the CMJ test (Fortes et al., 2021b; Freitas-Junior et al., 2021).

b) The participants' ITL was quantified using the s-RPE (Foster et al., 2001). This method has already been used in other studies involving volleyball athletes, proving effective in controlling internal training load. (Aoki et al., 2017; Freitas et al., 2014). After 30 minutes of each training session, the athletes answered the following question: "How was your training?". The athlete was asked to demonstrate their perception of the session's intensity on the 10-point Borg scale (0 = rest to 10 = maximum effort), according to the method developed by Foster et al (Foster et al., 2001). The internal load of the training session (i.e., arbitrary units; A.U.) was calculated as the product of the values demonstrated by the RPE scale and the total time of the session in minutes. The experimental condition internal training load was obtained from the sum of daily internal training loads for each experimental condition (control and social media). The athletes were familiarized with the session-RPE method for 30 days before beginning the investigation.

Procedures

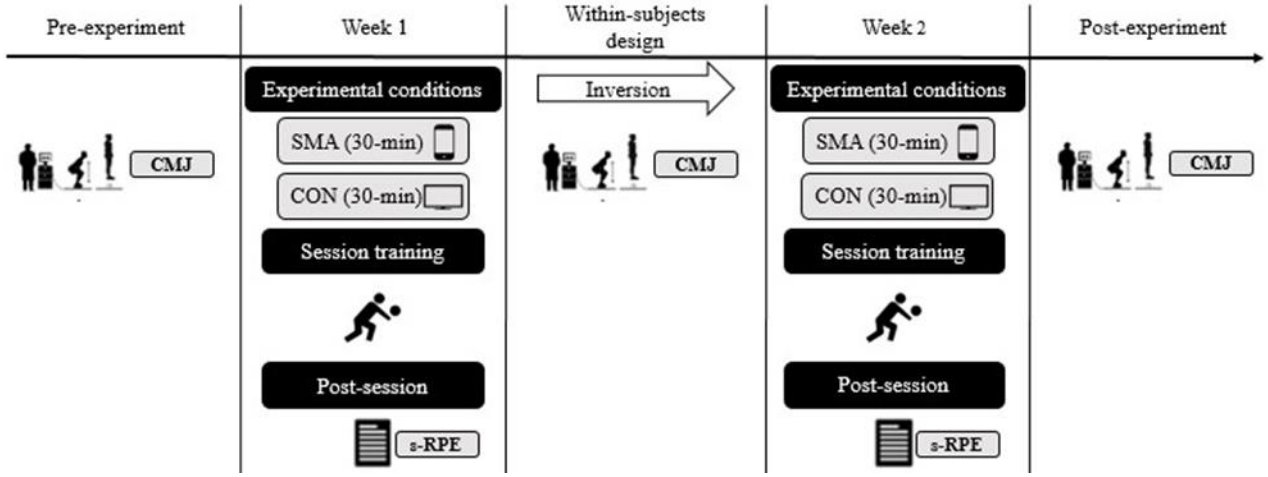
During initial assessments, participants were familiarized with social media and control protocols. We also collected data for CMJ. We then randomized the order of the two experimental conditions or each participant using a random number table generator (www.randomizer.org). Nine athletes participated in training routines in the first week and were induced to FM before the start of the training sessions (social media condition), while the other nine

athletes watched neutral documentaries (control condition). In the second week, the experimental conditions were reversed. The two experimental conditions include performing the CMJ before and after weeks of training and daily measurement of internal training load. Before each training session, the control condition watched TV for 30-minutes (5 different documentaries about Olympic Games), and the social media condition used social media app (Instagram®) on smartphones for 30-minutes. There was a 3-minute break between activities on social media or control and the beginning of the training sessions. The participants maintained their training routines during the experiment. Until the end of the experiment, participants were unaware of the study purpose. The step-by-step experimental procedures can be seen in figure 1. The participants abstained from any physical exercise and alcohol ingestion for 24-hours before testing during the two-week experiment, and they abstained from caffeine for at least 3-hours before each training session.

Two hours before each training session was forbidden, high demanding cognitive (e.g., social media). Before each session, participants reported whether they followed the proposed recommendations. We checked the time of use in every athlete's smartphone the time to use for the last two hours before the beginning of every training session.

Figure 1

Experimental design



Mental fatigue protocols

Immediately before each training session, the control condition watched emotionally neutral videos for 30-minutes on an 84-inch screen in a smartphone-free room. Studies related to mental fatigue and human performance have long used these emotionally neutral documentaries in control conditions because neither cognitive performance (Fortes et al., 2021c; Marcora et al., 2009) nor underlying brain mechanisms of mental fatigue were found to be altered (Franco-Alvarenga et al., 2019).

The social media condition used social media (Instagram®) on a smartphone for 30-minutes. We supervised the smartphone use to ensure the athletes only used social media apps (and not games or other apps). The two experimental conditions (control and social media) were in different rooms, and participants in each room were prohibited from talking to each other during these periods.

Statistical analysis

The Shapiro-Wilk test evaluated data distribution. The data was described in mean and standard derivation (SD). The Levene test verified homoscedasticity. The two-way Anova was used to analyze condition (control versus social media) x time (baseline versus post-experiment) interaction for CMJ. Possible statistical differences were identified using the Bonferroni post-hoc test. Partial eta squared (ηp^2) effect size (ES) was determined and

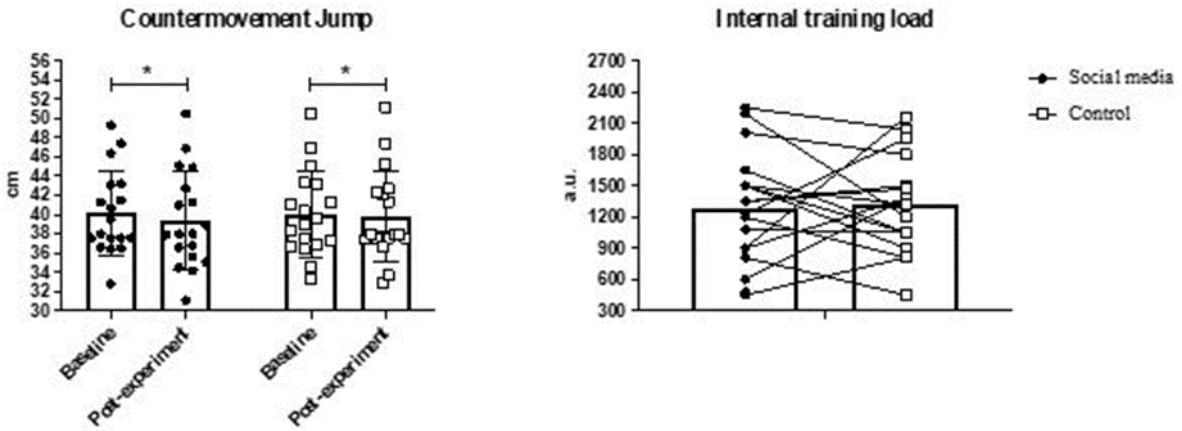
interpreted using the following cutoffs (Cohen, 1992): small effect, $\eta p^2 < 0.03$; moderate effect, $0.03 \leq \eta p^2 < 0.10$; large effect, $0.10 \leq \eta p^2 < 0.20$; very large effect, $\eta p^2 \geq 0.20$. The dependent t student test was used to compare the internal training load between control and social media conditions. In addition, we calculated ES differences at baseline versus post-experiment between control vs. social media condition to determine whether these differences were meaningful. We applied Cohen (1992) guidelines to interpret these ES findings for our highly trained participants: ES < 0.2 = trivial, 0.2 ≤ ES < 0.5 = small, 0.5 ≤ ES < 0.8 = moderate, and ES ≥ 0.8 = large. Data were processed in the Statistical Package for Social Sciences Version 21.0 (IBM Corp., Armonk, NY, USA) and GraphPad Prism 8 (San Diego, CA, USA) with a significance level of 5%.

RESULTS

There was no significant group x time interaction for CMJ (Figure 2; $F_{(1, 17)} = 0.56$; $p = 0.46$). There was no condition effect ($F_{(1, 17)} = 0.43$; $p = 0.51$), but there was a significant time effect ($F_{(1, 17)} = 4.79$; $p = 0.04$) for CMJ. Both experimental conditions (control and social media) impaired their CMJ ($p > 0.05$). CMJ data are descript in Table 1. There was no significant difference for internal training load between experimental conditions (Figure 2; $t_{(1, 15)} = 0.96$; $p = 0.95$). Internal training load data are descripted in Table 1.

Figure 2

Countermovement jumps and internal training load according to the experimental condition (control versus social media) in male volleyball players.



Note: *Difference baseline-to post-experiment ($p < 0.05$).

Table 1

CMJ and ITL for both experimental conditions (Control and Social Media) in male volleyball players.

Variable	Control	Social media	Effect	*F*	*p* ($CI_{95\%}$)	ηp^2 ($CI_{95\%}$)	ES_1
Countermovement jump (cm)							
Baseline	40.09±4.31	40.16±4.51	Condition	0.43	0.51 (0.40/0.64)	0.01 (0.003/0.02)	Small
Post-experiment	39.87±4.54*	39.32±5.29*	Time	4.79	0.04 (0.02/0.08)	0.05 (0.02/0.07)	Moderate
Δ%	-0.8±0.5	-2.5±1.4	Interaction	0.56	0.46 (0.35/0.57)	0.02 (0.004/0.03)	Small
ES_2	0.05	0.19					
Internal training load (a.u.)	1,275.00±529.33	1,312.94±474.28	Condition	*t*=0.96	0.95 (0.82/0.99)	*d* = 0.05	Trivial

Note: Δ% = percent delta from baseline-to post-experiment; ES_1 = effect size of interactions, ES_2 = effect size (pre vs post experiment); * = significantly difference compared to baseline ($p < 0,05$).

DISCUSSION

The present study aimed to verify the repeated effect of using social media on smartphones immediately before training sessions at ITL and CMJ in young international-levels volleyball athletes. According to the findings, it can be observed that the two groups (social media and control) showed a decrease in CMJ performance after the analyzed training period, but without differences between them. Likewise, the ITL was not different between conditions. Thus, the results found are partially contrary to the initial hypotheses formulated. It should be noted that this is the first study that analyzed the repeated effect of using social media on cross-designed smartphones.

Both conditions decreased the CMJ after the training week. These findings are in line with the results found by Delextrait et al., (2012), who reported a decrease in the CMJ after the third day of a regular week of training in basketball athletes. Actions, such as COD and VJ, performed on consecutive days might cause inflammatory processes and muscle injuries with a consequent decline in muscle power, especially in training periods with increased ITL (Johnston et al., 2013; Skurvydas et al., 2011). These processes may have arisen in the athletes in this study, which contributed to the reduction of CMJ. It was shown that the CMJ impairment is accompanied by an increase in blood CK levels in volleyball athletes after 25 days of training (Freitas et al., 2014). In the study by Freitas et al. (2014), the ITL perceived by the athletes was ~1500 AU, a value similar to the ITL perceived by the athletes in the present study ~1300 AU.

Although the athletes decreased the CMJ levels, MF condition did not affect this parameter. Previous studies have already pointed that MF does not affect performance in the CMJ (Fortes et al., 2021a; 2021b; Fortes, 2021c). International-level swimming athletes did not show a drop in CMJ after using social media on smartphones for 30 minutes (Fortes et al., 2021c). Likewise, amateur boxing athletes did not decrease CMJ after being induced to MF through social media on smartphones (Fortes et al., 2021b). In another study, young volleyball athletes induced to MF daily before training sessions showed no differences in CMJ after four weeks compared to athletes who were not induced to MF (Fortes et al., 2021a). The all-out task with a duration shorter than 30-s are regulated by the peripheral system (afferent pathways III and IV), especially by neuromuscular function (Silva-Cavalvcante et al., 2018), which might explain the results found for the CMJ.

Similar to CMJ, the ITL was not different between the experimental conditions, indicating that the daily use of social media on smartphones did not promote the more significant accumulation of ITL after the training week, refuting our initial hypothesis. These findings are contrary to those found by Fortes et al. (2021a), who reported higher ITL accumulation after four weeks for athletes who used social media on smartphones. Besides the study's duration (i.e., one week vs. four weeks) and the experimental design used (crossover x parallel-group), the athletes' levels might explain the controversy in the results. Higher-level athletes have greater inhibitory control, and it appears that athletes with greater inhibitory control are more resistant to MF (Martin et al., 2016). More studies are needed to confirm these arguments. It is worth noting that the s-RPE method has already proven effective for monitoring internal training load in volleyball athletes (Aoki et al., 2017; Freitas et al., 2014). This is because s-RPE has a positive relationship with exercise intensity (Halson et al., 2014). For example, Horta et al. (2017) found a positive correlation between the ITL and the number of jumps, after analyzing 30 training sessions in volleyball athletes.

Although this study presents innovative results, some limitations must be pointed out, such as the absence of manipulation check measures for MF, such as visual scale analogic (VAS), Stroop task, or electroencephalogram (EEG). However, previous studies have shown that using social media on smartphones for 30 minutes causes FM (Fortes et al., 2021b; 2021c). Moreover, the absence of interpolation measurement for the neuromuscular function should also be pointed out as a limitation. Carrying out studies with a crossover design for more extended periods and at different times of the season can provide accurate information about how MF can modulate physical performance and ITL in volleyball athletes and should be considered in future studies.

CONCLUSION

In conclusion, using social media on smartphones before training sessions for a week did not affect CMJ and ITL in international-level young volleyball athletes. The results might be explained by the athletes' level, who are probably more resistant to MF.

PRACTICAL APPLICATIONS

Identifying the effect of social média through smartphones on physical performance in athletes is essential so that sports technical committees have enough information to plan situations that minimize the possible harmful effects. In the present study, athletes who repeatedly used social media immediately before training sessions for a week had no impairment in CMJ performance and had no increase in ITL. The athletes' international level possibly contributed to these findings. Athletes with higher levels of inhibitory control are more resistant to MF, and high-level athletes tend to have higher levels of inhibitory control. Thus, technical committees are encouraged to plan situations that enable the development of aspects that can increase resistance to FM, such as inhibitory control, thus avoiding damage to sports performance.

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